EFFECT OF DIAMOND APPLICATION ON DIETARY INTAKE AND BMI AMONG OVERNUTRITION FEMALE COLLEGE STUDENT IN MALANG CITY, INDONESIA: A QUASI-EXPERIMENT STUDY

Miss Nurnaningsih Herya Ulfah

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

A Dissertation Submitted in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy in Public Health
Common Course
COLLEGE OF PUBLIC HEALTH SCIENCES
Chulalongkorn University
Academic Year 2021
Copyright of Chulalongkorn University

ผลของแอพพลิเคชั่นไดมอนด์ต่อการบริโภคอาหาร
และดัชนีมวลกายของนักศึกษาหญิงที่มีโภชนาการเกินในเมืองมาลัง ประเทศอินโดนีเซีย:
การวิจัยกึ่งทดลอง

น.ส.นูวนานิงสิ เฮอร์ยา อูฟาห์

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรดุษฎีบัณฑิต
สาขาวิชาสาธารณสุขศาสตร์ ไม่สังกัดภาควิชา/เทียบเท่า
วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2564
ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

Thesis Title	EFFECT OF DIAMOND APPLICATION ON DIETARY INTAKE AND BMI AMONG OVERNUTRITION FEMALE COLLEGE STUDENT IN MALANG CITY, INDONESIA: A QUASI-EXPERIMENT STUDY
By	Miss Nurnaningsih Herya Ulfah
Field of Study	Public Health
Thesis Advisor	Pokkate Wongsasuluk, Ph.D.

Accepted by the COLLEGE OF PUBLIC HEALTH SCIENCES, Chulalongkorn University in Partial Fulfillment of the Requirement for the Doctor of Philosophy

.... Dean of the COLLEGE OF PUBLIC HEALTH SCIENCES
(Professor SATHIRAKORN PONGPANICH, Ph.D.)

DISSERTATION COMMITTEE

.... Chairman
(Napaphan Viriyautsahakul, M.D., M.Sc.)

.... Thesis Advisor
(Pokkate Wongsasuluk, Ph.D.)

.... Examiner
(Assistant Professor MONTAKARN CHUEMCHIT, Ph.D.)

.... Examiner
(Assistant Professor KRAIWUTH KALLAWICHA, Ph.D.)

.... External Examiner
(Professor SURASAK TANEEPANICHSKUL, M.D.)

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

นูวนานิงสิ เฮอร์ยา อูฟาห์ :
ผลของแอพพลิเคชั่นไดมอนด์ต่อการบริโภคอาหาร และดัชนีมวลกายของนักศึกษาหญิงที่มีโภชนาการเกินในเมืองมาลัง ประเทศอินโดนีเซีย: การวิจัยกึ่งทดลอง . (EFFECT OF DIAMOND APPLICATION ON DIETARY INTAKE AND BMI AMONG OVERNUTRITION FEMALE COLLEGE STUDENT IN MALANG CITY, INDONESIA: A QUASI-EXPERIMENT STUDY) อ.ที่ปรึกษาหลัก : ปกเกศ วงศาสุลักษณ์

การใช้แอปพลิเคชั่นในโทรศัพท์มือถือ เป็นหนึ่งในตัวช่วยในการลดน้ำหนักในยุคปัจจุบัน ที่มีอัตราการเกิดภาวะโภชนาการเกินเพิ่มขึ้นทุกปี งานวิจัยนี้ มีวัตถุประสงค์เพื่อพัฒนาและตรวจสอบ ผลของโปรแกรมควบคุมอาหาร (ไดมอนด์) ต่อการบริโภคอาหาร และ BMI ของนักศึกษาหญิงที่มีภาวะโภชนาการเกิน ในเมืองมาลัง ประเทศอินโดนีเซีย โดยการศึกษานี้ จะแบ่งเป็น 2 ระยะ ได้แก่ ระยะที่ 1 เป็นการศึกษาแบบภาคตัดขวาง เพื่อการพัฒนาแอปพลิเคชั่น และ ระยะที่ 2 เพื่อตรวจสอบผลของการใช้งานแอปพลิเคชั่น ในระยะที่ 1 มีผู้เข้าร่วมเป็นประชากรตัวอย่าง 217 คน และมีผู้เข้าร่วม 123 คนในระยะที่ 2 เครื่องมือที่ใช้วัดผลการทดลอง ได้แก่ Tanita DC-360 และ ZT-120 Health Scale รวมถึงแบบสอบถามออนไลน์ นอกจากนี้ การวิเคราะห์สถิติที่ใช้ในการศึกษานี้ ได้แก่ Chi-square, Independent T-test, Dependent t-test, Mann Whitney U-test, Spearman Rho's test และ Binary logistic ผลการศึกษาในระยะที่ 1 พบว่า 12.8% ของกลุ่มตัวอย่าง เป็นนักศึกษาหญิง ที่มีปัญหาภาวะโภชนาการเกิน 87.10% ใช้โทรศัพท์มือถือ Android และ 37.30% ทานอาหารครบสามมื้อต่อวัน นอกจากนี้ ในระยะที่ 1 ยังมีการเก็บรวบรวมข้อมูลเมนูอาหารอีกด้วย ซึ่งได้แก่ อาหารคาว 121 รายการ ขนม 27 รายการ และเครื่องดื่มหวานอีก 22 รายการ เพื่อป้อนลงในฐานข้อมูลแอปพลิเคชั่น สำหรับระยะที่ 2 นั้น ผลการศึกษาพบว่า กลุ่มทดลองและกลุ่มควบคุม มีข้อมูลพื้นฐานที่คล้ายคลึงกัน (ค่า $p>0.05$) นอกจากนี้ ผลการศึกษาหลังจาก 8 สัปดาห์ กลุ่มทดลองพบว่า การบริโภคโปรตีน และ BMI ในกลุ่มทดลอง มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ในขณะที่กลุ่มควบคุม พบความแตกต่างอย่างมีนัยสำคัญคือ ไขมัน โปรตีน และปริมาณแคลอรี่ (p-value<0.05) ผลการศึกษาพบว่า คาร์โบไฮเดรต (p-value= 0.042) โปรตีน (p-value <0.000) แคลอรี (p-value=0.014) และ BMI (p-value= 0.002) มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ระหว่างประชากรทั้งสองกลุ่ม จากผลการทดสอบสเปียร์แมน แสดงให้เห็นว่า มีความสัมพันธ์กันอย่างมีนัยสำคัญระหว่างการเข้าใช้โปรแกรม "จดบันทึกมื้ออาหาร" กับปริมาณไขมัน และแคลอรี ของกลุ่มประชากรที่ใช้แอปพลิเคชั่น ยิ่งกลุ่มตัวอย่าง มีการใช้โปรแกรมนี้บ่อยมากเท่าใด การบริโภคไขมันและแคลอรี่โดยรวม จะยิ่งต่ำลง ซึ่งสรุปได้ว่า แอปพลิเคชั่นไดมอนด์ สามารถเป็นอีกหนึ่งทางเลือกที่มีประสิทธิภาพ ในการช่วยจัดการ การบริโภคอาหาร ให้เหมาะสม ลดการเกิดภาวะโภชนาการเกินได้

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

สาขาวิชา	สาธารณสุขศาสตร์	ลายมือชื่อนิสิต	
ปีการศึกษา	2564	ลายมือชื่อ อ.ที่ปรึกษาหลัก	

6274307853 : MAJOR PUBLIC HEALTH

KEYWORD: Application, Image detection, Food consumption, Overnutrition, Indonesia

Nurnaningsih Herya Ulfah : EFFECT OF DIAMOND APPLICATION ON DIETARY INTAKE AND BMI AMONG OVERNUTRITION FEMALE COLLEGE STUDENT IN MALANG CITY, INDONESIA: A QUASI-EXPERIMENT STUDY. Advisor: Pokkate Wongsasuluk, Ph.D.

Recently, using mobile applications for assisting weight loss programs is a common trend. However, the overnutrition rate is increasing every year. This research aims to develop and investigate the effect of Diet Monitoring (Diamond) application on dietary intake and BMI among overnutrition female college students in Malang City, Indonesia. Using 2 phases, this study used a cross-sectional study for phase I developing the app and a quasi-experiment for phase II investigating the effect of the application. 217 respondents were involved in phase I and 123 participants in phase II. The measurement tools were Tanita DC-360, and ZT-120 Health Scale, including an online questionnaire. In addition, the statistical analysis in this study was using Chi-square, Independent T-test, Dependent t-test, Mann Whitney U-test, Spearman Rho's test, and Binary logistic. Phase I showed results that 12.8% of survey participants were overnutrition female university students, 87.10% of phase I respondents used Android, and 37.30% of them had meals three times per day. In addition, 121 cuisine menus, 27 snacks, and 22 sweet beverages were collected in this phase as an application food database. For phase II, the results showed that the intervention and control groups had similar baseline data (p value>0.05). After 8 weeks of intervention, it depicted protein intake and BMI were significantly different in the intervention group while for a comparison group, the significant differences were fat, protein and total calorie (p-value<0.05). In addition, the result presented that carbohydrate (p-value=0.042), protein (p-value<0.000), total calorie (p-value=0.014) and BMI (p-value=0.002) were significantly different between both groups. Lastly, the Spearman test depicted that there was a significant correlation between assessing a "meal diary" feature with fat intake and total calories among Diamond application participants. The more the users use this meal diary feature, the lower their fat and total intake consumption. In the conclusion, the Diamond application can be an effective alternative solution to assist people in managing their dietary intake.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Field of Study:	Public Health	Student's Signature ....
Academic Year:	2021	Advisor's Signature ....

ACKNOWLEDGEMENTS

The author acknowledges all participants who are involved in this research during data collection. This research was funded by ASEAN Scholarship and CU Graduate School Thesis Grant from Chulalongkorn University Thailand, and research funding from Penerimaan Negara Bukan Pajak (PNBP) FIK Universitas Negeri Malang, Indonesia as well.

Nurnaningsih Herya Ulfah

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

TABLE OF CONTENTS

Page

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

CHAPTER I
INTRODUCTION

1.1 Background & Rational

1.1.1 Overnutrition Prevalence

Overnutrition is an abnormal condition because of excessive fat accumulation related to impair health (i.e., overnutrition and obesity). Overweight and obesity are associated with more deaths worldwide than underweight. Over 20 years, childhood obesity achieved epidemic proportions globally (2–5 yo). The most substantial evidence came from the Longitudinal Study of Fels, which involved 555 respondents from ages 1 to 18 years and assessed similar participants at age 35 (Guo et al., 1994). This research explained a powerful correlation between a high level of childhood BMI and fatness at age 35 (Guo et al., 1994) and, admitted with other studies, showed the possibility of being overweight raised according to child age and BMI percentile stage (Alberga et al., 2012, Guo et al., 1994, Whitaker et al., 1997). Globally, there is a significantly increasing trend in these two conditions. In 2016, above 1.9 billion people (39%) aged 18 years and older were overweight, and over 650 million of these people (3%) were obese. (World Health Organization, 2020c).

According to WHO data in 2016, more people are obese in all regions other than sub-Saharan Africa and Asia. The data showed that the United States has the highest number of obese population countries (36.2%) (World Health Organization, 2020c). However, in 2018, It showed that most of the Association of Southeast Asian Nations (ASEAN) countries experienced an increasing trend of overnutrition. Malaysia is the highest overnutrition country in ASEAN (around 40%), while Vietnam is the lowest (approximately 10%). Indonesia has undernutrition and overnutrition problems (double burden of malnutrition). It means that Indonesia should encounter the overnutrition problem while the undernutrition must be addressed immediately (Hanandita and Tampubolon, 2015).

The Indonesia Health Survey results stated that the obesity rate was inclined in the Indonesian adult population in 2018 from 15.4% in 2013 to 21.8% in 2018 (Indonesian Ministry of Health, 2018, Indonesia Ministry of Health, 2013). In detail, the overweight prevalence (Body Mass Index or BMI ≥23-27) in the population aged ≥ 18 years is 35.4%, while the obese people with a BMI ≥27 is 21.8% (women is higher than men, 29.3% 14.5%, respectively). The prevalence was higher in urban areas (25.1%) than in rural areas (17.8%). According to the age group, the highest obesity prevalence in Indonesia can be found in the 36-44 years age group (29.6%) (Indonesian Ministry of Health, 2018).

In 2018, East Java was one of 15 provinces that had a higher level of overweight (13.7%) and obesity (22.4%) prevalence in adult age (≥18-year-old) than the national majority, while the underweight prevalence reached 9.3%. Furthermore, Malang City is in the top 10 districts in East Java Province, with a high level of overnutrition, approximately 13.24% for overweight and 29.17% for obesity (population aged ≥ 18 years) (Indonesian Health Research Department, 2019). Especially for ages 17- 24, the overweight and obesity prevalence achieved 14.38% and 18.12% for males, while the females were 16.65% and 29.05%, respectively (Indonesian Health Research Department, 2019). Furthermore, Malang is the second-largest city in East Java after Surabaya (the capital of East Java Province). Besides, Malang is also known as a city of students because it has many universities, such as three government-owned universities and 44 private-owned universities (Malang Office Department, 2019). Most of the students come from other provinces (out of state students), staying in boarding houses or rented apartments.

According to the Indonesian Ministry of Health Data of 2018, the highest prevalence of obesity is in the 36-44 years old range age. However, the obesity prevalence increased dramatically in 17-24 years old (almost six times for women and three times for men). Some studies found that 17-24 years old is late adolescence or young adults age (Knost, 2013, Teipel, 2017, Simpson, 2009). They start to live individually, go to university, or seek a job at this age. When they lived separated from their parents, they often had unhealthy dietary habits and inadequate nutritional intake (Deliens et al., 2014, Alves and Boog, 2007, Nnanyelugo and Okeke, 1987).

Compared with workers, most students who started to live independently did not prepare food independently and preferred to take unhealthy food to consume. The Malang survey supported the frequency of junk food consumption for one week for overweight and obese girls who are out of state students and live in rent apartments are categorized at a high level (Septiana et al., 2018). The type of junk food that respondents often consume is fried chicken. While fiber consumption was classified as low. It also showed that they could not control their food because many food variants are available and easy to access (Septiana et al., 2018, Praditasari and Sumarmik, 2018). This diet pattern will lead them to be overweight and obese. A similar condition in the U.S, based on research results from the US national survey in 2005, depicted that 3 of 10 university students are either overweight (body mass index is 25.0–29.9 kg/m^2) or obese (BMI ≥30.0 kg/m^2) (American College Health, 2007).

Increasing BMI is the leading possibility factor to get non-communicable diseases, including 1) Cardiovascular-disease (especially stroke and heart disease), which were the primary causes of death in 2012; 2) Diabetes mellitus; 3) Musculoskeletal disorders (especially osteoarthritis - very disabling degenerative joint diseases); 4) Some cancers (including ‘breast, endometrium, ovary, liver, prostate, gallbladder, kidney as well as the large intestine). Overall, The risk of this non-communicable disease increases with increased BMI (National Institute of Diabetes and Digestive and Kidney Diseases, 2020). Research showed that females who have steadily overweight during their adult period between the 20s and 50s had practically five times higher possibility of getting chronic diseases than those with normal BMI for a similar adulthood period (Lu et al., 2011).

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Regarding this condition, some studies suggested that the young adulthood ages (18-25 years old) will be the initial period to change the unhealthy behaviour before starting to stagnate behaviour in middle and late adult age (Branje and Koper, 2018, Kroger, 2006, Erikson, 1968). It is also supported by other research that people at this age have reached optimum function of metabolism. Hence, having healthy eating behaviour can help repair and regenerate cells and prevent chronic condition development (Zimmerman and Snow, 2013).

1.1.2 Overweight and Obesity Prevention and Treatment Program

According to the World Health Assembly in 2004 and acknowledged again in the 2011 political declaration on non-communicable diseases (NCD), “WHO's Global Strategy on Food, Physical Activity and Health" represents actions required to assist a healthy and physical diet and regular activity. This method invited stakeholders to receive responsibility at international, national, and local stages to increase the population's diet and exercise activity pattern. Besides, the World Health Assembly welcomes the Ending Childhood Obesity Commission (2016) report and its six suggestions for reducing the obesogenic environment and the critical period in life's journey to overcome fatness in childhood. It can be used as a guideline to assist countries in implementing the Commission's recommendations accepted by the World Health Assembly in 2017 (World Health Organization, 2020c).

Currently, the Indonesian government is promoting the "national movement to reduce the obesity prevalence," better known as the Gerakan Nusantara Tekan Angka Obesitas (GENTAS), which encourages people to behave in a healthy lifestyle that starts with themselves, families, and people around us, and in our environment (Indonesian Ministry of Health, 2017). This program provides information about a) consumption of healthy food and balanced nutrition, taking at least five servings of vegetables and fruit each day; b) consumption of sugar, salt, and fat with the guidelines of G4 G1 L5 (maximum sugar consumption of 4 tablespoons or 50 grams per day, salt consumption a maximum of 1 teaspoon or sodium 2 grams per day, maximum fat consumption of 5 tablespoons or 67 grams per day); c) be diligent in regular physical activities such as walking, cleaning the house, and exercising, try to be done by BBTT (Good, Right, Regular and Measured); and d) maintain your ideal body weight and not risk by keeping your BMI in the range of 18-23 kg/m2 (Indonesian Ministry of Health, 2017). However, this program is ineffective because it is not promoted well, and most people should be aware of their unhealthy behaviour. Consequently, the overweight and obesity rates still increase year by year. In addition, the youngster age (university students) is rarely involved in the obesity program. The government focuses on HIV/AIDS, drug abuse, and adolescent pregnancy for youngster's age. To reach obesity program targets such as young adult people, the guideline books should be promoted on the ministry of health website and integrated with the application or social media group that shares the information about limiting diet and encourages healthy behaviour. The Diet Monitoring (Diamond) application is an application that counters the diet information and helps the user to monitor their diet.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

1.1.3 Mobile Health (mHealth) in Dietary Program

Nowadays, there is a change in information access trend from traditional media to the internet. In 2017, the internet was 3rd position among all media (96% television, 53% static outdoor, and 44% internet). Furthermore, in 2019, this number increased and achieved 64.8% for internet users (Association Of Internet Service Provider Indonesia, 2019). The majority of Indonesian internet users associate with the internet through their mobile phones daily. The internet's main objective is to communicate through instant messaging and connect to social media (Association Of Internet Service Provider Indonesia, 2019). Following this trend, there are many ways to help the dietary program succeed. One of the choices to support the diet program is electronic health (eHealth). WHO defined eHealth as the communication and sharing of information technology to help community health (World Health Organization, 2020a).

Research reported that a text message using-based treatment in overweight adults affected weight loss (mean change = −1.97 kg) for 16 weeks (Patrick et al., 2009). This is an ordinary devaluation in weight, while a clinical diet/physical activity for weight loss research over this time would be intended to result in a clinically relevant 5% weight loss (Donnelly et al., 2009). In another study, Ross and Wing's pilot RCT study depicted a self-monitoring technology (Fitbit activity monitor, scale and app) linked with concise mobile phone-based treatments in advanced consistency and weight loss than standard self-monitoring methods such as pedometer, paper booklet, body weight scale, and reference book (Ross and Wing, 2016)

Focus on managing the diet, many mobile-Health applications provided many topics compulsory to guide a balancing lifestyle. These involve suggested dietary consumption, the function of diverse food groups, recipes, energy expenditure, exercise, unhealthy life consequences, and daily tips to control weight. Plenty of applications also included guidance for mindful living or meditation (Sucala et al., 2013, Lyzwinski et al., 2019). Furthermore, enormous applications are feasible, while the healthcare staff did not have much time to assess the features and mHealth applications drawbacks. Commonly, evidence of mobile application evaluation for weight control is timely and highly relevant to guarantee their practical usage with health services procedures.

Regarding the limitation of the mHealth application, there were issues concerning privacy and accuracy of data in these mHealth applications. Enormous applications have little input from experts on physical activity or diet (Braz and Lopes, 2019). This issue leads to inaccurate and unreliable information (Chen et al., 2015, Bardus et al., 2016a). Furthermore, many applications do not include physical examinations by physicians. Hence, it questions the legality of the app's implications (Chen et al., 2015, Coughlin et al., 2015, Wharton et al., 2014).

Another critical issue is to ensure the user uses the application. The user will use the apps steadily when the application has interactive features. It was supported by a study that examined variant application effects on weight-loss outcome in overnutrition adults (Brindal et al., 2018). "supportive" applications contained knowledge support, managing consumption, prompts, personal fulfillment, rewards, and reminders, whereas "static" applications only supported recipes and weight loss knowledge (Brindal et al., 2018). When the apps were individually used together with personal support, the "supportive" applications group had attrition in the lower level, but no difference in weight loss outcome between the groups (Ghelani et al., 2020)

1.2 Research Gap

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Several research gaps are considered in this research:

1. Indonesian reducing obesity guidebook is not socializing well with the community, mainly the university student. Hence, the obesity prevalence is increasing every year.
2. Diet controlling application is a generally known application. However, most of those applications use manual records, do not synchronize with social media, and rarely have an Indonesian food database. Therefore, Indonesian need a tool that cached their need and easy to use to ensure their diet adherence.
3. Limiting diet applications that provided food calories information to help the users decide what they want to consume.

1.3 Research Question

Does Diamond application affect dietary intake and BMI among overnutrition female university students in Malang City, Indonesia?

1.4 Research Objective

General Objective

To develop and investigate the effect of Diamond application on dietary intake and BMI among overnutrition female university students in Malang City, Indonesia.

Specific Objective

Phase I

To develop the Diet Monitoring (Diamond) Application for managing the diet and BMI. It consists of.

1. To study mobile application usage among female university students in Malang City.
2. To survey the trend of local food consumption among female university students in Malang City for preparing the Diamond Application database.
3. To evaluate the accuracy of the meal diary feature to calculate the food image in Diamond apps.
4. To study the usability of Diamond apps interface among female university students in Malang City.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Phase II

To assess the effect of dietary monitoring (Diamond) application on dietary intake and BMI among female university students in Malang City, Indonesia. It consists of.

1. To compare the baseline data between the intervention and comparison group.
2. To compare the Diamond apps' effect on dietary intake and BMI within the intervention and comparison group.
3. To compare the Diamond apps' effect on dietary intake and BMI between the intervention and comparison groups.
4. To correlate the Diamond apps usage with dietary intake and BMI in the Intervention group.

1.5 Research Hypothesis

The research hypothesis focuses on phase II related to assessing the effect of the Diamond application.

1. There are effects on dietary intake and BMI before and after Diamond application implemented within the intervention group and control group.
2. There are effects on dietary intake and BMI after the Diamond application was implemented between the intervention and control groups.
3. There is a correlation between the Diamond apps usage with dietary intake and BMI in the Intervention group.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

1.6 Conceptual Framework of Phase II

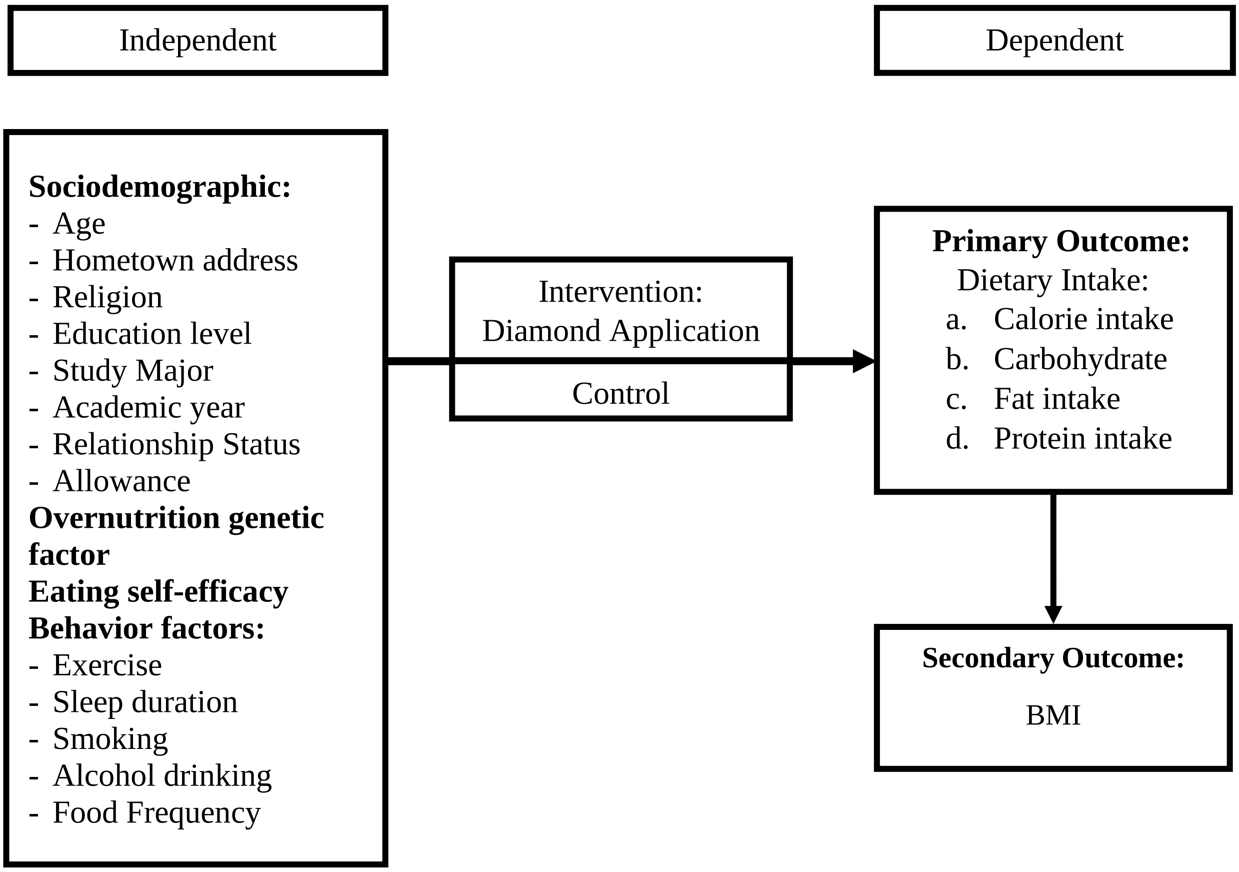


Figure 1. Conceptual Framework

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

1.7 Operational Definition

Operational definition in this research will describe as following:

Table 1. Operational Definition

No	Term	Operational Definition
1	Female University student	The women on age 18-24 years old registered as university students a day after joining the research.
2	Overnutrition	The condition that Body Mass Index >25 as Indonesian Ministry of Health Criteria. It consists of overweight (25.1-27) and obesity (>27).
3	Hometown address	Participant's hometown addresses areas such as rural or urban areas.
4	Religion	The respondent believed in God. Indonesian have six kinds of religion such as 1) Islam, 2) Cristian, 3) Catholic, 4) Hindu, 5) Buddha, and 6) Kong hu cu. A different religion will impact food choices.
5	Education level	Participants' education level consists of two degrees, undergraduate (bachelor) and master's degree
6	Major of study	Academic discipline to which students formally engage.
7	Academic year	Respondents enrolled at the registered academic program level.
8	Relationship status	The participant's relationship state is related to commitment.
9	Allowance	Amount of money that respondents got in a month from their parents and other sources.
10	Eating Self-efficacy	The participant believes in how confident they can change their diet and loss weight.
11	Regular Exercise	The frequency and kind of exercise that participants did each week.
12	Sleep duration	A total number of hours of participants habitual sleep at night.
13	Food Frequency	The list of food and beverage from phase I refers to the usual frequency of participant consumption over the period.
14	Diet Monitoring (Diamond) Application	Diet application to help Indonesian over-nutrient people manage their diet, focusing on image recognition in meal diary features and local food database. Otherwise, it has seven features as follows. 1. Profile refers to general information such as email and nickname to log in to the app's system. 2. Diet information belongs to the Indonesian reducing obesity guidebook program inserted in the apps as basic knowledge for users to support their diet program. 3. Estimated Energy Requirement (EER): calories estimation calculation (proper calories per day) regarding user's age, weight, height, and activity level. 4. A meal diary describes the features to capture the

No	Term	Operational Definition
		information from a camera or barcode or manual, and the user can decide how much they eat and save the meals. 5. Diet reminder (calories reminder, eating time reminder) refers to notification that reminds users about their calories left per day after inputting the EER and meal diary features. 6. A meal graph refers to a chart that displays the EER and meal diary input data per day, week and month to inform the achievement of the user's calories. 7. Exercise record belongs to a feature that helps the user to identify their exercise activity per day.
15	Primary outcome	The first effect that showed up after the intervention was implemented. Dietary intake is the primary outcome of this research.
16	Dietary intake	The nutrient intake of overnutrition female university students focuses on. a. Total calorie intake refers to all calories amount of meals that the respondent consumed (Kcal). b. Carbohydrates intake refers to the carbohydrate amount in the food consumed by respondents (grams). c. Fat intake refers to the fat amount in the food consumed by respondents (grams). d. Protein intake refers to the protein amount in the participants food consumption (grams)
17	Secondary outcome	The outcome appeared as the impact of the primary outcome. The secondary outcome of this research is Body Mass Index (BMI).
18	Flutter program	An open program by Google for building multi-platform applications from a single codebase.
19	Yolo Program	*a program provided the estimations and visualizations required during the image processing workflow. It showed the accuracy of image processing in meal diary features and displayed it on graphics (outside the Diamond application).*
20	Firebase Analytics	It is a free app measurement solution that provides insight into app usage and user engagement. It will present the researcher with the user's demographic, retention, and engagement with the Diamond application.
21	24 hours recall form	Form used to measure the dietary intake by capturing the detailed information about all meals and drinks consumed by respondents past 24 hours.
22	Nutri-survey	Software that nutritionists commonly use to analyze the nutrient food such as carbohydrates, fat, protein, fiber, and total calorie with a standard food database. This software is conducted and validated by the SEAMEO RECFON organization.

CHAPTER II
LITERATURE REVIEW

This literature review summarizes articles and textbooks related to the research topic (nutrition and dietary application). Besides, it describes in detail the term used in this research.

2.1 Nutrition Status

Nutritional status explains nutrition in the form of certain variables (Supariasa et al., 2016). Moreover, nutritional status measures a person's body condition according to the dietary intake and the nutrients used in the body. Nutritional status is divided into three categories such as undernutrition, regular nutrition, and overnutrition (Almatsier, 2010). A person's nutritional status depends on nutritional intake and needs. The dietary requirements of individual people are different. It depends on age, gender, activity, weight, and height. When intake nutrition is balanced with body needs, it will produce good nutritional status. For instance, protein requirements among children under five are not the same as adolescents' needs of adolescents. The energy needs of students who become athletes will be far more significant than students who are not athletes (Par'i et al., 2016).

Malnutrition was used to define an excess, deficiency, or imbalance of nutrients range, bringing about quantifiable unfavourable impacts on body organization, work, and clinical results. It can allude to either under-or over-supported people, even though it is commonly utilized for undernutrition. Malnutrition happens for a psychosocial reason as well as an outcome of illness. It legitimately influences clinical results and is related to substantial medical care consumption (Saunders et al., 2011).

Excess nutritional intake compared to requirements will be stored in in-kind reserves in the body. For example, if someone has excess carbohydrate intake resulting in increased blood glucose, it will be held in deep fat body fatty tissue. Conversely, when someone consumes fewer carbohydrates than the body's needs, the fat reserves will be processed through the process of catabolism into blood glucose and becomes the body's energy.

2.1.1 Overweight and Obesity Prevalence

Global data in 2016 indicated that more than 340 million youngsters and youth adults 5-19 were overweight or fat. Overweight and heftiness predominance among youngsters and youth adults 5-19 has risen significantly from only 4% in 1975 to over 18% in 2016. in 2016, The ascent happened correspondingly among young men and women (18% of young ladies and 19% of young men were overweight) (World Health Organization, 2017).

In Indonesia, the commonness of overweight and fatness has expanded over twenty years already among kids, teenagers, and grown-ups. The pace of overweight and obesity among kids and teenagers matured 5-19 out of 2018 expanded to 21.8% from 15.4% in 2013. The obesity prevalence (Body Mass Index or BMI ≥23-27 and BMI ≥27) in the population aged ≥ 18 years is 35.4%, while the obese population with a BMI ≥27 is 21.8%. In the population aged ≥18 years who are obese, the prevalence is higher in women (29.3%) than in men (14.5%) (Indonesian Ministry of Health, 2018). A higher prevalence was found in cities (25.1%) than in rural communities (17.8%). While as indicated by the age gathering, the highest obesity majority can be found in the age group 40-44 years (29.6%) (Indonesian Ministry of Health, 2018).

As one of the crowded populations in Indonesia, East Java has a predominance of overweight in adolescents aged 16-18 years, rose from 1.4% in 2010 to 9% in 2013, and increased to 13.7% (2018). A report from the East Java Health Office showed that the prevalence of overnutrition in 2018, Malang City has a high level of overweight and obese for the population aged ≥ 18 years (approximately 13.24% and 29.17%, respectively) (Indonesian Health Research Department, 2019). The data survey used a cross-sectional study. It has different subjects for each age range. In detail, for young adult ages (17- 24 years), it showed that for males, the overweight and obesity prevalence achieved 14.38% and 18.12%, while the female were 16.65% and 29.05%, respectively. The prevalence detail shows as following:

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

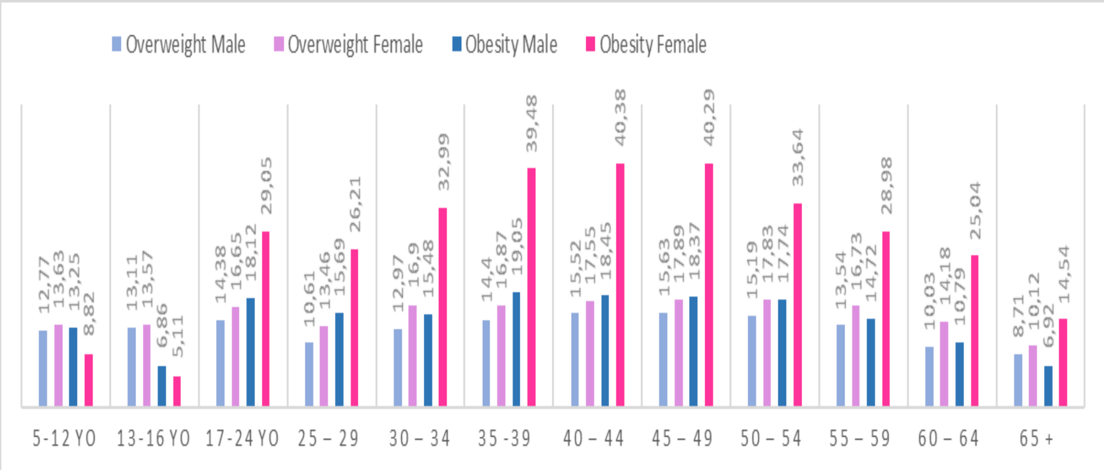


Figure 2. Overnutrition Prevalence (%) Based on Age in Malang City, Indonesia (Indonesian Ministry of Health, 2018)

2.1.2 Nutrition Status Assessment

Overnutrition (overweight and obesity) is characterized as "irregular or extreme fat collection that presents a danger to wellbeing". Contingent upon age, there are various techniques to gauge a body's sound weight that are accessible. For example, it is hard to create one detailed record to estimate overweight and heftiness in kids and teenagers because their bodies go through numerous physiological changes as they develop (World Health Organization, 2020d). In detail of these, it will be explained as follows.

1. Children aged (0-5 years)

   The children under five nutritional status is measured by age, body weight, and height. A toddler's weight is measured by a digital scale with a precision of 0.1 kg, while the height is determined using a height examination instrument with an accuracy of 0.1 cm. The height and body weight variables of children under five are presented in three anthropometric indices: bodyweight/age, height/age, and body weight/height. For youngsters under five, every kid under five's body weight and stature is changed over into normalized esteem (Z-score) utilizing anthropometric principles for WHO toddlers in 2006. Moreover, according to each indicator Z-score, the nutrient status of children under five is determined as follows (Indonesian Ministry of Health, 2018).

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

a. Severe Undernutrition : Z-score < -3.0 SD
b. Moderate Undernutrition : Z-score ≥ -3.0 SD up to Z-score < -2.0 SD
c. Normal : Z-score ≥ -2.0 SD up to Z-score ≤ 2.0 SD
d. Overnutrition : Z-score > 2.0 SD

2. For individuals aged 5-18 years

The nutritional status of children at 5-18-year-old is grouped into three age categories, such as 5-12 yo, 13-15 yo, and 16-18 yo. Nutritional status parameters used for this age group are according to the anthropometric measurement of weight and height. It was presented in height index according to age (H/A) and Body Mass Index by age (BMI/A). Using anthropometric norms for the child at 5-19 years WHO 2007, each child's Z-score of H/A and BMI/A values were calculated. Furthermore, based on the Z-score, the BMI status of children is categorized as follows (Indonesian Ministry of Health, 2018).

a. Very thin : Z-score < -3.0 SD
b. Thin : Z-score > -3.0 SD up to < -2,0 SD
c. Normal : Z-score > -2.0 SD up to < 1,0 SD
d. Overweight: Z-score > 1.0 SD up to < 2,0 SD
e. Obesity : Z-score > 2.0 SD

3. Body Mass Index (BMI)

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

BMI is the instrument generally used to gauge and screen for overweight and heftiness in grown-ups (> 18 years old) and supported the child's physical measurement. BMI is characterized as weight in kilograms isolated by height in meters squared. BMI is identified with the measure of fat in their bodies for the vast majority, raising the danger of numerous medical issues. Medical services proficient can decide whether an individual's well-being might be in danger due to their weight. (The National Institute of Diabetes and Digestive and Kidney Diseases, 2017).

BMI was created as a danger pointer of illness. Some primary conditions identified with overweight and fatness incorporate sudden passing, cardiovascular diseases, hypertension, osteoarthritis, diabetes, and cancer. BMI is likewise prescribed to use in kids and teenagers. In kids, BMI is determined concerning grown-ups and afterwards contrasted and z-scores or percentiles. During youth and immaturity, the proportion in the range of weight and tallness differ with sex and age, so the cut-off qualities that decide the healthful status of those matured 0–19 years are sex and age-explicit. In 2006, the cut-off BMI for kids grew 0–5 years as a finding of overweight and heftiness were 97th and the 99th percentile, individually. For those matured 5–19 years, overweight is characterized as a BMI for-age an incentive more than +1 SD and corpulence as a BMI-for-age an incentive more than +2 SD (World Health Organization, 2019). Besides, the cut-off purpose for anthropometric parameters prediction for Cardiovascular Disease (CVD) causative factors for South Asian males was 23.4–24.2 kg/m2, while for women, the scope was broader at 23.6–25.3 kg/m2. In addition, for Waist Circumference (WC) cut-off value was higher for males (84.5–89.5 cm) than females (77.5–82.0 cm). Waist to Hip Ratio (WHpR) cut-off values were also higher for males (0.93–0.95) than females (0.85–0.88). For both sexes, the optimal Waist to Height Ratio (WHtR) cut-off values were 0.51–0.55, i.e., WHtR >0.5 associated with cardiometabolic risk indicators (Prasad et al., 2013).

In 2017 Indonesia Ministry of Health had the BMI standard as overweight categorized for women is higher than 23 kg/m^2. However, the standard was revised in 2019 as follows .

Table 2. Nutritional Status Based on BMI Score in Indonesia

	Category	BMI
Thin	High level of weight loss	< 17.0
	Mild weight loss	17.0 – 18.4
Normal	Normal	18.5 – 25.0
Obese	Overweight	25.1 – 27.0
	Obesity	>27.0

Source: (Indonesian Ministry of Health, 2019)

2.1.3 Young Adult Age Nutrition

Young adults or late adolescents are people in their late teens or early twenties to their thirties age. There are many categories of young adults. In his stage of development, Ericson showed that late adolescence is related to the person aged 20-25 years old (Erikson, 1968). The other definition from the SAHRC report, young adulthood raging, is 18-24 years old. Simultaneously, the Joint Strategic Needs Assessment (JSNA) Report showed that 18-25 years is the range for young adults

(State Adolescent Health Resource Center, 2013, Nyman, 2017). Besides, WHO stated that “adolescent” as a person in 10-19 years old and “youth” as 15-24 years old (World Health Organization, 2018). The Late adolescence/young adult is the ultimate goal participants for health promotion program, including nutrition program because:

1. Adjust to self-physical sense

   Physical and sexual body transformation is initially complete. For young men, they might continue to grow until 21 years old. Youth at this age have acceptance of their physical appearance (State Adolescent Health Resource Center, 2013).
2. Adjust to abstract thinking skills

   Young adults can think conceptually, identify the principles, and apply them to current situations. In addition, they think about their future, concerning many probabilities, logical sequences of possible events. The greater competency to consider distinctive points of view at the same time can affect to increase empathy and concern for others feeling. They also have an interest in many societal issues. These competencies make the youth value the people's differences and perspectives better and appreciate many correct answers to solve the problem (State Adolescent Health Resource Center, 2013).
3. Can adopt individual values

   Late adolescences develop self-feeling as personal and as a part of society. They define their identity feeling alongside issues such as physical attributes, gender, ethnicity, and sexuality. They still have time for identity exploration, especially in education, family, personal relationships, and work (State Adolescent Health Resource Center, 2013).
4. Stage of emotionally stability and responsibilities

   Youth examines the competence necessary for expecting roles and deal with multiple labour market requirements in this stage. They also try to accomplish the expectations regarding their commitment to family, public, and citizenship. Furthermore, young adult is the transition to university, work, and independent living as well. Late adolescence commonly remains in school and work-life and marry subsequently. In addition, they predict the sequence of home-leaving,

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

education level, full-time employment, cohabitation or marriage life, and parenthood (State Adolescent Health Resource Center, 2013, Simpson, 2018).

5. Develop to sexually maturing body and feelings

   Late adolescence adapts sexually and establishes sexual identity sense. This stage contains personal characteristics such as femininity or masculinity into individual identity, values about sexual behaviour, and relationship skills. Romantic severe relationships begin to acquire. Majority regard fidelity, love, and lifelong commitment as an essential part of having successful relationships (State Adolescent Health Resource Center, 2013).

6. Optimum function of metabolism

   Young adult age is a stage where the person peaks their primary physical condition. Their system of organs and body is fully matured. Maintaining health at other age levels is essential to practice a good lifestyle at this age. Healthy lifestyle habits involving eating behaviour can prevent chronic disease and repair and regeneration cells (Zimmerman and Snow, 2013).

2.1.4 Treatment and prevention

Overnutrition (Overweight and obesity), just as their connected non-communicable sicknesses, are to a great extent preventable. The most suitable choice (the decision that is the most open, accessible, and reasonable) can forestall overweight and heftiness. At a personal level, individuals can limit energy admission from fats and sugars sources, increment intake of vegetables, just as fruits, grains, and nuts, and take part in activity movement (an hour daily for kids and 150 minutes spread over the week for grown-ups). Hence, stable conditions and networks form individuals' decisions by picking more advantageous nourishments food and regular movement. (Brown and Summerbell, 2009).

Essential counteraction expects to build up a healthy life, a dynamic way of life, and keep youngsters and youths inside the scope of average body weight. General wellbeing prohibition is by all accounts the most reasonable structure because few different cofactors of morbidity and mortality of prosperous networks can be forestalled (Pandita et al., 2016). For those kids and fat young people, the second level

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

of anticipation is required. Large Therapeutic mediation programs expect to keep up weight reduction and standardize body fat and weight. They need to alter the eating and physical activity of the corpulent kid and set up a new lifestyle and healthier behaviour. Intervention programs must incorporate behaviour segments to continually change fat kids and teenagers (Pandita et al., 2016, Brown and Summerbell, 2009).

Singular obligation can possibly have its full impact when communities can approach for healthy habits. Thusly, it is fundamental to help people at the cultural level by following the suggestions. Through the continued execution of data-based and populace based strategies, regular movement and more advantageous dietary decisions are accessible, moderate, and effectively open to everybody, especially devastated people. A case of such an approach is an expense on sugar-improved refreshments that will affect sugar consumption in community (World Health Organization, 2020b).

The Healthy Living Community Movement Program (GERMAS) activated by the Indonesian government is one way to reduce non-communicable diseases, including overw eight and obesity in Indonesia (Indonesia Ministry of Health, 2016). GERMAS is a movement that aims to change unhealthy behavior to healthy behavior. This program was also followed by promoting healthy hygiene behavior and support for infrastructure programs on a community basis. 7 Pillars of the Healthy Living Community Movement (GERMAS): Carry out physical activities; Consume fruits and vegetables; Do not smoke; Do not consume alcohol; Checking health regularly; Cleaning up the environment, and using a toilet (Indonesia Ministry of Health, 2016). Research by (Dewantari et al., 2020) shows that GERMAS counselling is done once per week for six weeks, can significantly increase the implementation of GERMAS and reduce BMI substantially.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

In addition, currently, The Disease Prevention and Control Department of the Indonesian Ministry of Health launched the promotion of a national movement to reduce the obesity prevalence or better known as “Gerakan Nusantara Tekan Angka Obesitas” (GENTAS), which encourage that there are three essential things must be done by someone to prevent and control the obesity, named: adjust the diet; actively movement; and entertainment (Indonesian Ministry of Health, 2017).

First, setting the proper diet to prevent and control obesity, such as managing food consumption patterns, can use a dinner plate with a T shape. The dinner plate model can regulate the consumption of vegetable intake at twice the rate of food containing carbohydrates. The amount of food containing protein consumed is the same as the amount of food containing carbohydrates. The amount of fruit consumption is at least the same as the amount of food that is a source of carbohydrates or food that becomes a source of protein (Indonesian Ministry of Health, 2017). Second, be active every day according to the ability and condition of the body. The main principle in physical activity is increasing energy using and fat burning. Physical activity and physical exercise are inseparable parts of therapy to lose weight and maintain ideal body weight. Physical activity is recommended to be a routine activity to control weight. For obesity, they can do moderate exercises minimum of 150 minutes per week or strenuous activities at least 75 minutes per week or a combination. Lastly, people must enjoy their days with fun activities such as recreation, hobbies, vacationing with family, worshipping and getting enough sleep (Indonesian Ministry of Health, 2017).

2.2 Health complications of overweight and obesity

Overnutrition can lead to many diseases. The detail about these explained as follows.

1. Type 2 Diabetes Mellitus. Obese children's evidence increased metabolic risk factors, and those with a family history of T2DM appear to be at most significant risk for the development of T2DM (Pulgaron and Delamater, 2014). Type 2 diabetes affects approximately 11% of US adults and 8% of adults worldwide. Furthermore, 37% of US adults have prediabetes (51% of those aged 65 years or older). For both conditions, overweight and obesity are major risk factors(Franz et al., 2015).
2. High Blood Pressure. Obese had considerably increased the risk of systolic and diastolic in the hypertensive range, especially in older adolescents (Oduwole et al., 2012). In both sexes, overweight and obese participants had a significantly higher prevalence of hypertension and higher SBP/DBP levels than normal-weight subjects. BMI was the only significant independent predictor for the

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

difference in SBP/DBP measurements and hypertension prevalence among the lifestyle risk factors examined. An increase of 1 BMI unit was associated with, on average, a 2.0 mmHg (1.4 mmHg) and a 1.3 mmHg (0.8 mmHg) increase in SBP and DBP in males (females), respectively (Papathanasiou et al., 2015).

3. Joint Problems. The recent evidence depicted that being overweight or fat significantly impacts these young people's health and well-being and may contribute to ongoing health problems such as musculoskeletal pain and bone/joint dysfunction in later life (Smith et al., 2014). There was a statistically significant increase in the frequency of neck pain, shoulder pain, elbow pain, wrist and hand pain, leg pain, arm pain, ankle-foot pain, low back pain, hip pain, and knee pain in the fatness group parallel with the normal-weighted people (Turgut et al., 2014).
4. Gallstones (GSD). The pervasiveness of gallstones expanded with expanding weight. However, the correlation was more grounded in women than men (Koebnick et al., 2012). Overweight and corpulent patients with BMI ≥23 kg/m2 had an essentially higher frequency of gallstones than those with a lower BMI (Park et al., 2016). The pervasiveness of GSD was 17.8%. The following change for age and afterwards, other potential danger factors, all corpulence records, aside from subcutaneous stomach fat tissue (SAT), were related to GSD in ladies with the proportion of the most noteworthy changes saw in Waist-to-Height Ratio (WHtR). Conversely, WHtR was the primary related record in men. The pattern of expanding corpulence measures over the quartiles with the danger of GSD was huge in subgroups of WHtR and BMI in ladies and WHR in men (Radmard et al., 2015).
5. Cardiovascular Disease (CVD). Public mainstream drifts in CVD hazard factors showed that albeit minor upgrades have happened in all weight gatherings, hazard factors keep on being higher in fat and overweight people. Nevertheless, its backhanded impacts on CVD hazard, early epidemiologic proof from the Framingham Heart Study, the Nurses' Health Study, and the Manitoba study set up obesity as a leading independent factor for CVD (Bhupathiraju and Hu, 2016). In the obesity group, there was a significant increase in the heart rate. In contrast, the HRV parasympathetic parameters were less, and the sympathetic parameter

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

low frequency (LF) or high frequency (HF) ratio was more than that of the regular weight group (Yadav et al., 2017).

2.3 Factors associated with overweight and obese

1. Sociodemographic: Age, Gender, Marital status, Education, Income

There are many Sociodemographic factors correlated with overweight and obesity. Evidence in the literature depicted the essential predictors of overweight and fatness including individual-level behaviour, demographic characteristics, and socioeconomic factors. A further explanation about sociodemographic and overweight and obesity associations will be examined as follows.

a. Age. Experiencing overweight and obesity increased steadily with increasing age for females and males. For example, 16.3% overweight prevalence in 20-24 years while 32.0% in 45- 49 years in women (Letamo, 2011). The overnutrition predominance among preschool kids was lower than among young youngsters (Shan et al., 2010).

b. Gender. The overnutrition was higher among young men than among young ladies in all age gatherings, and the sex distinction was broader in metropolitan than in countryside zones. Most of the obese among young men (12-18 yo) were twice that among young ladies in China (Shan et al., 2010). White American young people's overweight and obesity profile were inverse to black American youths (Al-Hazzaa et al., 2012). Similar to the black American youth obesity profile, based on a Nationwide survey in 2018, it showed that women have a higher prevalence of obesity and overweight than men (29.3% and 14.5%, respectively) (Indonesian Health Research Department, 2019). Women appear to have a higher tendency to store fat. Besides, after pregnancy, females frequently have an issue not losing the abundance of weight they acquired. However, social culture also identifies with work and relaxation exercises adequate for women in specific social orders. Particularly the Muslim countries, women commonly do less regular exercise and sport which can raise the possibility to excess weight. In addition, women has responsibility to choose the food and allocate food in household, it can possibly impact to increase overweight risk in children (Roemling and Qaim, 2012).

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

c. Marital status. The odds of being overnourished (overweight or obese) were higher among married adults than their counterparts (Dagne et al., 2019). Overweight and corpulence were likewise basic among the as of now wedded contrasted with a never-wedded ladies and men. Right now, hitched ladies were 1.5 times bound to be overweight or stout than the individuals who are not married (Letamo, 2011).
d. Education level. Factors significantly associated with a higher prevalence of overweight and obesity were age and education among females (Ajani et al., 2015). Among men, overweight and corpulence were more articulated among those with post-graduate programs contrasted and their partners with other instructive accomplishments, assuming any. Ladies with the post-graduate program were 1.8 times bound to be overweight and hefty than those with no education level (Letamo, 2011).
e. Income. The populace at a low economic level has a high commonness of being overweight. Being overweight in this setting is related to deficient movement and common dietary variety (Mayega et al., 2012). Youths from a family payment of three least wages or more had multiple times the higher possibility of overabundance weight when contrasted with youngsters in a family with a lower price. (Souza et al., 2014).

2. Genetic. An obese child was more likely to have obese parents and lower education (Bingham et al., 2013). Having at least one overweight parent was a possible factor for being overweight or obese (Bhuiyan et al., 2013)
3. Eating behaviour. Frequent consumption of snacks was also a substantial cause factor for overweight and obesity. Additionally, frequently eating fast food was the identified risk factor for obesity, while sweetened drinks were not significantly contributed (Shan et al., 2010). Eating habits like junk food, chocolate, and eating outside at the weekend have a remarkable effect on overweight and obesity prevalence among middle to high SES groups (Goyal et al., 2010). Overweight and corpulence were more ordinary in the individuals who skipped breakfast than the individuals who regularly ate at home (Maddah and Nikooyeh, 2010). Stout guys and females had less great dietary propensities, including less successive

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

breakfast (< 3 days every week), milk and fruit, yet had a higher consumption of sweet beverages and desserts/chocolates.

4. Unhealthy behavior. The odds of being over nourished (overweight or obese) were higher among adults who had drunk alcohol than their counterparts (Dagne et al., 2019). Among young ladies, smoking cigarettes and dejection were related to overweight or weight. While among young men, lacking consumption of fruits and cigarettes were related to overweight or heftiness (Peltzer and Pengpid, 2011).
5. Sleep habits. Inadequate sleep was also a significant risk factor for overweight and obesity (SHAN et al., 2010). The current investigation gives proof that short rest length (<10 hours) is a danger factor for overweight and obesity in youngsters (Chaput et al., 2011).
6. Physical Inactivity. Exercises were related with overweight and weight, separately. Youngsters who went through two hours or more every day staring at the TV, or on PCs and computer games were bound to be fat than the others (Shan et al., 2010). Solid proof for an opposite relationship between movement and overweight, moderate proof for a positive relationship between sedentary life – for the most part TV seeing – and overweight (Te Velde et al., 2012).

2.4 Dietary Intake

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Dietary intake is the daily nutrient consumption of an individual, including the calories and food quantities. Nutrition status means the bodies condition related to the diet. Dietary intake evaluates commonly be used to measure the current daily food consumption. Dietary intake Assessment and dietary behaviours intervention are the keys in fitness care. There are methods to measure dietary intakes, such as 24-hour recall, nutritional statistics, and food frequency questionnaires (FFQs).

Twenty-four-hour dietary accuracy depend on the interviewer skill. They should ask the respondent for details of meals and liquids ate within 24-hour (Lee et al., 2017). A twenty-four-hour dietary recall was conducted to quantify the usual dietary intake for individuals. To improve the accuracy of 24 hours recall, it may be repeated on numerous activities to account for variety in consumption. Other studies said it needs at least 3 times on random days (2 days on weekdays and 1 day on weekends). In addition, for dietary records methods, the respondent records their food and drinks fed on over one or more days (Lee et al., 2017).

The other dietary intake method is the Food Frequency Questionnaire (FFQ). An FFQ is used to measure the usual frequency of intake using a listing of supplied meals for particular periods. This approach has advantages for analyzing the standard nutritional consumption in a vast population. It examined how regularly people eat foods and the scale of the portions once in a while. In addition, this approach is cheaper and briefer. However, an FFQ is unable to include all meals and liquids that people consumed (Food and Nutrition Technical Assistance, 2016). The differences of each method will be explained in Table 4 as follows.

Table 3. Differences in Dietary Methods

Difference item points	**24-Hour Dietary Recall**	**Dietary Records**	**Food Frequency Questionnaires (FFQs)**
Categories	methods of recall	methods of real-time recording	methods of recall
period	Short-term methods	Short-term methods	Long-term methods
How to collect data	The individual was approached to review and depict their meal and drinks in the last 24 hours. Information arrangement might be both questioner or self-controlled, and it routinely observes the psychometric guidelines of organized, multi-faceted meetings that encourage individuals from their depictions	The people are requested to tape each meal or drink they consumed in real-time. People also are asked to record the actual portions of food they ate.	It notes the frequency of food and beverages consumptions over an extended time duration, maximum commonly a year.
Strength	1. It can monitor the common intake of the community and help identify the need for dietary nutrients for a subpopulation. 2. It is convenient, fast, and easy to assess dietary information of	1. It provided better information on individuals' calories and protein intakes. 2. It can assess many variations of dietary consumption over a more extended period	1. can monitor the usual intake of the population, and able to identify the dietary needed of the population. 2. It can assess dietary consumption over a more extended time

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Difference item points	24-Hour Dietary Recall	Dietary Records	Food Frequency Questionnaires (FFQs)
	diet.		
Limitation	1. The individual might be misreporting in their food’s intake. It can be influenced by their characteristics (e.g. gender, age, overnutrition, or undernutrition). It will lead to a misclassification with the expected associations 2. It required trained staff and relied on the participant's short-term memory.	1. It needs high costs and complicated procedures. Hence, it is less used in big-scale of diet-disease associations epidemiologic investigations. 2. It required weighing food, a lot of time for preparation, and establishing a workload for the participants, which can create deviations in normal food intake (particularly a quantities underestimation) and low completeness and retention rates.	1. Possibly recall bias because people were required to report their consumption retrospectively and commonly refer to a long time. 2. It cannot count for people food variation and did not allow an accurate estimation of food serving sizes

Sources: (Béjar et al., 2018, Hock et al., 2018, Naska et al., 2017)

2.5 Overweight and obesity correlation with diet intake

Food and drinks depicted the energy balance condition's 'energy in' side, with the energy-yielding supplements being fat, protein, vitamin, and carbohydrate. Extensive consideration has been centred around energy equilibrium and characterizing the energy necessities for health. Children's stage is in energy offset with a generally steady bodyweight direction (Collins et al., 2010). If energy intake is higher than the required energy needed, excess weight gain will ensue and vice versa. Energy necessities for growth are moderately small and include the energy expected to combine developing tissues and those stored in those tissues. Albeit children are accounted for to have a natural control of hunger and can coordinate admission to energy needs, this biological system can be more straightforward abrogated by ecological and social elements in more established youngsters (Collins et al., 2010).

Juvenile requires sufficient energy (kilojoules/calories) and supplements to empower average growth and advancement. Meeting wholesome necessities and maintaining a strategic distance from an abundance of weight increase, a healthy dietary example comprising vegetables, fruits, lean meat, whole grains, or elective protein sources and dairy items should be devoured. Dietary components have been read broadly for their potential commitments to the increasing paces of weight. The food factors analyzed incorporate fast food utilization, snack foods, sweet drinks, and portion estimates. High sugar and fat should be limited to forestall overweight and fatness (Sahoo et al., 2015, Todd et al., 2015).

It is particularly significant for inert teenagers, whose endeavour is less actual than prescribed to avoid high fat and high sugar food. For youths who embrace huge movement, energy prerequisites will be higher, and such people may need to build their consumption of healthy food appropriately. The arrangement of sufficient calories for growth can be checked by following the body composition and movement. Decreasing calories, as well as an expansion in exercise, might be needed to limit weight gain. Any decrease in energy admission should begin with diminishing high sugar food, high fat (for example, comfort and takeaway food, snack, cakes and desserts, and sweet drinks), and expanding admission of vegetables, fruits, low-fat dairy items whole grains (Todd et al., 2015).

Puberty is a progress time from guardians/gatekeepers to their responsibility regarding their food decisions. Reliable with more considerable authority over the dietary decision is the potential for changes in food inclination driven by hormonal, lifestyle, environmental, and social alterations. Youth is regularly connected with expanded rest span, affecting eating schedules and food consumption guidelines. Hormonal changes might be entangled in an inclination for sweet, high-fat food or intense. Dietary inclinations of kin and friends, social advertising, and TV or video promoting can likewise impact food decisions. Combined with the accessibility of cheap food and drink high in calories and low in nutrients, these changes can replace healthy food sources with those high in sugar and fat. Such dietary changes may modify energy balance, be less nutritious, and decrease the capacity to meet micronutrient prerequisites (Todd et al., 2015, Peltzer and Pengpid, 2011).

Related to this condition, nowadays, Indonesian adults and children consume ultra-processed foods (instant noodles, fried snacks, fast food). In support, Indonesia survey data showed that household food expenditure on rice and cooking oil is higher every year (Oddo et al., 2019). The level of fried food consumption in Indonesian society is very high. People preferred fried food to steamed food because fried food has a delicious taste and a low price. It is easy to get and attract buyers due to its look. Another favourite food of Indonesian people is consist of coconut milk and oily texture while they lost interest to consume the vegetable (Diguna et al., 2015).

Figure 3. Indonesian Food

2.6 Indonesian Balance Diet Guideline

The Nutrition Guide for Balanced Diet Principles, as a result of the agreement on a world food conference in Rome in 1992, is believed to overcome the double burden of nutritional problems, both deficiency, and excess nutrition. In Indonesia, the principle is known as the Balanced Nutrition Guidelines. The basic Balanced Nutrition Guidelines is that the daily consumption of food must contain nutrients in the type and amount (portion) that require each person's needs or age group. Food consumption must pay attention to the principles of the 4 pillars of diversity in food, clean living behavior, physical activity, and maintaining an average weight (Indonesia Ministry of Health, 2014).

In another term, balanced nutrition is namely sufficient in quantity, sufficient in quality, containing various nutrients (energy, protein, vitamins, and minerals) that the body needs to grow (in children), to maintain health and to carry out activities and functions of daily life (for all age groups and physiologists), and store nutrients to

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

meet the body's needs when consuming food that does not contain the nutrients needed (Indonesia Ministry of Health, 2014).

Figure 4. Balanced Nutrition Pyramid

The Balanced Nutrition Principle consists of four components: a series of efforts to balance between nutrients that come out and nutrients that regularly monitor body weight. The Four Pillars are eating various foods, having healthy life behaviour, physical activity, maintaining, and monitoring normal weight (Indonesia Ministry of Health, 2014).

1. Food source of carbohydrates. For instance, rice, vermicelli, biscuits, oatmeal, corn, potato, white bread, cassava, macaroni, and noodle.
2. Vegetable has high protein—for example, beans, soybeans, and tofu.
3. Animal Protein. Such as fresh fish, beef, chicken, eggs, and shrimp, milk.
4. Vegetable Food Group
   a. Low calories: cucumbers, lettuce, vegetable tomatoes, ear mushrooms, and turnips.
   b. Nutrient per serving (100 grams) is 25 calories: spinach, bit, kale, cabbage, eggplant, and Carrots.
   c. Nutrient per serving (100 grams) is 50 calories: papaya leaves, pea, and young jackfruit.

5. Fruit Groups contain many minerals and vitamins such as avocados, grape, red apple, star fruit, mango, melon, pear, papaya, and banana.

According to the balanced nutrition principle, Indonesia has another guidance for nutrition called RDA. Recommended Dietary Allowances (RDA) are the average adequacy of nutrients a day for almost all healthy people (97.5%) according to age, sex, body size, physical activity, genetic and physiological conditions to achieve optimal health. In Indonesia, the Nutrition Adequacy Rate (RDA) is compiled in the National Food and Nutrition Study (WNPG) every five years since 1978. This RDA reflects the average daily intake consumed by the population and is not an individual. Unlike the nutritional needs (requirements), which illustrates the number of minimal nutrients needed by each individual influenced by genetic factors (Indonesia Ministry of Health, 2014).

2.7 Plate portion concept in managing weight

Many studies supported that a larger food portions and beverages have a role in obesity development. Regarding this situation, it is challenge to find methods to manage the portion size effects. One system includes instructing people to choose advantageous portions and to take device that assisted the portion management. Despite the fact that it has restricted information on whether training projects or devices lead to long term impact on dietary patterns and body weight. Another technique is to utilize pre-portioned foods (PPFs) to add composition of food and decline choices about the amount of food to eat. Be that as it may, it is unknown if they make a superior comprehension of fitting segments or not.

Regardless of portions management are significant for weight control, convincing individuals basically to 'eat less' of dinners probably won't be the best procedure if a high-energy-dense diet excessively raises the energy consumption than the individuals who eat lower in energy thickness. If people take a lower energy substance in their food, they can eat fulfilling divides and control their body weight simultaneously. For example, when individuals eat their daily food, even minor changes in energy thickness can influence everyday energy intake. In case, a grown-up might eat 1200 g of meals with an overall energy density of 1.8 kcal g – 1 (energy admission is 2160 kcal). On the off chance that the energy thickness was diminished by 0.1 kcal g - 1

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

with a similar load of food was eaten, at that point, the individual would take 2040 kcal. This way, a humble change in the overall energy density in diet would diminish energy consumption by 120 kcal every day. Individuals could keep eating their daily amount of meals and manage their weight. The food portion that is commonly used will be depicted as follows.

Figure 5. Food Portion Guidance

2.8 Self-efficacy theory

Self-efficacy is derived from Social Learning theory, which achieved acknowledgement as a health change and maintenance behaviour predictor. Self-efficacy is a person's belief in their capability to accomplish a task or target a specific behaviour (Bandura, 1977). For instance, the confidence level of capacity to walk after myocardial infarction or a belief that physical exercise will improve the cardiovascular condition. Bandura theorizes that when efficacy information is accepted, it must be cognitively processed and used by persons to judge their abilities (Fitzgerald, 1991).

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

People who have higher-level self-efficacy are more likely to remain their efforts until success than those with lower-level self-efficacy. Self-confidence is domain-specific, such as a person having a high sense of efficacy in one domain (e.g., healthy food consumption) is not necessarily followed by high efficacy in another aspect (e.g., exercise) (Wilson et al., 2016). Bandura classified four significant information sources that affect self-efficacy. The first, performance accomplishment, addresses learning by individual experience that achieves a difficult task. Performance achievement is an essential efficacy expectations source. Repeated failures in performing specific behaviour will dwindle perceived self-efficacy, while success will improve it (Wilson et al., 2016).

The second self-efficacy source is vicarious experiences or chance to observe another person perform a similar behaviour, e.g., participating in a cardiac rehabilitation program where people report successful performance of smoking cessation after a myocardial infarction can improve one's mastery expectations. Third, Verbal persuasion. For instance, the physician tells the patients that they can modify their diet or stop smoking or control cholesterol. Finally, the physical feedback or physiological arousal that people rely on to judge their ability, such as pain, fatigue, or anxiety, might be perceived as signs of physical inefficacy. Improving self-efficacy and performance can use relaxation training and assisting the person in understanding their symptoms. Figure 2 a self-efficacy model (Fitzgerald, 1988).

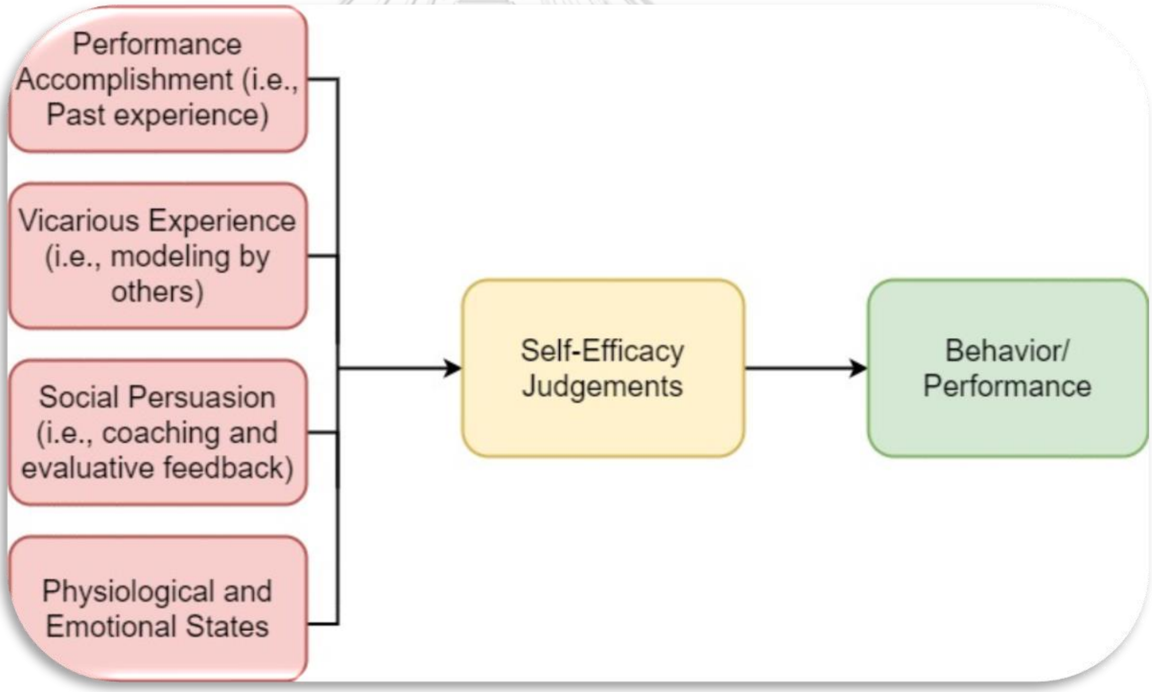


Figure 6. Self-Efficacy Theory (Bandura, 1977)

Some studies suggest that self-efficacy is an essential predictor of success in weight loss and behaviour changing in obese (Byrne et al., 2012, Warziski et al., 2008, Hays et al., 2014, Shin et al., 2011, Elfhag and Rössner, 2005). Other studies, in contrast, have not found these correlations (Teixeira et al., 2004, Annesi, 2007).

Effects heterogeneity studies might cause uniformity lacking in which self-efficacy has been included in weight-loss trials. In other cases, measures of self-efficacy for diet or eating habits (Warziski et al., 2008, Shin et al., 2011) are needed. Hence, the self-efficacy variable will be used as an independent variable that might influence this research's intervention or outcome. People with high self-efficacy commonly succeed in their diet program.(Wilson et al., 2016)

2.9 Image Processing Technology

Image processing is a method to describe several procedures on a picture to get an extended picture or concentrate some valuable data. It is a sign preparing type in which info is a picture, and output might be a picture or segments/features connected with its appearance (Van Heel et al., 1996). There are three steps in image processing (Van Heel et al., 1996):

1) Importing the picture through picture procurement devices;
2) Analyzing and controlling the picture;
3) Output in which results could be changed model or report based on image analysis.

This image processing advantage builds edge acknowledgement, and when it is joined with sub-pixel handling, reliable estimation is much of the time achieved. Measurement accuracy is overseen when observing bent, intelligent surfaces where slight changes in shading or brightening would 'trip up' common machine vision frameworks (team., 2001). Contrary, if the object size is smaller than the pixel size, it cannot be accurate detection as a significant limitation of this system (Van Heel et al., 1996). The technology in this research used Convolutional Neural Network (CNN). The first problem that comes up with this technology is the accuracy. Last decade it had an accuracy of around 30-50%. But nowadays, it has been reported that it developed an accuracy higher (>80%) (Mhalagi, 2019).

2.10 Technology-Assisted Diet

Nowadays, teenagers and youthful grown-ups are commonly the prior and more energetic adopters of innovations (Daugherty et al., 2012). Due to advances in technology and full acknowledgement by youths, it is conceivable to use innovation for healthy weight administration and heftiness (Chen and Wilkosz, 2014).

Preliminary dietary appraisal research on youths indicated that they favoured utilizing technologies over-designed paper or pencil techniques. In any case, in the current study, grown-ups (> 35 years of age) were discernibly less confident than youths in utilizing this innovation (Daugherty et al., 2012).

There is a possible effect of lately technology advancements (for example, the Internet or dynamic video games) for youths and youthful grown-ups on weight-related results. The survey proposes that both dynamic video games and Internet-based intercessions, including diet and movement parts, can diminish obesity in the youngest, mainly through Internet-based treatment (Chen and Wilkosz, 2014).

There are six categories of innovative dietary appraisal technology for example (I) Personal Digital Assistants' PDA-innovations', (ii) 'phone-based advances', (iii) 'Intelligent PC based advances', (iv) 'Online Technology', (v) 'Camera and recording device based technology' and (vi) 'Scan and sensor-based advances' (Illner et al., 2012). There is no reasonable proof that one arrangement is more powerful than another in looking at the different modalities of innovation and their conveyance (Internet versus active video games). Contingent upon the age of the members, various modalities may be more appealing than others. For instance, a young juvenile may incline toward exergames and connect with peers. In contrast, a young adult may lean toward a phone application or an Internet-based program for weight management that could be utilized privately (Chen and Wilkosz, 2014).

The vast majority of the new technologies in dietary appraisal supposedly had to cover methodological features with the ordinary methods prevalently utilized for nutritional epidemiology. Their fundamental potential to improve dietary appraisal is through a more expense and time-viable, less muddled information collection approach and higher subject acknowledgement (Illner et al., 2012). Some research that supports the evidence that technology can assist dietary intake will be explained as follows.

2.11 Related Study with Diamond Application

Table 4. Previous study related with dietary applications

No	Name (year)	Methodology	Type of technology and features	Results	Limitation
1	(Turner-McGrievy et al., 2013)	a post hoc analysis of a 6-month randomized weight-loss trial	'Fat Secret' calorie and exercise monitoring app (or other mobile diet and exercise apps that they liked)	Actual Activity (PA) application clients self-observed exercise more often over the 24 weeks of study (2.6±0.5 days/week) and detailed higher deliberate PA (196.4±45.9 kcal/day) than non-application clients (1.2±0.5 days/week PA self-checking, $p<0.01$; 100.9±45.1 kcal/day purposeful PA, $p=0.02$). Exercise application users likewise had a considerably lower BMI for 24 weeks (31.5±0.5 kg/m2) than non-clients (32.5±0.5 kg/m2; $p=0.02$)	for PA self-observing, members were possibly asked whether they utilized an application or didn't utilize an application, which implies the examination missed different approaches to follow PA (sites or paper diaries).
2	(Wharton et al., 2014)	randomized controlled trial with compare smartphone app (n= 19), memo (n=13), and	"Lose it" supports a large food database, and users can use the diary feature to record their food. It gave immediate feedback on daily food calories using graphics. In addition, this	The three groups reduced weight. However, the Smartphone app (Lose It!) recorded dietary data more persistently than a paper-based group but not with	Only available for iPhones and does not have dietary advice for users.

No	Name (year)	Methodology	Type of technology and features	Results	Limitation
		paper-based (n=15) in 8-week	app calculated the daily energy requirement according to the pre-identified weight loss target (1 lb/wk) and the user's anthropometric information.	the memo group.	
3	(Breton et al., 2011)	In observation, the latent class analysis was used to identify subgroups of apps based on endorsement diet practices	noticing the application which contained (1) intelligent devices, similar to food as well as activities journals, plans, and weight diagrams or outlines; (2) food healthful data sets where clients can discover calories, fat, and fibre on a wide assortment of nourishments; (3) data that gave counsel on weight the executives or weight reduction; (4) association with others Internet site; and (5) social strengthen/networking (i.e., took into consideration communications with others, given away to earn uphold from a specialist, describe a messaging board, or an approach to connect with an interpersonal interaction webpage like Twitter)	Just a few applications had at least five of the 13 practices (15%). The idle class study uncovered three fundamental sorts of applications: diet, exercises, and weight diaries (19%); dietary suggestions and diaries (34%); and weight trackers (46%)	Numerous applications have lacked proof of educated substance, and client appraisals were not related to the exhibition of applications

No	Name (year)	Methodology	Type of technology and features	Results	Limitation
4	(Boushey et al., 2015)	Mixed methods combining quantitative and qualitative protocols	a mobile food record (mFR) that allows users to take images of their food and beverages at eating occasions, which could address the barriers of hand-written pen and paper or digital entry methods that still require spelling and focused entry. Image analysis methods have the potential to automatically identify foods and beverages in the image and estimate volumes	Young ladies were more likely than young men to catch pictures of their eating events (Fisher accurate test, P=.03). Members were bound to take photos of their morning meals (90%, 36/40) and snacks (90%, 72/80) and most drastically averse to catching evening and night snacks, 54% (43/80) and 40% (32/80), respectively. The important topics from the focus groups concerning utilizing the mFR were games, rewards, and the need to find out why they were using the application. The consequences of the convenience poll demonstrated that including a game segment would be fundamental to building eagerness to utilize the mFR, and a large part of the	It has a problem with hand recording of the think-aloud method. It makes the phone has low performances

No	Name (year)	Methodology	Type of technology and features	Results	Limitation
				members indicated a craving to use the mFR for seven days or more.	
5	(Casperson et al., 2015)	The researcher instructed participants to capture foods and beverages they consumed before and after eating. It is used to gauge a fiducial marker in the picture. Members were also approached to give text descriptors, including the sum and kind of food and drink intake.	The food record application (The Frapp) was intended for common settings utilizing cell phone advances. Dissimilar to past applications and single-reason electronic gadgets to record dietary admission, the FRapp coordinated the camera work and text section, prompts predefined for eating events (e.g., breakfast, lunch, supper, tidbit), and continuous correspondence among clients and clinician/specialist. Six dietary consumption input techniques can be empowered inside the FRapp by the agent: (1) catching and commenting on food pictures, (2) composing in free content food descriptors, (3) discourse to-message transformations with food thing extraction, (4) record voice for later playback, (5) catching food	Youths will utilize cell phones outfitted with an application to record dietary admission in a free-living environment; notwithstanding, a minority of members followed all bearings. Easy to use portable food record applications may build member agreeability, expanding our comprehension of young adult dietary consumption and eating patterns	A restriction of FRapp was an independent instrument to gather juvenile dietary consumption. Just 16% of recorded eating functions utilizing the FRapp incorporated the essential aspects of pre-and-post-meal pictures, a fiducial marker, and text portrayals of the food. Missed meal pictures can't be recorded retrospectively, but the user can get the information using text or voice recording.

No	Name (year)	Methodology	Type of technology and features	Results	Limitation
			mark/nourishment realities/scanner tag photographs, and (6) choosing from as of lately consume food sets. These info approaches can be utilized independently or in blend with participants.		
6	(Fukuoka et al., 2015)	A Randomized control trial with 61 overweight participants for 4-month.	The treatment was called the mobile phone-based diabetes prevention program (mDPP), with a standard DPP curriculum for overweight adults. The features support are daily message/video clips, calories diary and physical activity record.	There is a significant result of combining mDPP and pedometer intervention to reduce weight (-6.2 kg), while the control group gained weight (3 kg) ($p<0.001$) and saturated fat intake ($p=0.007$).	Only for iPhone, and there is no food calculation.
7	(Whitelock et al., 2019)	A randomized control trial which involved 107 overweight and obesity adults in UK. The intervention is 8 weeks.	The intervention group received an eating smartphone application with a standard booklet of dietary advice and text message, while the control group received the booklet and message. The Features of this dietary application are a photograph diet record, customized mealtime reminder, audio clip (2.5 min), and “star”	The intervention is not significantly different in energy intake and weight loss between the intervention and control group. However, the intervention group experienced reducing a weight (-1.2 kg) and energy intake (-220.9 kcal), while the control group reduced	There are integrated with social media and food calculation calories.

No	Name (year)	Methodology	Type of technology and features	Results	Limitation
			reward.	weight (-1.1 kg) and energy intake (-300.0)	
8	(Lee et al., 2017)	Feasibility study with 33 adolescence participants in 47 days using Diet-A.	Diet-A is the device that focuses on real-time feedback on their diet and determines food and nutrient intakes. The participant is measured pre and post-intervention using one day 24 hours recall form. Feature: voice and manual input for the dietary record, nutrient calculation of nutrients, statistics of nutrient intakes, reminder intake, advice, and five food recommendation, Korean food database.	It showed decreasing in sodium (p=0.04) and calcium (p=0.03) consumption between pre- and post-intervention (3-month measurement). In addition, 61.9% of respondents described that they were satisfied using Diet-A to control their food consumption.	There are no social media integrated

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

CHAPTER III
METHODOLOGY

This study had two phases. (1) The first phase focused on developing the Diamond application based on the survey's results in female undergraduate students. This survey used a snowball sampling technique by an online form that will be shared on social media. (2) The second phase was a quasi-experiment study to evaluate the effect of Diamond application. This design was appropriate for a heterogeneous population like Malang city, which has different characteristics of respondents.

3.1 Phase I – Developing Application Procedure

3.1.1 Research Design

Phase I applied a cross-sectional study. This phase aimed to 1) Depict mobile application usage; 2) Describe local food trends among female students in Malang City, Indonesia, to ensure the database in Diamond app and provide food list for phase II; 3) Evaluate the accuracy of features in Diamond apps; 4) Study the usability of Diamond apps interface. There were six steps in phase I. The details are as follows (3.1.7).

3.1.2 Study Area and Population

The study area was in the Centre of Malang city (Lowokwaru District). Lowokwaru district is the second district with the highest population growth (0.5). It is also called a "student district" as it has 3 public and 44 private-owned universities (Statistics of Malang Municipality, 2020). Phase I had two types of participants: participants for mobile usage and food survey step and testing step. We involved participants who met the inclusion and exclusion criteria. The survey steps' participants required the inclusion and exclusion as follows.

Inclusion criteria:

1) Female age 18-24 ages.
2) Registered as a university student in one of a university in Malang.
3) Willing to participate.

Exclusion criteria:

1) Follow a certain diet.

3.1.3 Sample size and Sampling Technique

The sample size in this research is based on the proportional formulation for the unknown population because we do not know the total number of female university students in Malang city. This research participants were female university students in Malang Indonesia. The number for survey participants were estimated as follows (Lwanga et al., 1991).

$$n = \frac{{Z_{\alpha/2}}^2 pq}{d^2}$$

$$n = \frac{1.96^2 \times 0.166 \times (1 - 0.166)}{0.05^2}$$

$$n = \frac{0.5331}{0.0025}$$

$$n = 213.25$$

Noted:

Zα: Confidence level at 95% (1.96)

p: Probability of overweight female case in 17-24 years old (16.65 %) (Indonesian Health Research Department, 2019)

q: 1-p

d: Precision 5% (0.05)

The calculation shows that the sample size for the database survey was 213 female students and added 10% of retention rate then the total sample size were 234 participants. The convenience sampling technique by online form was used to recruit the participants. We shared the online questionnaire on social media such as Instagram, Facebook and WhatsApp. We received 230 feedback questionnaires and after screening the data, we selected 217 participants for further analysis. Furthermore, we involved 30 participants in testing step but we loss follow up 5 participants in the end of testing period.

3.1.4 Measurement Tools

The measurement tools in phase I were online questionnaires. There were three kinds of online questionnaires used in Phase I:

1) Measurement tools for requirements survey step

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Step 1 used an online questionnaire, a modification questionnaire from a previous study. There were four components to this questionnaire (appendix 1).

Part 1: Demographic characteristics consisted of 6 questions.

1) Age
2) District address
3) Length of stay in a Malang
4) Degree
5) Major of study
6) Allowance

Part 2: Health profile consists of 4 questions

1) Weight
2) Height
3) Food Allergic
4) Chronic disease

Part 3: The mobile application usage consists of 4 parameters (Kreutzer, 2009).

1) Smartphone usage (5 questions)
2) Favourable application (1 question)
3) Duration of using smartphone features (1 question)
4) Rest break (2 questions)

Part 4: Food and dietary habit consisted of 4 parameters (Diguna et al., 2015).

1) Meal frequency (1 question)
2) Favourite food (3 questions)
3) Snack frequency (1 question)
4) Favourable snack and beverage menu (3 questions)

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

2) **Measurement tools for Step 2: Designing Wireframes and development path steps**

This step was creating the application framework and ensuring database correction. Three validation experts from Indonesia in the nutrition field assisted in this process. The feedback questionnaire was sent 7 days after the experts installed the application. This questionnaire aims to examine the application performance and the outcome. It used a questionnaire (16 questions) which were modified from the previous study (appendix 2) (Rahadi, 2014).

3) **Measurement tools for steps 4 and 5: validation and maintenance steps**

There were three parts of measurement tools for this step. First, it used to result from Yolo lite3 program for accuracy evaluation. Second, the usage Diamond interface used the Firebase Analysis program results. Last is the previous study's feedback questionnaire to understand users' perception of the Diamond Application. The details are explained as follows.

Part 1: Accuracy Evaluation

The evaluation of image accuracy used Yolo lite3 analysis integrated with the application. When the image detection feature was activated, the Yolo lite3 would also be activated. Yolo lite3 is a device for providing the estimations and visualizations required during Artificial Intelligent (AI) workflow. It enables the following examination metrics: loss and accuracy, projecting embeddings to a lower-dimensional space, visualizing the model diagram, and considerably more. There are three parts of Yolo lite3 below (TensorBoard Team, 2018):

1. The Scalars dashboard shows how the loss and metrics change with every period. It can track learning rate, training speed, and other scalar values.
2. The Graphs dashboard can assist in visualizing the model. In this situation, the Keras graph of layers is demonstrated to assist the developer in ensuring that the model was conducted accurately.
3. The distribution and histogram dashboards show the description of a Tensor over time. This can be valuable for visualizing loads and biases and verifying that they change expectedly.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

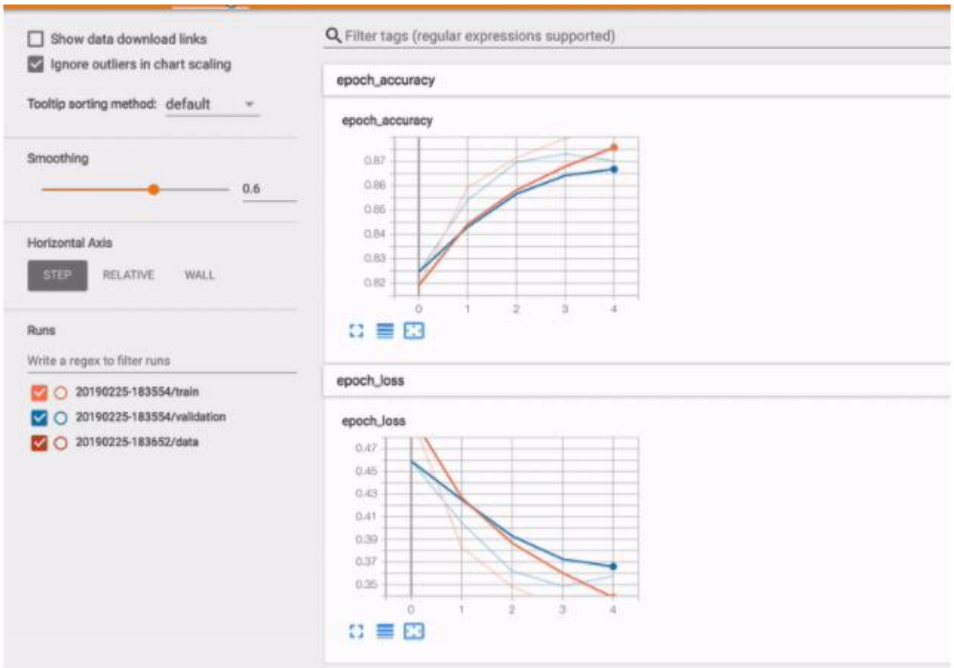


Figure 7. Yolo lite3 Display
Source: (TensorBoard Team, 2018)

Part 2: Usability of Diamond interface

The usability of the Diamond interface was measured using Firebase Analytics. Firebase Analytics is a Google-free app measurement solution that provides insight into app usage and user engagement (Google Team, 2019). It gave the researcher data about the real-time user activity such as 1) demographic information (profile of users), 2) Retention (how often they use the apps), 3) Engagement (how much time they spend & on what), and 4) Average Revenue (if the apps use to purchase system) (Anirudh, 2020, Google Team, 2019). For instance, when users open the application, the firebase analytics system would describe the response times from users. With this firebase analytic, the researcher can monitor the engagement of application users, such as how many users uninstall after the installment and what features they frequently use.

Figure 8. General Display of Firebase Analytics

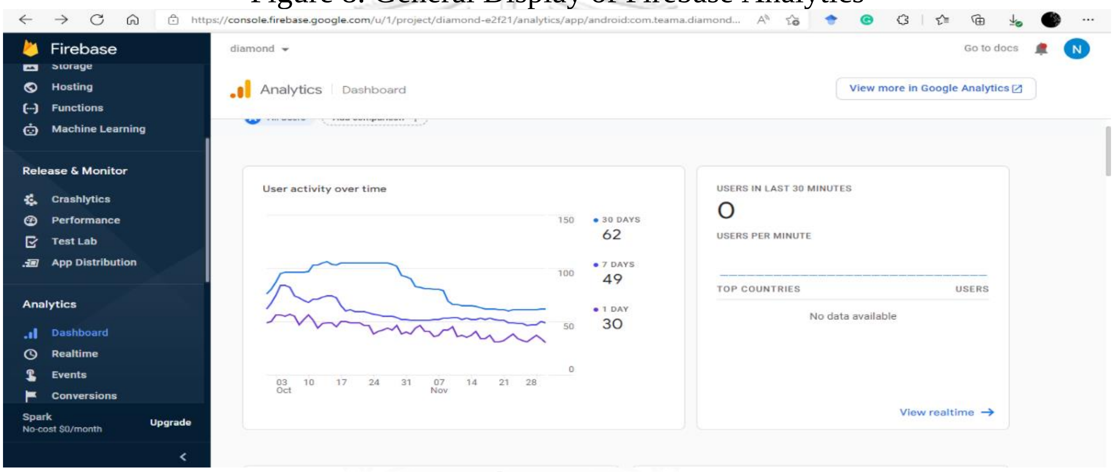


Figure 9. Firebase Dashboard that explained the Apps Usage

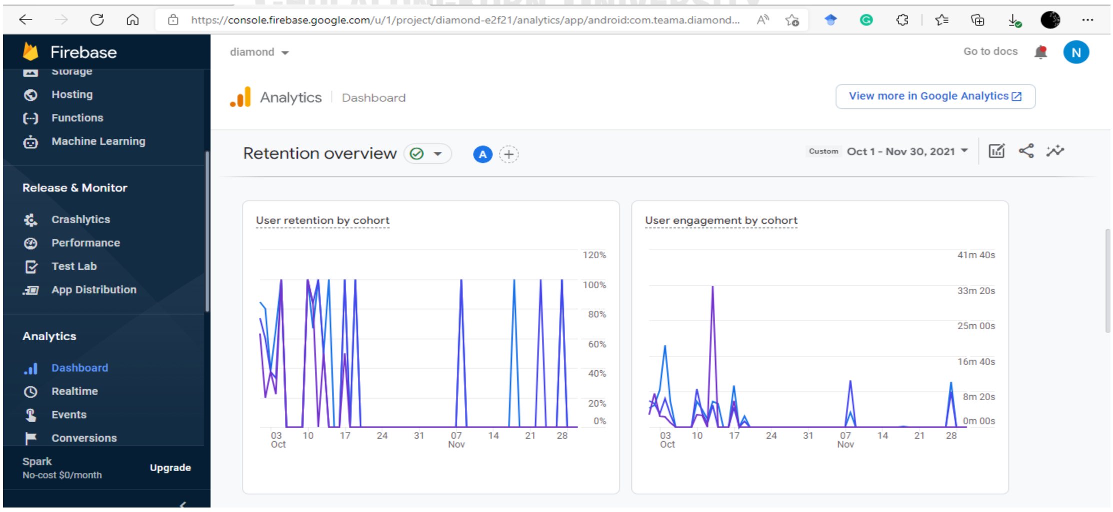


Figure 10. Retention Rate Display

Part 3: the feedback on the prototype application. The testing respondents received questionnaires from a previous study about diet application (21-item questions) (Lee et al., 2017).

3.1.5 Validation Measurement Tools

The validation and reliability of the instruments are explained as follows.

1. Questionnaire for survey step

The online survey questionnaire was a modification questionnaire from the previous studies. The questionnaire was translated into the Indonesian language using a back-translated method. The questionnaire consisted of sociodemographic, mobile application usage, dietary habits and local food consumption. It was validated by three experts using the Item Objective Congruence (IOC) cut-off point >0.8. In addition, this questionnaire didn't use a reliability test because all item questions asked about fact and their behaviour.

2. Questionnaire for expert validation

It used a questionnaire (16 questions) which were modified from the previous study (appendix 2) (Rahadi, 2014). It was validated by three experts using the Item Objective Congruence (IOC) cut-off point >0.8 and did not used reliability test.

3. Questionnaire for validation and maintenance steps

The accuracy (Yolo lite3) and Diamond usability (Firebase analysis) did not have validation and reliability tests because both used Artificial Intelligent (AI) system. In addition, we used feedback questionnaire, this questionnaire was translated into the Indonesian language using a back-translated method. It was validated by three experts using IOC, which had a cut-off point of 0.8. Similar to the questionnaire in step 1, it also did not use a reliability test.

3.1.6 Data Collection

Data collection for Phase I was divided into two parts. The details are as follows.

1. Data collection for survey step (Part 1)

   First, this questionnaire was shared using the messenger group to reach the participants, such as Facebook, Instagram and WhatsApp. 230 responses were received at this period. Then, we screened the responses data based on eligible for inclusion, exclusion criteria and incomplete data. 217 participants that was included in the analysis. In detail, the informed concern was provided on the first page of this online questionnaire. Then, the participant continued to fill out the form and sent it back to the system. After the data was collected, the data from part I was analyzed to conduct the framework and food database application and provide the food list for a food frequency questionnaire (FFQ) for phase 2.

2. Data collection for prototype validation step (Part 2)

   After finished the prototype, we validated the prototype of Diamond to three nutrients experts from Indonesia. We shared the link of Diamond application instalment also the feedback questionnaire by WhatsApp messenger. Moreover, after 1-2 weeks, the experts complete the feedback questionnaire and we can analyse the data.

3. Data collection for testing and maintenance steps (part 3)

   In the beginning, we involved 30 participants in this step. Then, after four weeks of Diamond application instalment, only 25 participants sent the feedback questionnaire. The accuracy and usability of the Diamond app measurements were activated when the user started to install and use the apps. Furthermore, after four weeks, the user received the online feedback questionnaire to give their perception of this application's performance—twenty-one questions related to the feedback after using the Diamond application (appendix 4).

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

3.1.7 Phase I Process

There were six steps to finish phase I and produce the Diamond Application. The details are as follows.

a. Requirement the features and contains

This step was online survey results which described mobile application usage and local food in Malang as a database application. This survey collected data from female university students with certain inclusion and exclusion criteria. There were 230 responses from the online questionnaire we shared. Then, after screening based on inclusion and exclusion criteria and completeness of questionnaire and there were 217 respondents left. Even the sample size needed only 213, all responses data (217 responses) were analyzed for further because all data were appropriate for analysis.

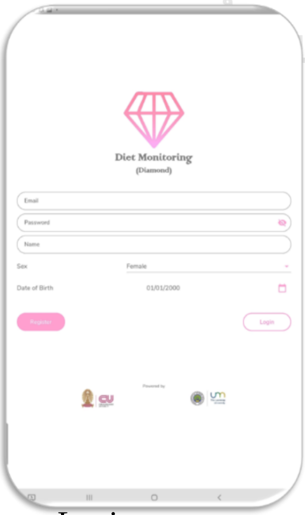
b. Designing wireframes and development path

After finishing step 1, the researcher and IT team designed the Diet monitoring (Diamond) Application. Based on the survey, the Diamond application used the Android operating system because most Indonesian students utilize an Android smartphone (Android 5.0 lollipop) rather than the IOS operating system. The primary function of this application is to build the users' awareness about their dietary intake by using easy methods. We used Flutter to conduct the wireframes apps. Flutter is Google’s portable User Interface (UI) toolkit for crafting delightful, natively compiled applications for web, mobile, and desktop from a single codebase (team, 2022). In addition, for image processing, we used a single shot detector model called You Only Look Once (YOLO) lite version 3 model to train the image detection (detailed in 3.1.4). In addition, prepare food database was be finished in this step.

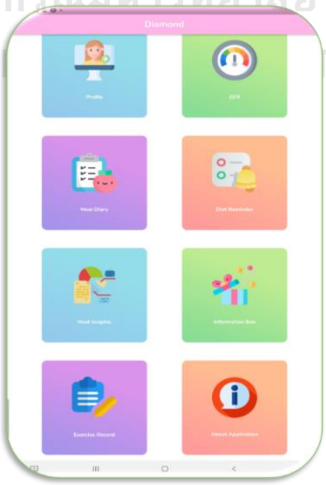
c. Prototype structure

Diamond application prototype was a detailed part of wireframes part by constructing all features application and inputting the food database. There are seven features in Diamond application, these were detailed as follows.

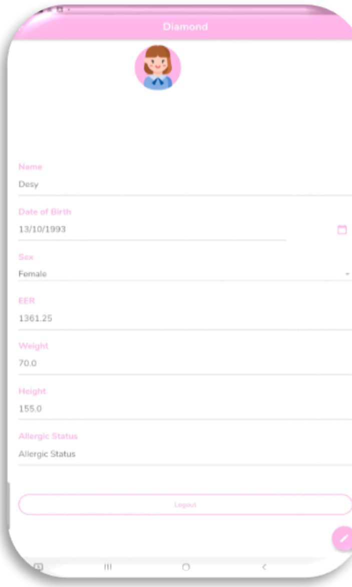
จุฬาลงกรณ์มหาวิทยาลัย



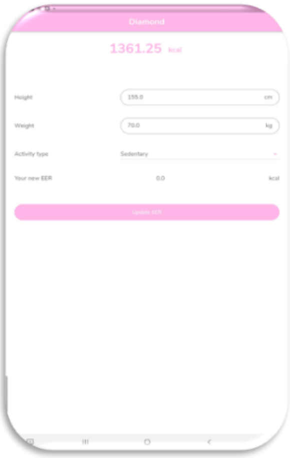
Login



display



profile

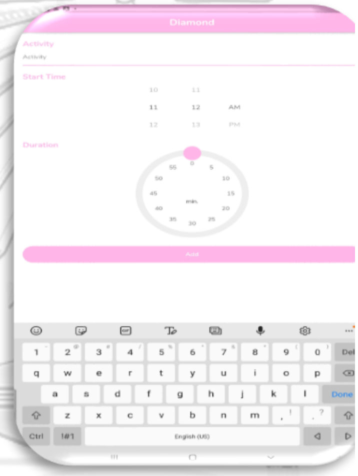


EER

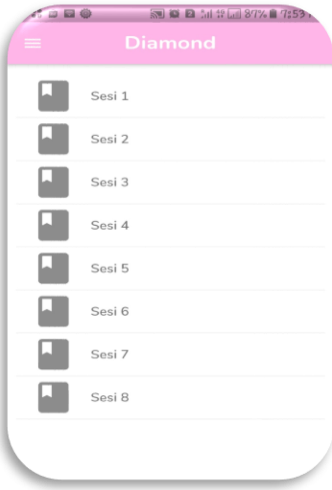
Food manual search

Meal graph

Reminder



Exercise record



Information box

CHULALONGKORN UNIVERSITY

After conducted prototype, three experts in nutrients validated the Diamond Application to evaluate the performance and application interface.

d. Testing stage

This step measured two things. First, user engagement and interface feedback. In the beginning, it involved 30 participants. These participants were collected from the voluntary online requirement with criteria as follows.

Inclusion criteria:

1) Females aged 18-24 ages.

2) Registered as a university student in Malang City.

3) Using Android.

4) Willing to install Diamond Application for 4 weeks.

Exclusion criteria:

1) Pregnant and lactation period.

2) Consume medication for any chronic and mental disease.

3) Follow a certain diet for at least 3 months.

Then after 4 weeks, only 25 participants sent the interface feedback questionnaire. During the testing stage, the participants reported any debug they found.

e. Maintenance stage

After receiving the feedback questionnaire, we checked the errors in feature operation based on the participant's report from the testing step and tried to fix all debug they reported.

f. Final Diamond Application

The last step of this developing process was approval application to use in a real target application to assess the effect of the Diamond application.

3.2 Phase II – Intervention of Application

3.2.1 Research Design

After phase I completed, the next phase of this research was to assess the effect of the Diamond application on dietary intake and BMI among overnutrition female university students. This phase used a quasi-experiment because the population is heterogeneous, and the Covid-19 situation impacted university policy about state students in Malang. In addition, the intervention group received the diet monitoring (Diamond) application, while the control group did their usual behaviour. The outcome data were collected twice (at baseline and after eight weeks intervention).

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

3.2.2 Study Area and Population

The study area of this research was Malang City (Lowokwaru district). There are three public universities in this city. They were located less than 3 km away from each other. The study population focused on female university students who had overnutrition (BMI >25). The university selected to be the research site has the highest number of female students and is willing to participate as a research site. Universitas Negeri Malang as intervention site and Universitas Maulana Malik Ibrahim as control site. Because this design study was a quasi-experiment, the participants were not able to be randomized into intervention and comparison groups. However, the participants received informed concern to choose whether participate and be involved in data collection or not.

The eligibility criteria for participants were based on the literature review. The female university students who participated in this research were matched with these two criteria:

Inclusion criteria:

1. A young adult aged 18-24 years old.
2. BMI >25.
3. Have Android smartphone.
4. Familiar to use the application.
5. Living outside the university boardinghouse.
6. Willing to participate.

Exclusion criteria:

1. Pregnant and lactation period.
2. Received any medication for chronic diseases such as cardiovascular disease, asthma, and cancer.
3. Consume drugs regularly for depression and mental disorder.
4. Have metabolic syndrome such as hypertension, diabetes.
5. Athlete. They have different type of diet requirements (Neglia, 2021)
6. Following a certain diet for at least three months.

3.2.3 Sample Size and Sampling Technique

The sample size in phase II was based on calculation from a previous study which has similar outcome and intervention related with dietary application from Fukuoka 2015 research which stated that using a smartphone device has an essential role in weight loss and BMI. It used 61 participants to prove the intervention's effectiveness (Fukuoka et al., 2015). The sample the formulation came from Cohen's d sample size for comparing two independent means as follows.

$$n = \frac{(Z\alpha + Z\beta)^2(\sigma 1^2 + \frac{\sigma 2^2}{c})}{(\mu 1 - \mu 2)^2}$$

$$n = \frac{(1.96 + 0.84)^2(3.41^2 + \frac{3.63^2}{1})}{(32.2 - 30.2)^2}$$

$$n = \frac{7.84 \text{ x } 24.84}{4.00}$$

$$n = 48.68$$

Noted:

n : sample size

μ1, μ2: means of two groups (intervention and control group) = 32.2 and 30.2

σ1, σ2: Standard deviations = 3.41 and 3.63

c: Ratio of the sample size of the two groups (c=n2/n1) and c = 1

n1, n2: Sample size of group 1 and group 2 = 30, 31

Zα: 1.96

Zβ: Power of 80% = 0.84

From the calculation, it was concluded that the sample size for each group was 49 participants. However, considering the estimated low attrition rate of 30%, the participants were grouped as 63 respondents (total respondent is 126). The researcher shared the voluntary participation link to university students using social media such as Instagram and WhatsApp groups. We received 129 eligible candidates then after 8 weeks intervention, there were 123 participants who involved in analysis. The detail explained as follows.

Chulalongkorn University

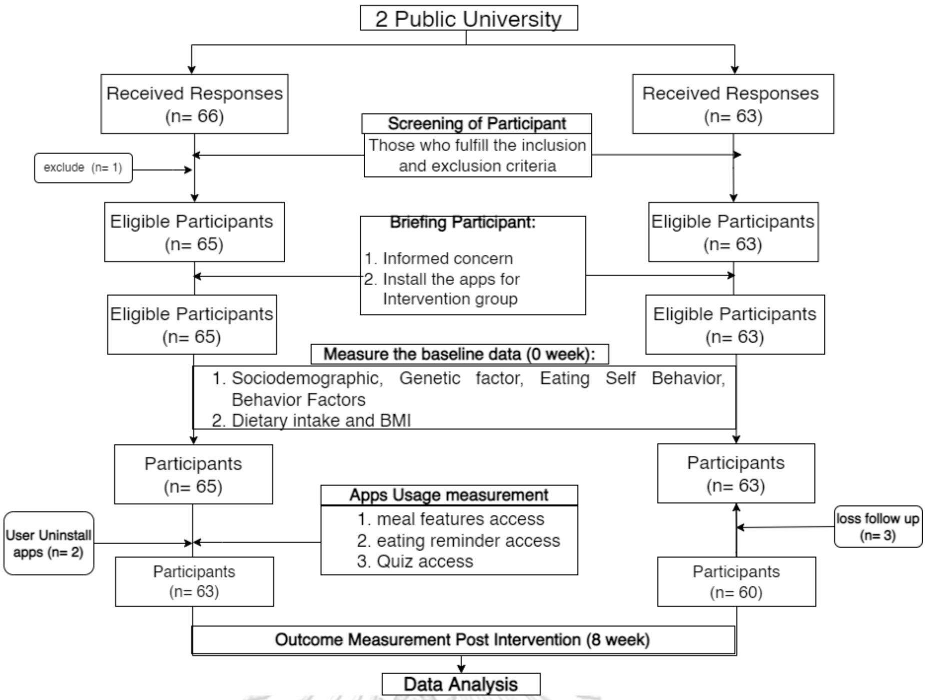


Figure 11. Consort diagram

3.2.4 Measurement Tools

There were three measurement tools used in this phase II: 1) Questionnaire for baseline; 2) 24 hours recall form for dietary intake; 3) physical measurement tools for BMI measurement. It detailed as follows.

1. Questionnaire for baseline.

This Questionnaire had four parts which described the homogeneity of intervention and control groups. The detail parts explained as follows.

a. Part 1. Sociodemographic

This part is related to the condition of the participants. There were 8 item questions in part 1, it explained as follows.

1) Age

Age explained how old (in a year) the respondents were according to the day of joining the research. It is classified as continuous data.

2) Hometown address

It referred to the area that the respondent's family addresses, such as rural or urban areas. It was categorized as nominal data (a rural area or an urban area).

3) Religion

It’s related to the respondent's belief in God. Indonesia’s government recognizes only six official religions. However, this research classified as Muslim and Non-Muslim. Different religions had a different impact on food choices.

4) Education level

   Education level is a program enrolled by the respondent during the research. There were two types of education level in this research: undergraduate (bachelor) and master's degree.

5) An academic year of study

   The academic year of the study described the year level of respondents. It was classified as categorical data such as <4 years and $\geq$ 4 years.

6) Major of study

   A study major was an academic discipline in which students formally engage. It was classified as nominal data that consisted of health major or non-health major.

7) Relation status

   It refers to the participant’s relationship that is related to commitment. It was classified as categorical data such as single and, in a relationship/engaged/married.

8) Allowance

   Allowance explains how much money the respondent got from the parents and other sources in a month. It was classified as numerical data

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

b. Part 2. Genetic factor

   It refers to the respondent’s parents who were obese or overweight. It was classified as categorical data, such as the mother being obese or overweight and the father being obese or overweight.

c. Part 3. Eating self-efficacy

   Part 3 measured participants' beliefs about how confident they can change their diet and lose weight. The questionnaire used was from The Weight Efficacy Lifestyle Questionnaire (WEL), which contained 20 questions; thus, this questionnaire was commonly used in eating behaviour for weight loss programs

(Ames et al., 2012). However, after validation, it has 18 item questions to deliver the eating self-efficacy.

d. Part 4. Behaviour factors

Part 4 measured variable as follows.

1) Exercises (4 items)

It explained the exercise activity, exercise per week and exercise time.

2) Sleep duration (1 item)

It refers to how many hours of participants habitual sleep at night. It was categorized as categorical data such as <6 hours, 6-9 hours, >9 hours.

3) Smoking (1 item)

It was related to the respondent's smoking status. It was classified as never smoke and ever smoke.

4) Alcohol drinking (1 item)

The alcohol drinking was categorized as categorical data such as ever and never drinking.

5) Food Frequency Questionnaire (FFQ)

FFQ refers to estimating the frequency of respondents' food and beverage consumption. The Food Frequency Questionnaire (FFQ) item used a list of food and beverage from phase I. There were 15 meal menus, 5 snacks, and 5 beverages which were measured in this part.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

2. Questionnaire for Dietary intake

Dietary intake refers to nutrients that respondents consumed. Dietary intake was measured using 24 hours recall form 3 times (2 days on a weekday and 1 day at a weekend). This assessment was conducted before the intervention (week 0) and after intervention (week 9). To assist respondents for estimating their portion correctly, they received food model in a pdf file (appendix 8). The dietary intake focused on macronutrients such as carbohydrate, protein, fat, and total calorie intake because these nutrients were related to body weight. The interview results were transformed to nutrient intake by using nutria-survey software from SEAMEO RECFON, Indonesian Ministry of health, we used factsectret (Makanan dan Merek di Indonesia (fatsecret.co.id)) to estimate the calories each food. The form of dietary intake displayed as follows.

1. Name of Interviewer :	Date of Recall:
2. ID number of Participant :	takes nutritional supplement : Y/N
	if Y, list type:
Mealtime	**Serving abbreviations**
1. Morning (4 to 9 a.m) 4. Afternoon (2 to 5 p.m)	tbsp= tablespoon c=cup
2. Midmorning (9 to 11.30 a 5. Evening (5 to 8 p.m)	tsp=teaspoon lb=pound
3. Noon (11.30 to 2 p.m) 6. Late Evening (8 p.m to 4 a.m)	Oz=ounce sl=Slice

Meal Time		List Menu and Description (List Food and Additional Ingredient) list makanan dan isi makanannya	Amount		Gram/ml conversion	Nutrient (kal/Kkal)			
Type	Time		Amount	Serving Abb		Carbohydrate	Fat	Protein	Total Calories
						Kal	Kal	Kal	
Breakfast	04.00 - 09.00 a.m								
Snack	09.00 - 11.30 a.m								
lunch	11.30 a.m - 2.00 p.m								
snack	2.00 - 5.00 p.m								
	5.00 - 8.00 p.m								
dinner	8.00 p.m - 04.00 a.m								
Total									

Figure 12. 24 Hours Recall Form and Calculation Calories

3. Body Mass Index (BMI)

BMI is related to measuring participants body fat based on height and weight. This measurement was conducted twice (pre-intervention and post-intervention). The tools used to measure the height were ZT-120 Health Scale, while the weight was used digital bathroom scale from Tanita DC-360.

Tanita DC - 360

ZT-120 Health Scale

3.2.5 Validation Measurement tools

The validation and reliability of the instrument will be explained as follows.

1. Baseline Questionnaire

This questionnaire was translated into the Indonesian language using a back-translated method. Furthermore, the questionnaire was validated by three experts using the Index of Consciousness (IoC), which cut an off point of 0.8.

2. Dietary Practice Instrument

A dietary practice used 24 hours recall form from the Indonesia ministry of health (standard form) (Indonesia Ministry of Health, 2018). A briefing was conducted for the interviewer to ensure the similarity of the data collector's perception of the questionnaire.

3. Body Mass Index (BMI)

There were two tools to measure the BMI: 1) Weight scale using Tanita DC-360; 2) height measurement using ZT-120 Health Scale. Both brands were known as guaranteed tools for validation. In addition, the tools were Universitas Negeri Malang properties so the staff calibrated the tools before the measurement starts.

3.2.6 Data Collection

There were three stages of data collection in this research. First, in preparation, the researcher confirmed to the university that choosing an intervention and control group and explained to the leader the objective and facilities provided in this research. Then, the requirement voluntary participant used an online questionnaire. In addition, the researcher prepared 6 research assistants (data collector). The assistants have background in nutrition (4^{th} year university students in nutrition department). They received briefing session to provide a similar perception about the research measurement as well. This briefing has 3 sessions: 1) the goal of this research and the role of participants; 2) how to approach the respondent; 3) the outcome measurement (calibration and how to measure) and the covid protection tools they need whether they need to meet the participants.

There were 123 eligible participants who were involved in this research. The researcher explained the concern of this research to participants through Zoom meeting, and when the participants decided to join the intervention, the enumerator sent the baseline questionnaire to them. The participants in both arms spent 10-15 minutes answering the baseline questionnaire. Furthermore, for the outcomes baseline, we had different methods. Dietary intake was collected by interview. The enumerator confirmed the respondents to do the interview three times a week (2 days on workdays and 1 day at weekends, randomly days). All participants decided to do phone interviews rather than a direct interview because it was more flexible and avoided spreading of covid-19 and we sent them the portion meter to assist them estimate the food they consumed (appendix 10). For BMI measurements, we facilitated them to go to Universitas Negeri Malang to do the BMI measurement for approximately 1 week in the fourth week of September 2021.

Measurement BMI in week 0

Measurement BMI in week 9

CHULALONGKORN UNIVERSITY

The afterwards stage was an intervention. This step started with a briefing session for participants in both arms separately by an online meeting. The Intervention group participants got a Diamond Application instalment, while the control group didn’t receive any program. This intervention was conducted for eight weeks with two times the measurement of outcomes (pre-intervention and post-invention). In 8 weeks, the app users can use the features provided in apps to control their intake, and the progress of their diet intake could be seen every day.

The last stage was post-intervention. Both groups received the outcome measurement after eight weeks of instalment of Diamond application in the intervention group. In addition, for the intervention group, the researcher collected the usage of the Diamond application from the Firebase analysis program (it is integrated into a Diamond application) to monitor the user activities during eight weeks instalment. Data analysis was implemented after the team researcher received all data.

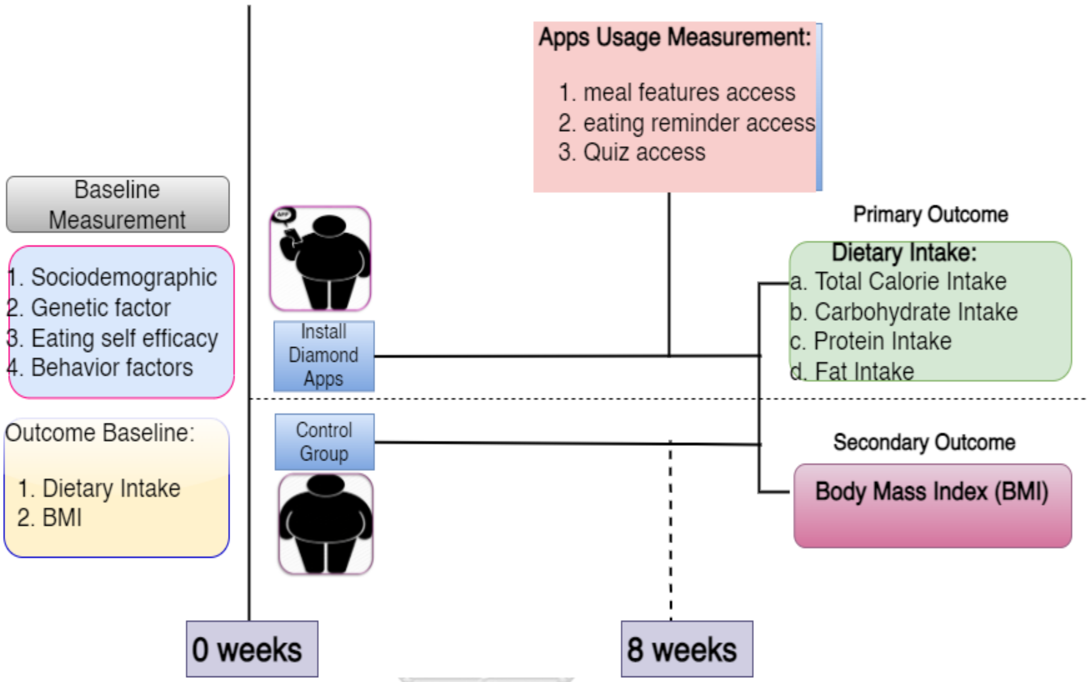


Figure 13. Data Collection Timeline

3.3 Intervention and Procedure

3.3.1 Application Draft Contains

Diet Monitoring (Diamond) Application is an application to assist the overnutrition female university students to manage their food intake efficiently (using image detection). Unlike common applications, this application uses photo cameras to estimate food calories and help users decide how much food they want to consume. The diamond app has Indonesian cuisines as the primary food database. Thus, it's easier for the users to input the food they consume rather than using other diet applications that generally use Western food as their database. In addition, Bahasa (Indonesian National language) and the English language were provided as their language options.

Following the benefit of using this app, it has a diet reminder feature to inform the users about the calories left per day after inputting their food in the meal diary feature. Diamond application has several features that come together to support the objectives. The features in this app will be explained as follows, while the details can be seen in the phase I process (pages 46-49):

1. Profile feature

   The user fills in the data to start using a Diamond application. It has a name, date of birth, sex, EER, weight, height, allergic status and profile picture.

2. Estimated Energy Requirements (EER) Calculation

   EER feature is a feature to estimate the user's proper energy needed per day. When the user finishes filling the data, the system calculates the appropriate daily calories based on the data.

3. Meal diary feature

   When the users use this feature, they can choose an image detection or scan barcode feature to record their food. If they can't find the description and the food calories, they can still use the manual input to search for the food nutrient. Afterwards, they could decide how much they consume and then fill the decision for food feature to record the food they ate. During the intervention, the users report the menu does not exist in the database. Then, the app database was upgraded after receiving the report.

4. Diet reminder feature

   This feature increases the user's awareness of how many calories are left today and helped the users to set up mealtime regularly. It showed 3 times a day for eating reminder (breakfast at 07.00 am, lunch at 12.00 pm, and dinner at 18.00 pm).

5. Meal Graph Feature

   A graph which correlated with the EER and meal diary features. The users can monitor the chart by day, week, and month.

6. Diet information feature

   The other feature of the Diamond app is diet information. It consists of a message about a diet suggestion such as regular healthy food, food portions, food substitution, Indonesian nutrient guidelines, and diet advice. Furthermore, the user challenges themself to do the quiz and challenge card.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

7. Exercise record feature

The exercise record was a complementary feature that helped the users identify their exercise activity.

3.3.2 Intervention Schedule

The detail of the box information feature will be explained in Table 5.

Table 5. Box Information Feature Pop-up

Schedule		Activities & Materials
	Week 0	1. Introduce research objective by Zoom meeting: a. Participants in the intervention group: explain the benefit of this application, their essential role in this intervention, and the application guideline. b. Participants in the control group: describe their important role in this research even do not received any intervention and the benefit of joining it. 2. For the intervention group, by Zoom meeting, the participants were assisted in installing the Diamond application and how to operate this app. 3. Measuring the baseline (sociodemographic, genetic factor, eating self-efficacy and behaviour factors) and outcome (Dietary practice and BMI) for both groups
Session 1	Week 1	Diet information feature material about “how to start to manage the diet” pop up on Monday at 07.00 am
Session 2	Week 2	Diet information feature material: 1. Message about healthy diet (food type, vegetable and fruit consumption) pop up in Monday at 07.00 am 2. The quiz about the session 1 and session 2 materials pop up on Sunday 05.00 pm.
Session 3	Week 3	Diet information about “food portions” and “challenge 1: less carbohydrate for 1 week” pop up on Monday at 07.00 am
Session 4	Week 4	Diet information feature: 1. Information about meal plans (frequency and substitution food) pop up on Monday at 07.00 am 2. The quiz about the session 3 and session 4 topics pop up on Sunday 05.00 pm.
Session 5	Week 5	Diet information about “substitution food” and “challenge 2: less fried food”
Session 6	Week 6	Diet information feature: 1. Message about Indonesian nutrient guidelines (food balancing composition) pop up on Monday at 07.00 am 2. Session 5 and session 6 topics quizzes on Sunday 05.00 pm.
Session 7	Week 7	Diet information about “Indonesian nutrient guideline (beverage and snack)” and “challenge 3: less sweet drink.” pop up on Monday at

Schedule		Activities & Materials
		07.00 am and on Sunday 05.00 pm, respectively.
Session 8	Week 8	Diet information feature: 1. Information about diet advice pop up on Monday at 07.00 am 2. the quiz about the session 7 and session 8 topics on Sunday 05.00 pm.
	Week 9	1. Measuring post-intervention outcomes (Dietary practice and BMI) for both groups 2. Measuring the usage of an application using Firebase analysis data 3. Closing of research and reporting the result

The research intervention was an instalment Diamond application for the intervention group. The intervention group received the diet information based on the Indonesian obesity guideline book and managed their diet with other features such as Estimated Energy Requirements (EER), meal diary and diet reminder feature. While, the control group did not received any intervention. After eight weeks, the intervention and comparison groups received the outcome measurement (dietary intake and BMI) to know the effect of using the Diamond application.

3.3.3 Application Usage Measurement

This application used a Firebase analytic program to ensure the application features usage in the intervention group. This detailed feature was described in measurement tools at phase I for the testing and maintenance stage (pages 42-44). These reports helped the researcher to monitor the user activity.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

3.4 Research Flowchart

The resume of this research will be explained in the figure as follows.

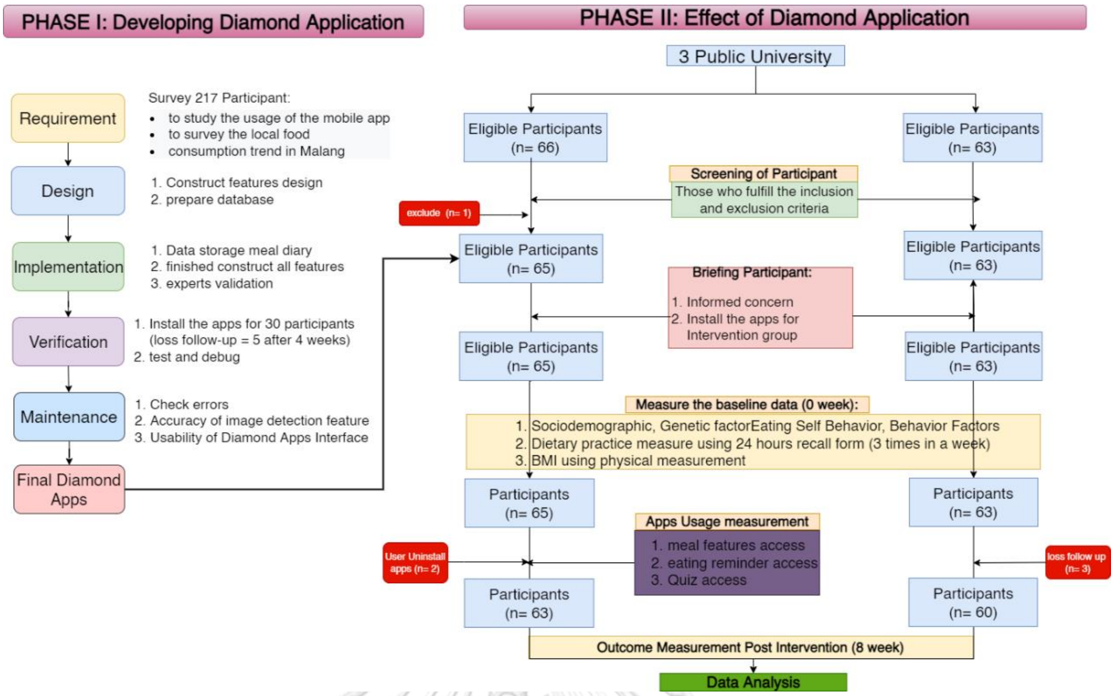


Figure 14. Research Phase Steps

3.5 Data Analysis Phase I and Phase II

Data analysis is explained in two parts. Several statistical analyses were included in this research.

3.4.1 Data Analysis Phase I

Data analysis phase, I used descriptive statistics (frequency, mean, median, percentage) for mobile phone usage and local food trend among female students (part I) and accuracy, usability and feedback of Diamond application (Part 2) as well. In addition, we analyzed the data to know the relationship between each variable with BMI. To know the appropriate test, numerical data such as age, meal frequencies and BMI were analyzed using normality test. Then, if data was not normal, we categorized it and used the chi-square test or fisher exact test.

3.4.2 Data Analysis Phase II

The data analysis used in Phase II will be explained as follows.

1. Depicting the baseline variables.

The descriptive statistic explained the percentage of participant characteristics, including sociodemographic, genetic factors, eating self-efficacy, and behaviour factors. Then, for outcome variables such as dietary intake and

BMI. We used chi-square and Spearman rank to examine the association between variables and BMI.

2. To compare the baseline and outcome measures between the intervention and control group.

   There were two types of data scales used in baseline and outcome measurement:

   a. Mann Whitney U test

      Age, living allowance, and BMI (height, weight and BMI data)

   b. Chi-Square Test and Fisher exact Test

      Hometown, academic year, study major, genetic factor, exercise activity. While for fisher test was used for education variables. Relationship status, eating self-efficacy level, exercise per week, exercise time, sleep time per week, smoking and drinking alcohol.

   c. Independent T-Test

      Dietary calories include carbohydrates, protein, fat, and total calorie.

3. To assist the effect of a Diamond application

   The research outcomes were dietary intake (total calorie, carbohydrate, protein and fat) and Body Mass Index. Both of these outcomes were continuous data. The statistical analysis was used:

   a. Wilcoxon signed-rank test

      We are comparing within-group (week 9 – week 0) for both groups.

   b. Independent T-Test

      Comparing the changing value of both groups for carbohydrate and total calorie.

   c. Mann Whitney U test

      Comparing the changing value of both groups for fat, protein and BMI.

4. To investigate the relationship of Diamond application usage with the outcomes in the intervention group

   a. Pearson correlation test: meal diary and engagement with carbohydrate and total calorie and BMI.

   b. Spearman rho test: opening reminder, quiz participation and mean score of quiz with dietary intake (carbohydrate, fat, protein and total calorie).

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

c. Binary logistic regression: to determine the impact of multiple independent variables with outcome: engagement component (opening reminder, meal diary, quiz participation, mean score of quiz and engagement) and BMI.

3.6 Ethical Procedures

Based on the Helsinki Declaration, involving humans in medical research to conduct new knowledge should be done using the ethical standard to ensure respect for their rights and health (Williams, 2008). This research used a quasi-experiment which chose the university with a well-known investigator and appropriate competencies. The participants were informed about the benefit and side effects of the intervention period. The confidentiality of the participants would be maintained as part of the regulation, and no discrimination was allowed.

The research protocol was submitted to the Chulalongkorn ethics committee (029.1/64) and Bhakti Wiyata ethics committees in Indonesia (No:100/PP2M-KE/I/2021) to define issues related to the research and assure the understanding process in the data measurement. In addition, this ethical approval ensured the study would not assault existing regulations. The results were discussed for feedback and future recommendation. Moreover, informed consent was given to the participant as a form that described the information about this research. The data included affiliation, research purpose, reporting procedure when the side effect is present, and permission to leave the study. Furthermore, data analysis and publication were published based on the ethical publishing standard.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

CHAPTER IV
RESULTS

This study consisted of two phases. The first phase was cross-sectional descriptive to examine mobile usage and trend of local food consumption and develop a Diet Monitoring (Diamond) Application. Afterwards, the second phase was a quasi-experiment to assess the effect of Diamond application among overnutrition female university students. The intervention program was eight weeks and measured the outcome twice (pre- and post-intervention).

This chapter depicted results in two phases: Phase I was divided into 1) The requirement results: a) Characteristic of respondents, b) Mobile application usage, c) Food and dietary habits, 2) Designing wireframes and development path, 3) Diamond application prototype, 4) Testing stage results, 5) Maintenance stage results, 6) Final application. Furthermore, phase II was divided into 1) Baseline respondents' characteristics and 2) The effect of Diamond application among overnutrition female students.

Phase I

4.1 The requirement results

4.1.1 Characteristic respondents

Two hundred seventeen respondents were eligible for analysis. Table 6 and 7 described the characteristic of the survey's participants and their correlation with Body Mass Index (BMI). The health profile aspect results describe the average respondent's weight as 53.14 kg, and the mean height was 156.98 cm. Based on the weight and height data, we calculated the BMI. It depicted that most respondents had normal BMI (68.20%) with average of BMI is 21.28+3.30 kg/m^2. Normality test is needed to ensure the appropriate analysis test. Then because data >50, the results of normality test used Kolmogorov Smirnov Test result. The numerical data in this survey is age and BMI. The results of normality test were depicted as follows.

Age:

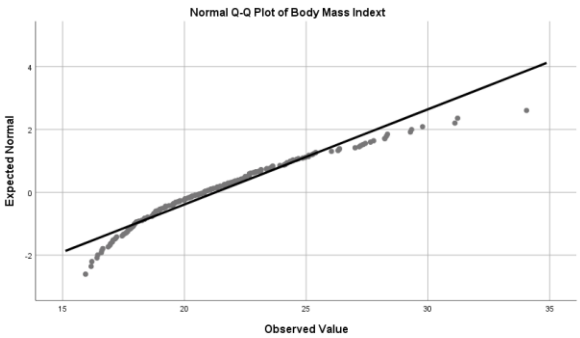
	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Age	.143	217	.000

a. Lilliefors Significance Correction

BMI:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Body Mass Index	.071	217	.010

a. Lilliefors Significance Correction



The average respondent's age was 21.51±1.37 year old and all respondents (100%) were bachelor's degree students and because the age and BMI were not normal distribution, we correlated age and BMI using Spearman Rank Test. Table 6 showed that there were association between age and length of stay associated with BMI (p-value $\leq$ 0.05). In addition, based the Correlation coefficients (R), it showed that even these low correlation, age had positive correlation while length of stay in study area had negative correlation with BMI.

Table 6. Correlation between age and BMI among survey participants.

Variable	R	p-value
Age	0.205	**0.002***
Length of stay in study area	-0.171	**0.012***

*p-value was analyzed by Spearman rank test (significant when p-value $\leq$ 0.05).

In addition, the categorical data were analyzed using Chi-Square test. Overall, only living arrangement had association with BMI while studying major, living allowance, and food allergy showed insignificant association results.

Table 7 shows 51.15% participants lived independently, 74.65% of respondents were non-health science, 82.02% of participants' monthly stipends were <$104.45, and 76.50% of them didn't have any food allergies. Those factors were not correlated with BMI (p-value=0.660, 0.487, 0.4457, respectively). The details were explained as follows.

Table 7. Characteristics of survey participants

Variables	Total participants (n, %)	Body Mass Index (BMI) Status			p-value
		Undernutrition (n,%)	Normal (n,%)	Overnutrition (n,%)	
Living arrangements					**0.010*C**
Living with parents	106 (48.85)	31 (29.24)	62 (58.50)	13 (12.26)	
Living alone	111 (51.15)	16 (14.41)	80 (72.07)	15 (13.52)	
Study Major					0.660C
Health science	55 (25.35)	11 (20.00)	34 (61.81)	10 (18.19)	
Non-health science	162 (74.65)	36 (22.22)	108 (66.67)	18 (11.11)	
Living allowance per month					0.487C
< $ 104.45	178 (82.02)	41 (23.03)	114 (64.04)	23 (12.93)	
$ 104.45 – 208.90	39 (17.96)	6 (15.38)	28 (71.80)	5 (12.82)	
Food Allergic					0.447C
Have Allergic	51 (23.50)	11 (21.57)	36 (70.58)	4 (7.85)	
Don't have allergic	166 (76.50)	36 (21.67)	106 (63.86)	24 (14.47)	

*p-value was analyzed by Chi-square test (Significant when p-value ≤ 0.05).

4.1.2 Mobile application usage

Mobile application usage was explained in three parts. There are eight questions related to this part. Generally, the participants used Android with 64-128 GB. Most of them used 4G as their networking and spent around $3.52-$7.02 per month to buy an internet package.

Table 7 describes the participants' mobile phone profiles. The survey revealed that 87.10% of respondents used Android, and 56.70% had around 64-128 GB of storage. Most smartphone networking types used were 4G (79.70%), and the internet expenses were about \$3.52-\$7.02 (50.70%). Additionally, the respondents used smartphones approximately 9 hours per day, and 51.20% of respondents recharged their mobile phones twice daily. The result details were explained as follows.

Table 8. Survey results of respondents' smartphones profile

Characteristics		Number of participants (n=217)	Percentage (%)
1.	**Smartphone System**		
	Android	189	87.10
	IOS	28	12.90
2.	**Smartphone storages (Internal and external)**		
	Not known	1	0.50
	<32 GB	46	21.20
	32-63.9 GB	42	19.40
	64-128 GB	123	56.70
	>128 GB	5	2.30
3.	**Mobile Networking Type**		
	3G	6	2.80
	LTE	38	17.50
	4G	173	79.70
4.	**Internet Package Expenses**		
	<\$3.51	38	17.50
	\$3.52-\$7.02	110	50.70
	\$7.03-\$10.52	45	20.70
	>\$10.52	24	11.10
	Mean ± SD = USD 5.54 ± 4.23, Max = USD 3.14, min = USD 0		
5.	**Smartphone usage**		
	Mean ± SD = 9.05 ± 3.85, Max = 20, min = 7		
6.	**The Mobile Phone Recharge Frequency (per day)**		
	1 time	83	38.20
	2 times	111	51.20
	3 times	10	4.60
	>3 times	13	6.00

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

a. Smartphone features

Table 8 provides information on smartphone features and their association with BMI among female university students. Overall, most participants have the entertainment features on their smartphones. The survey showed that all respondents had to message apps and more than half of them had photo & video edited apps (57.60%), music application (60.37%), e-commerce apps (77.96%), E-payment apps

(54.84%), travel application (58.53%), social media applications (93.55%), mailing application (85.25%), online meeting apps (78.34%), entertainment apps (93.09%) in their smartphone while games application and health apps as the minority user, 35.02% and 29.49%, respectively. In addition, chi-square analysis showed an association between owning games applications (p-value= 0.035), e-commerce apps (p-value=0.001) and BMI.

Table 9. Association of smartphone features and BMI among female university students

Variables	Total participants (n, %)	Body Mass Index (BMI) Status			p-value
		Undernutrition (n,%)	Normal (n,%)	Overnutrition (n,%)	
Message application	217 (100.00)	47 (21.66)	142 (65.44)	28 (12.90)	
Photo&video edited app					0.808^{C}
Don't have	92 (42.40)	21 (22.83)	58 (63.04)	13 (14.13)	
Have	125 (57.60)	26 (20.80)	84 (67.20)	15 (12.00)	
Music application					0.104^{C}
Don't have	86 (39.63)	23 (26.75)	49 (56.98)	14 (16.27)	
Have	131 (60.37)	24 (18.32)	93 (70.99)	14 (10.69)	
Games application					**0.035*^{C}**
Don't have	141 (65.98)	28 (19.86)	100 (70.92)	13 (9.22)	
Have	76 (35.02)	19 (25.00)	42 (55.26)	15 (19.74)	
E-commerce app					**0.001*^{C}**
Don't have	50 (23.04)	19 (38.00)	30 (60.00)	1 (2.00)	
Have	167 (77.96)	28 (16.77)	112 (67.07)	27 (16.17)	
E-payment app					0.213^{C}
Don't have	98 (45.16)	25 (25.51)	58 (59.18)	15 (15.31)	
Have	119 (54.84)	22 (18.49)	84 (70.59)	13 (10.92)	
Travel application					0.300^{C}
Don't have	90 (41.47)	24 (26.67)	56 (62.22)	10 (11.11)	
Have	127 (58.53)	23 (18.11)	86 (67.72)	18 (14.17)	
Social media app					0.543^{C}
Don't have	14 (6.45)	2 (14.29)	9 (64.29)	3 (21.43)	

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Variables	Total participants (n, %)	Body Mass Index (BMI) Status			p-value
		Undernutrition (n,%)	Normal (n,%)	Overnutrition (n,%)	
Have	203 (93.55)	45 (22.17)	133 (65.52)	25 (12.32)	
Mailing application					0.353^C
Don't have	32 (14.75)	10 (31.25)	18 (56.25)	4 (12.50)	
Have	185 (85.25)	37 (20.00)	124 (67.03)	24 (12.97)	
Online meeting app					0.383^C
Don't have	47 (21.66)	13 (27.66)	30 (63.83)	4 (8.51)	
Have	170 (78.34)	34 (20.00)	112 (65.88)	24 (14.12)	
Health support app					0.527^C
Don't have	153 (70.51)	34 (22.22)	97 (63.40)	22 (14.38)	
Have	64 (29.49)	13 (20.31)	45 (70.31)	6 (9.38)	
Entertainment app					0.285^C
Don't have	15 (6.91)	5 (33.33)	7 (46.67)	3 (20.00)	
Have	202 (93.09)	42 (20.79)	135 (66.83)	25 (12.38)	

*Significant based on C= Chi-square analysis (p-value≤0.05)

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

b. Mobile activities

Table 9 illustrates the association of participants' smartphone activities with BMI among female university students. Generally, it depicted those participants frequently doing activities such as sending text messages, listening to music, shopping online, watching movies, playing social media, studying, and searching for entertainment news and information.

The survey describes that most respondents regularly (>6 times per week) used their smartphone to send messages (87.10%), listen to music (67.28%), do shopping (68.66%), watch movies (62.21%), use social media (79.26%), study online (63.13%), search information (82.03%), and entertainment news (53.92%). In contrast, they did less for activities such as editing videos (13.36%), playing games (27.65%), travelling activities (27.19%), using E-payment (13.36%) and mailing

(29.95%). In addition, regarding chi-square analysis, there were association between mobile activities such as editing video (p-value= 0.034), listening music (p-value= 0.027), playing games (p-value= 0.004), using social media (p-value= 0.027), and searching entertainment news (p-value= 0.031) with BMI among female students. The details were explained as follows.

Table 10. Respondents' mobile activities and BMI among female university students

Variables	Total participants (n, %)	Body Mass Index (BMI) Status (21.28+3.30)			p-value
		Undernutrition (n,%)	Normal (n,%)	Overnutrition (n,%)	
Video Editing app activity frequency					**0.034*C**
≤6 times per week	188 (86.64)	43 (22.87)	125 (66.49)	20 (10.64)	
>6 times per week	29 (13.36)	4 (13.79)	17 (58.62)	8 (27.59)	
Text message app activity frequency					0.697C
≤6 times per week	28 (12.90)	6 (21.43)	17 (60.71)	5 (17.86)	
>6 times per week	189 (87.10)	41 (21.69)	125 (66.14)	23 (12.17)	
Listening music app frequency					**0.027*C**
≤6 times per week	71 (32.72)	22 (30.99)	44 (61.97)	5 (7.04)	
>6 times per week	146 (67.28)	25 (17.12)	98 (67.12)	23 (15.75)	
Playing games app frequency					**0.004*C**
≤6 times per week	157 (72.35)	34 (21.66)	110 (70.06)	13 (8.28)	
>6 times per week	60 (27.65)	13 (21.67)	32 (53.33)	15 (25.00)	
Shopping activity app frequency					0.236C
≤6 times per week	68 (31.34)	11 (16.18)	50 (73.53)	7 (10.29)	
>6 times per week	149 (68.66)	36 (24.16)	92 (61.74)	21 (14.09)	
Travelling app activity frequency					0.305C
≤6 times per week	158 (72.81)	35 (22.15)	106 (67.09)	17 (10.76)	
>6 times per week	59 (27.19)	12 (20.34)	36 (61.02)	11 (18.64)	
Watching movies app frequency					0.061C
≤6 times per week	82 (37.79)	18 (21.95)	59 (71.95)	5 (6.10)	
>6 times per week	135 (62.21)	29 (21.48)	83 (61.48)	23 (17.04)	
Social media app frequency					**0.027*C**

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Variables	Total participants (n, %)	Body Mass Index (BMI) Status (21.28±3.30)			p-value
		Undernutrition (n,%)	Normal (n,%)	Overnutrition (n,%)	
≤6 times per week	45 (20.74)	8 (17.78)	36 (80.00)	1 (2.22)	
>6 times per week	172 (79.26)	39 (22.67)	106 (61.63)	27 (15.70)	
E-payment app frequency					0.147[C]
≤6 times per week	188 (86.64)	41 (21.81)	126 (67.02)	21 (11.17)	
>6 times per week	29 (13.36)	6 (20.69)	16 (55.17)	7 (24.14)	
Study app activity frequency					0.091[C]
≤6 times per week	80 (36.87)	23 (28.75)	50 (62.50)	7 (8.75)	
>6 times per week	137 (63.13)	24 (17.52)	92 (67.15)	21 (15.33)	
Searching information app frequency					0.059[C]
≤6 times per week	39 (17.97)	7 (17.95)	31 (79.49)	1 (2.56)	
>6 times per week	178 (82.03)	40 (22.47)	111 (62.36)	27 (15.17)	
Searching entertainment news app frequency					**0.031*[C]**
≤6 times per week	100 (46.08)	28 (28.00)	64 (64.00)	8 (8.00)	
>6 times per week	117 (53.92)	19 (16.24)	78 (66.67)	20 (17.09)	
Mailing app activity frequency					0.279[C]
≤6 times per week	152 (70.05)	34 (22.37)	102 (67.11)	16 (10.53)	
>6 times per week	65 (29.95)	13 (20.00)	40 (61.54)	12 (18.46)	

*Significant based on C= Chi-square analysis (p-value≤0.05)

4.1.3 Food and dietary habits

The last part of the questionnaire was about food and dietary habits. There were nine-item questions related to food and dietary habits. Each result was explained as follows.

a. Meal frequencies

Table 10 explains the meal frequencies of the survey's participants. This survey showed that 37.30% had meals three times a day while more than 50% had two meals (30.90% of them missed their breakfast).

Table 11. Respondent's meal frequency

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Categories	Number of participants (n=217)	Percentage (%)
1 meal per day (lunch)	9	4.10
2 meals per day (breakfast and lunch)	19	8.80
2 meals per day (breakfast and dinner)	41	18.90
2 meals per day (lunch and dinner)	67	30.90
3 meals per day	81	37.30
Mean + SD = 2.33 + 0.55, Max = 3, min = 1		

b. Favourite breakfast menu

Figure 15 shows the favourite breakfast menu of the survey's respondents. Open questions collected 135 breakfast menus as part of the questionnaire. According to the menus rank, there were 15 breakfast menus that respondents preferred. Overall, the majority of breakfast menu was rice as the carbohydrates source. Most respondents (16.3%) chose nasi pecel (rice with steamed vegetables and peanut sauce), while milk was also favourite in the top 15 on the breakfast menu.

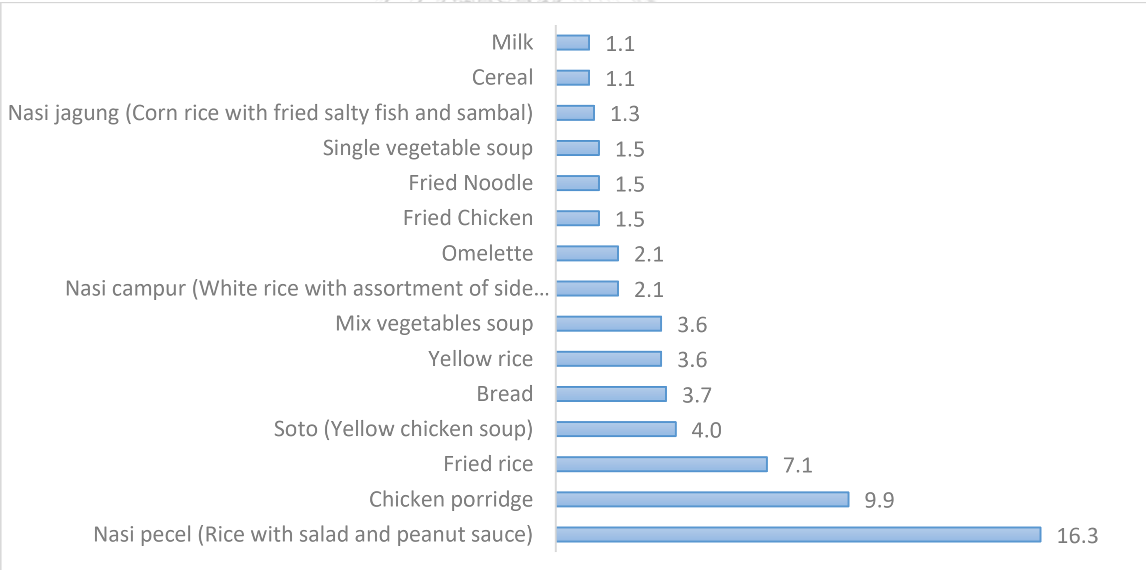


Figure 15. Top 15 breakfast menus

c. Favourite lunch menu

Figure 16 represents respondents' lunch favourite menus. There were 151 menus of lunch to survey results. Then, we ranked the menus to be 15 favourite menus. 32.7% of participants chose fried chicken as their lunch menu, while other local dishes such as rawon (spicy beef in black nut soup) are also favourites in the top 15 lunch menus. The lunch menu was not different from the breakfast menu.

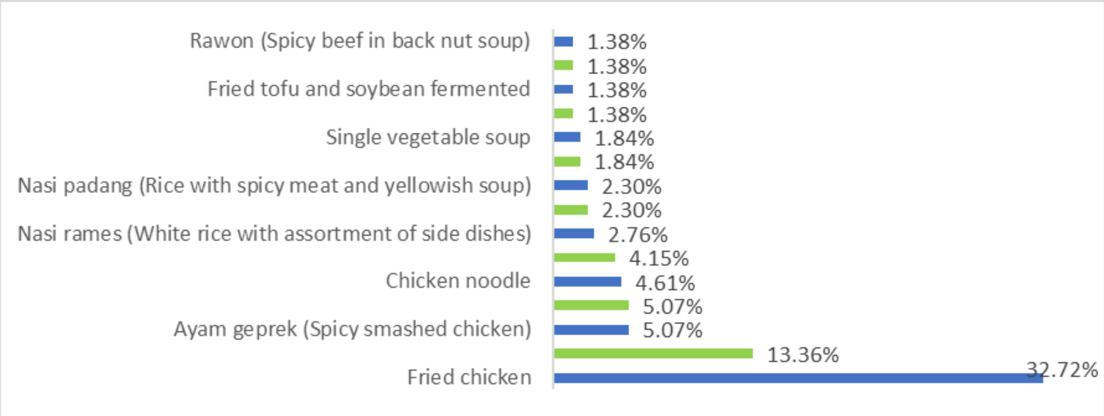


Figure 16. The top 15 lunch menus

d. Favourite dinner menus

Furthermore, Figure 17 shows the top 15 dinner menus. There were 120 dinner menus, and it ranked among the 15 favourite dinner menus. This figure represented that more than half of respondents chose fried rice (61.3%) while cap jay (vegetable stir-fry) was also a favourite in the top 15 dinner menus.

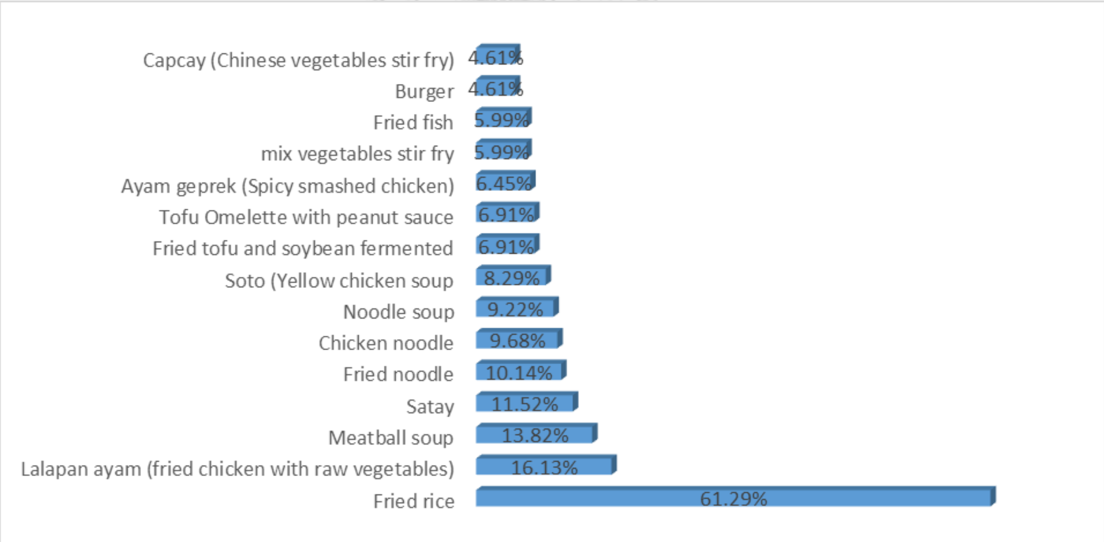


Figure 17. Top 15 dinner menus

e. Favourite meal menus

Resuming the breakfast, lunch and dinner menus, we classified the local food to be 121 food menus ordinary consumed by female university students in Malang City, Indonesia. Figure 18 depicts 30 menus that respondents favourited. More than 70% of respondents chose fried rice, while they agreed that balado (chicken with curly red chilies sauces) as an Indonesian signature dish was also a favourite in the top 30 food menus.

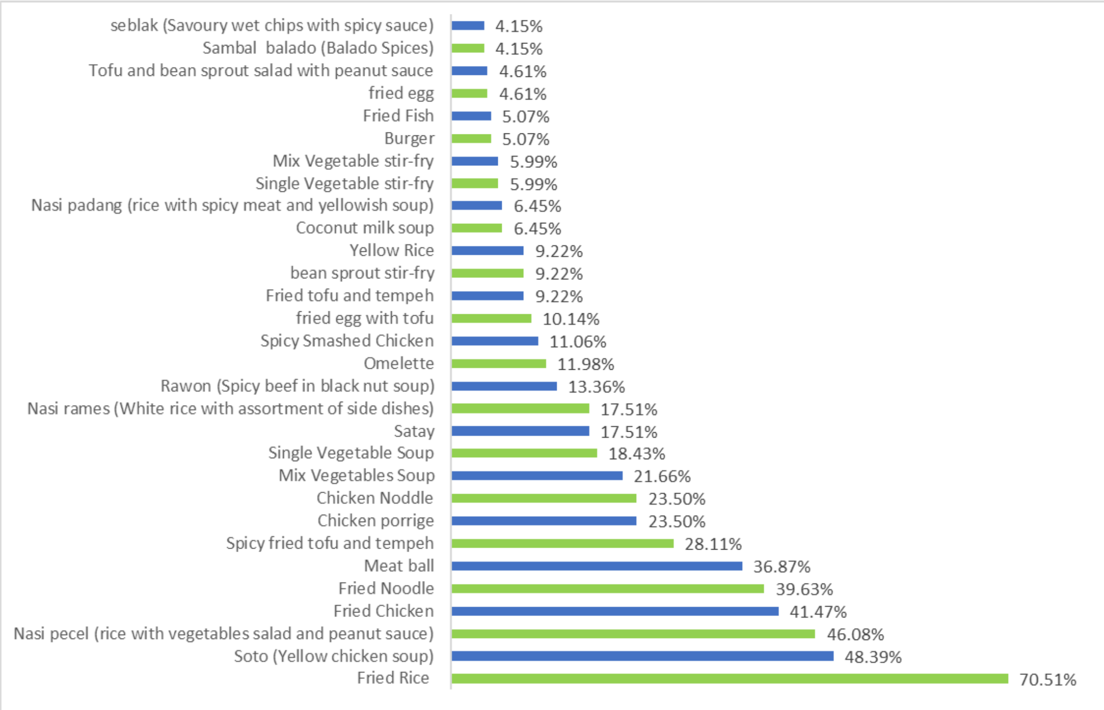


Figure 18. Top 30 general food menus

menu results focusing on 28 overnutrition female university students besides the general respondents' results. Figure 19 represents the top 15 favourite menus of overnutrition female university students. It can be seen that all of the overnutrition respondents chose fried rice as their favourite menu (100%). This result is similar to the general participant's result. In addition, it showed rawon as an Indonesian national dish, also a favourite of overnutrition respondents. Rawon is Indonesian signature delicious food which is categorized as a high-fat food.

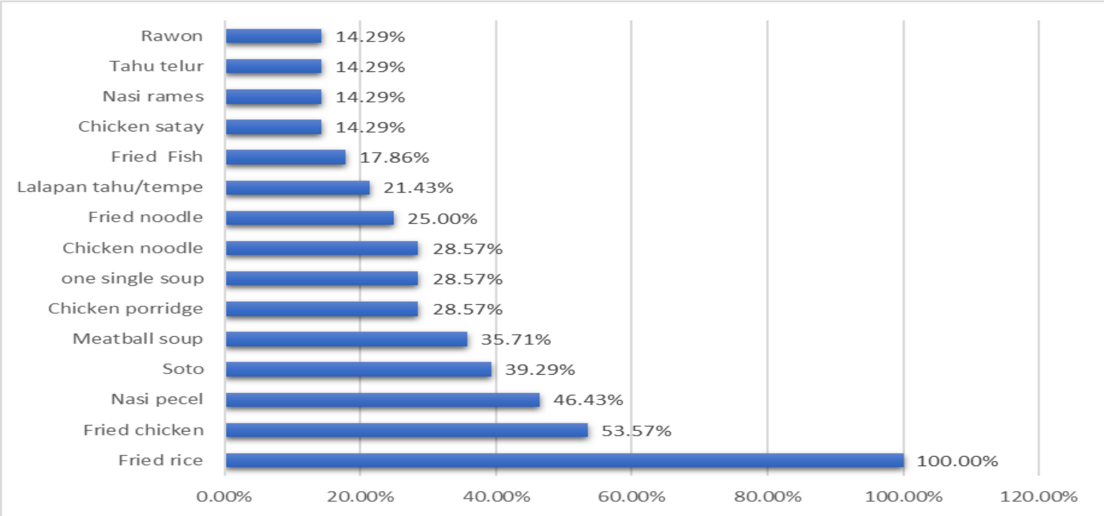


Figure 19. Top 15 of overnutrition respondents' food menus

f. Snack consumption frequency

Table 11 describes the snack frequency of survey participants. The survey result illustrates that 35.50% of participants consumed snacks 1-2 times daily. In addition, the other higher number of respondents declared that they ate snacks twice per month (24%).

Table 12. Respondents snack frequency

Snack frequency	Number of participants (n=217)	Percentage (%)
2 times per month	52	24.00
1-2 times per week	16	7.40
3-6 times per week	41	18.90
1-2 times per day	77	35.50
more than 3 times per day	31	14.30

g. Favourite snack menu

Figure 20 portrays twenty-seven snacks in the participants' survey. More than 40% of respondents selected biscuits/pastry (41.47%) and crackers (41.03%) as their favourite snacks, while marshmallows or sugary snacks are fewer favourites.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

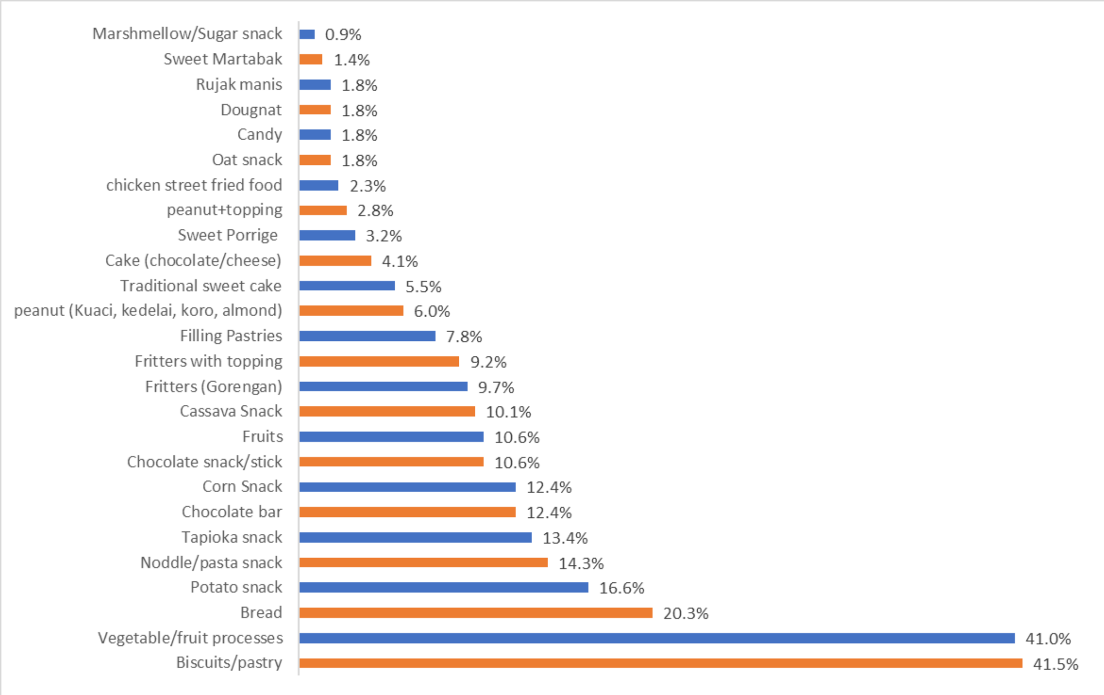


Figure 20. Respondents' favourite snack menus

Furthermore, Figure 21 describes the snack menus of overnutrition respondents. Similar to the general population preferred, they loved to consume biscuits/pastry (39.29%) and crackers (35.71%).

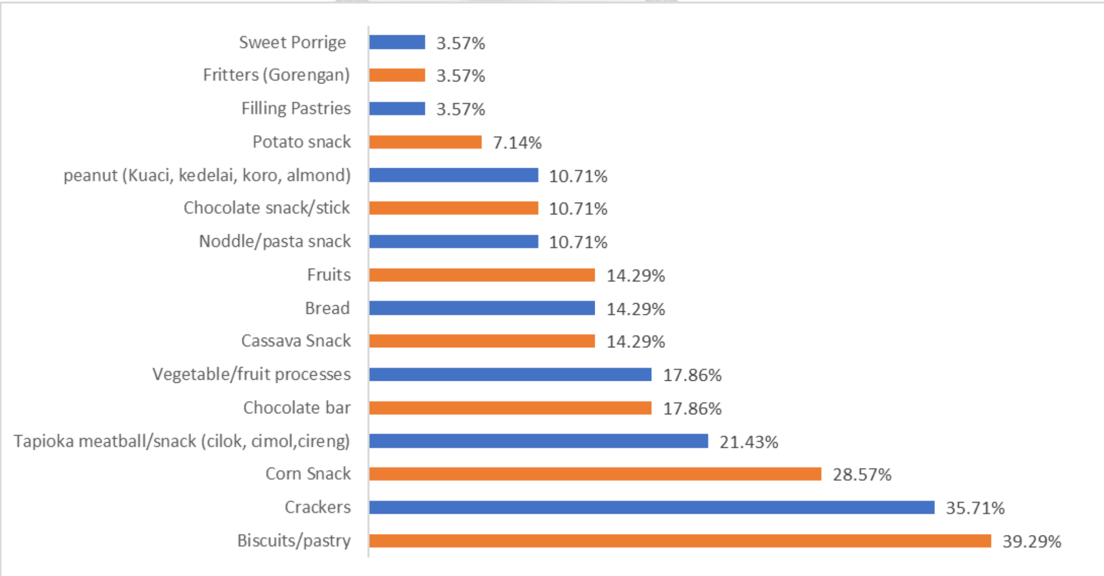


Figure 21. Overnutrition respondents' snack menus

h. Sweet drink consumption

Table 12 illustrates participants' preference for consuming sweet beverages. The online survey results showed that more than 60% of respondents admitted that they liked to consume sweet drinks while the rest did not like to drink them.

Table 13. Respondents' sweet drink consumption

Sweet drink consumption	**Number of participants (n=217)**	**Percentage (%)**
Yes	140	64.50
No	77	35.50

i. Favourite sweet drink

Figure 22 depicts twenty-two sweet drink menus were collected from the survey. It showed that nearly 50% of respondents chose iced milk tea with topping as their favourite sweet drink, while yoghurt and fruit soup had less interest to participants. Their top 5 favourite sweet drinks were classified as high-sugar drinks, and if consumed in excess and long period, it will impact their health conditions.

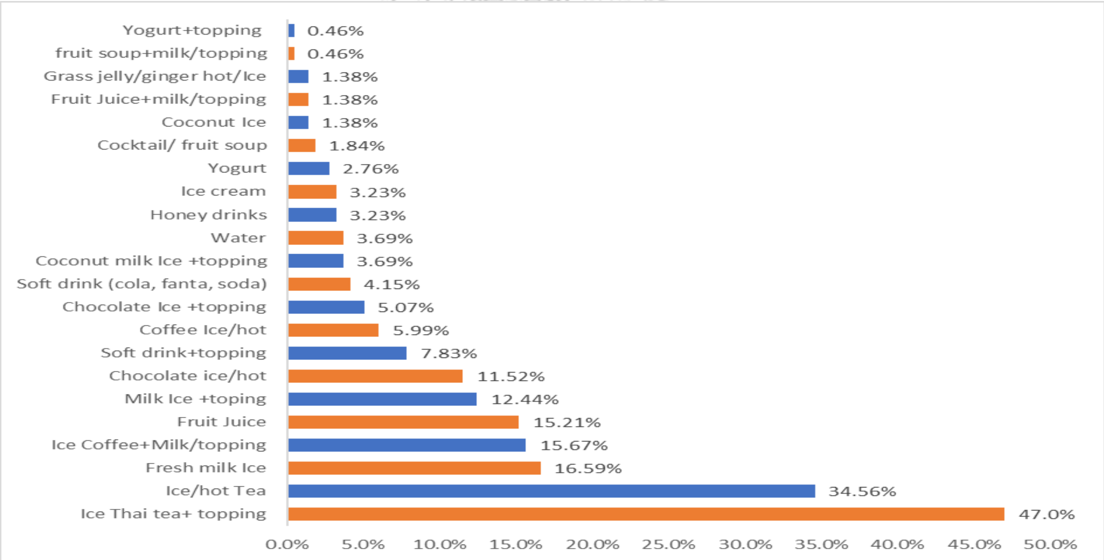


Figure 22. Respondents' sweet drinks' favourite

In addition, Figure 23, which describes overnutrition respondents' sweet beverage choices, shows a similar trend to general participants' favourites. They admitted that they liked to drink Thai tea with toppings (60.71%), including boba, whip cream, grass jelly, and ice or hot tea (53.57%). This beverage is also categorized as a high sugar drink and will be higher depending on the topping its used.

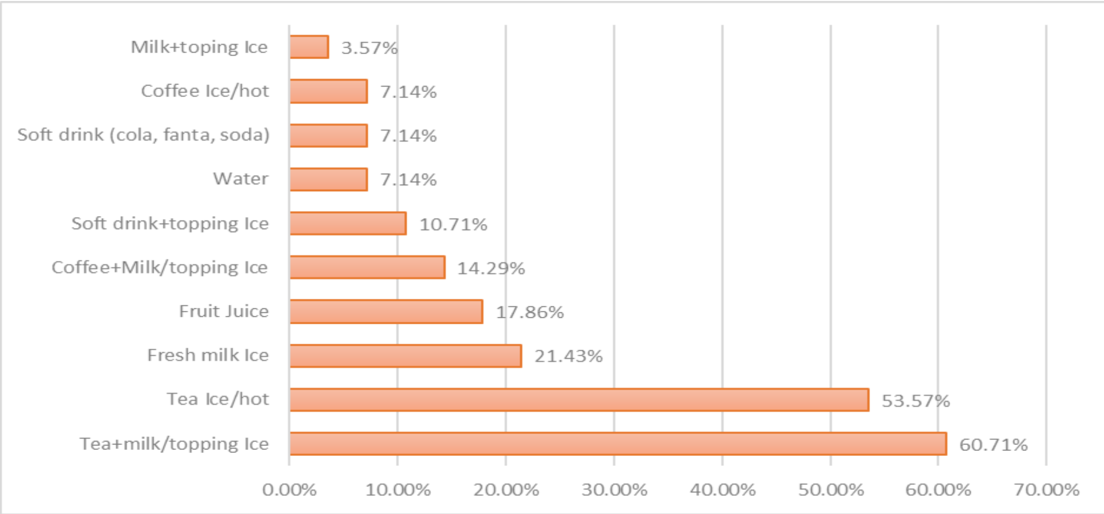


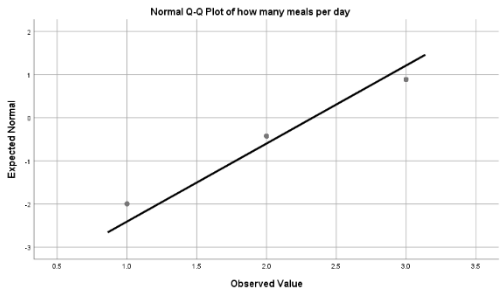
Figure 23. Overnutrition respondents' sweet beverages

Furthermore, to know the association between main course frequencies and snack consumption with BMI among female university students. We did the normality test for meal frequency and BMI as numerical data.

Meal Frequency:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
how many meals per day	.352	217	.000

a. Lilliefors Significance Correction



BMI:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Body Mass Index	.071	217	.010

a. Lilliefors Significance Correction

It shows meal frequencies and BMI were not normal distribution. Table 14 showed that meal frequency has correlation with BMI (p-value<0.000) and has R -0.249. It means that even low correlation, the meal frequency has negative correlation with BMI.

Table 14. Correlation between meal frequency and BMI among female university students

Variable	R	p-value
Meal frequency	-0.249	**<0.000***

*p-value was analyzed by Spearman rank test (significant when p-value ≤ 0.05).

Table 15 showed snack consumption associated with BMI among female university students (p-value= 0.013), while sweet beverages consumption preference is not significantly associated with it.

Table 15. Association between food consumption and BMI among female university students

Variables	**Total participants n (%)**	**Body Mass Index (BMI) Status**			**p-value**
		Undernutrition (n,%)	**Normal (n,%)**	**Overnutrition (n,%)**	
Snack consumption					**0.013***
2 times per month	52 (23.97)	5 (9.62)	39 (75.00)	8 (15.38)	
1-2 times per week	16 (7.37)	4 (25.00)	8 (50.00)	4 (25.00)	
3-6 times per week	41 (18.89)	9 (21.95)	28 (68.30)	4 (9.75)	
1-2 times per day	77 (35.49)	17 (22.07)	52 (67.53)	8 (10.40)	
> 3 times per day	31 (14.28)	12 (38.70)	15 (48.40)	4 (12.90)	
Sweet Beverages consumptions					0.151
Yes	77 (35.47)	18 (23.37)	54 (70.13)	5 (6.50)	
No	140 (64.53)	29 (20.71)	88 (62.86)	23 (16.43)	

* Significant by C= Chi-square analysis (p-value≤0.05)

These results mean that we need to consider meal frequencies and snack consumption to succeed in managing BMI.

4.2 Designing wireframes and development path

After finishing the survey stage. The result related to the wireframes of the application was sent to the developer. The data consisted of.

1. Application Size

   Based on mobile usage data survey results, the Information Technology (IT) team considered creating this application for Android because more than 80% of respondents used Android. In addition, the size of the application should be user-friendly. The developer made the application sizes accessible to users (considering the feature and the image detection). After calculating all Diamond Application features, the smartphone which considers installing this app should have free storage approximately 200 MB.

2. Food database

   Approximately 170 menus were received from an online survey. Then, we estimated calories from the Indonesian Ministry of Health reference food database. There were two sources of food local databases for Indonesian food, such as Nutrisurvey- Indonesian food database and the Indonesian Ministry of Health (https://panganku.org/id-ID/semua_nutrisi). For menus that cannot be found in the Nutrisurvey and Indonesian Ministry of health, we used factsectret (Makanan dan Merek di Indonesia (fatsecret.co.id)) to estimate the calories. All menus were converted to calories in Kcal (Figure 24).

	Snack	Porsi (gr/ml)	Porsi URT	english	Energy (Kcal)	Carbohydrate (gr)	Carbohydrate (Kcal)	Lemak (gr)	Lemak (Kcal)	Protein (gr)	Protein (Kcal)
1	Sweet Martabak	90	1 potong sedang	1 medium piece	270.00	37.37	149.48	11.31	101.79	7.01	28.04
2	Crepes	50	1 buah	1 piece	112.00	10.83	43.32	5.54	49.86	4.38	17.52
	Filling Pastries					0		0		0	
3	Molen	40	1 buah	1 piece	84.8	7.3	29.2	6.2	55.8	0.6	2.4
	Biscuits/pastry					0		0		0	
4	Nastar	15	1 buah	1 piece	75	12.66	50.64	2.14	19.26	1.14	4.56
5	Cake (chocolate/cheese)	30	1 potong	1 piece	104	15.48	61.92	4.65	41.85	1.16	4.64
6	Oat snack	20	1 potong	1 piece	100	13	52	5	45	1	4
7	Cassava Snack (keripik singkong)	25	1 mangkok kecil	1 small bowl	100	14	56	5	45	0	0
8	Ketela goreng	30	1 potong	1 piece	40	6.37	25.48	1.58	14.22	0.28	1.12
	Noddle/pasta snack					0		0		0	
9	Makaroni original	30	1 mangkok kecil	1 small bowl	145.4	14.8	59.2	8.7	78.3	2.5	10
10	Makaroni pedas	30	1 mangkok kecil	1 small bowl	127.5	15.5	62	7.5	67.5	2.9	11.6
11	Makaroni asin	30	1 mangkok kecil	1 small bowl	143.3	14.5	58	8.6	77.4	2.5	10
12	Makaroni telur	20	1 mangkok kecil	1 small bowl	65.6	4.8	19.2	4.3	38.7	2	8
13	Mie lidi	60	1 piring kecil	1 small plate	219.6	32.8	131.2	7.3	65.7	5	20
14	Chocolate bar	30	1 batang	1 bar	170	14	56	11	99	9	36
	Potato snack					0		0		0	
15	Keripik kentang	38	1 mangkok kecil	1 small bowl	153	13.93	55.72	10.49	94.41	1.84	7.36
	Vegetable/fruit processes					0		0		0	
16	jasuke	100	1 mangkok kecil	1 small bowl	157	24.4	97.6	5.3	47.7	6.2	24.8
	Crackers (fruit,vegetable)					0		0		0	
17	Kerupuk	10	1 buah	1 piece	35	3.26	13.04	2.29	20.61	0.43	1.72
18	Stik balado	10	1 mangkok kecil	1 small bowl	60	6	24	3.5	31.5	1	4
19	Stik tahu	40	1 mangkok kecil	1 small bowl	117.5	8.3	33.2	9	81	1.7	6.8
20	Bread	75	1 potong sedang	1 medium piece	213.67	42.53	170.12	2.03	18.27	5.93	23.72

... calories 2 | calories 3 | food list calories | snack list calories | drink list calories | Sheet1

Figure 24. Food calories conversion

3. Conducting image detection

The Diamond application needs 200-500 images/iterations from google image and a photo camera for one training menu. Hence, this study used about 102,000 iterations (epochs) in the training process. The smaller the loss/error value, the greater the model's accuracy level. The food database was 170 menus, including foods, snacks and drinks. It was challenging to bring all food menus into image processing training because the object (food) had many colours and condiments. To face this problem, we used some steps as follows.

a. We excluded drink menus (21 drinks) because those were liquid and snacks (25 menus) and cereal (1 meal) because most of them were packaging and had barcodes (170 was reduced to be 123 menus).
b. We found that 123 foods' accuracy was extremely poor level, with many undetected foods as the results. Hence, we excluded some menus which had identical colors (from 123 menus was reduced to be 100 menus).
c. The accuracy of 100 menus was much better compared with 123 menus. However, we still found many misidentifications and undetected menus. It shows that the accuracy was not good enough to detect the food. Then, we reduced it again to 75 menus. In the last training, we reduced it to 50 menus. The detail menus as follows.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

1. Apple
2. Koloke (Chinese sweet and sour chicken)
3. Ayam bakar (Grilled chicken)
4. Ayam krispy (Crispy chicken)
5. Ayam lalapan (Chicken with chilli sauce)
6. Fried chicken
7. Chicken galangan
8. Tapioka meatball
9. Eeg with Bali spices
10. Pisang (Banana)
11. Batagor (fish dumpling with peanut sauce)
12. Botok (tofu or tempeh with shredded coconut steamed was covered by banana leaf)
13. Chicken porridge
14. Burger
15. Cah kangkong (water spinach stir-fry)
16. Capcay (Chinese mix vegetables stir-fry)
17. Chicken katsu
18. Dimsum
19. Donat
20. Fu yung hai (Hisbiscus egg)
21. Gado Gado (Javanese salad with peanut sauce)
22. Gudeg (young jackfruit with spicy coconut milk)
23. Gulai Iga (Indonesian curry soup with rips)
24. Ice cream cone
25. Grill fish
26. Fried fish
27. Fried mushroom
28. Chicken curry
29. French fries
30. Coffee
31. Egg martabak
32. Fried noodle
33. Soup noodle
34. Fried rice
35. Yellow rice
36. Nasi pecel (rice and vegetables salad with peanut sauce)
37. Omelette Noodle
38. Opor ayam (chicken in spicy coconut gravy
39. Oseng kacang tempe (soy bean fermented and long bean stir-fry)
40. Pasta
41. Rawon (Spicy beef in black nut soup)
42. Chicken satay
43. Sour vegetable soup
44. Clear vegetable soup
45. Soto ayam (yellow chicken soup)
46. Steak
47. Sushi
48. Milk
49. Sweet Martabak
50. Spicy tofu

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

The IT team needed approximately 80 hours per 20 menus to training the system. Hence, the total image training was approximately 600 hours. Figure 25 shows the graph with an enormous loss/error value even though the number of iterations has been immense. In that case, it indicates that the model/dataset is not optimal (low accuracy). From 123 menus, only 50 menus had high precision (>70%) (Figure 26).

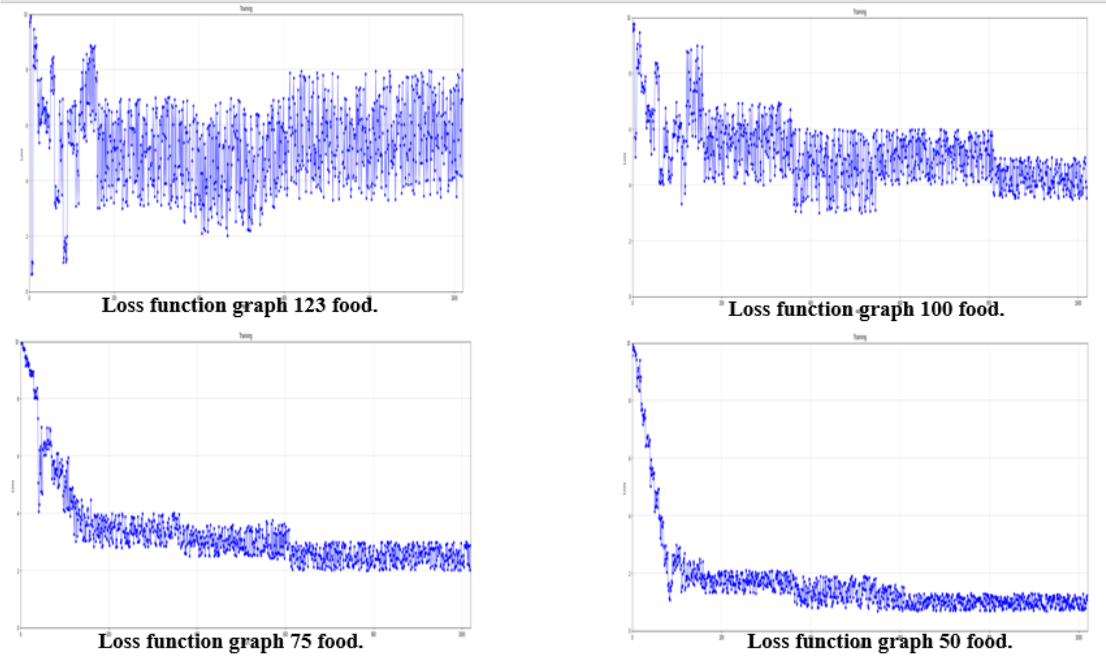
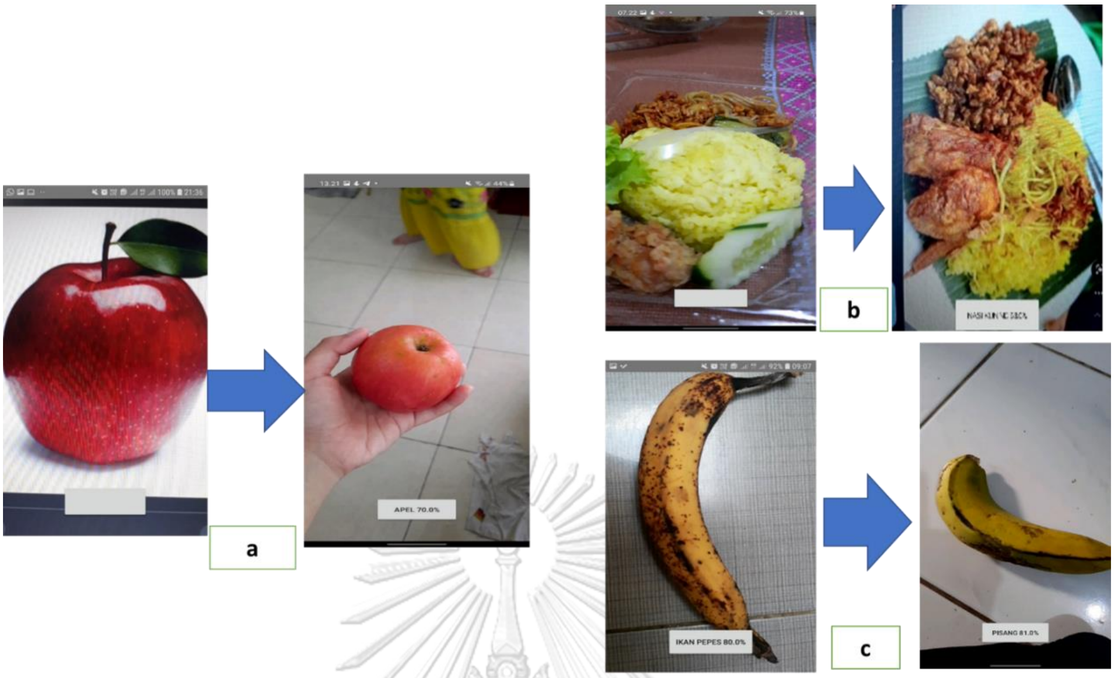


Figure 25. Loss graphic

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY



4. The barcode database

Figure 26. Results of image detection from 123 food training to 50 food training: a) "undetected apple" to "detected apple"; b) "undetected yellow rice" to "pictured yellow rice"; c) "misdetection banana" to "detection banana"

The Barcode database had approximately 25 snack barcode data based on snack surveys. Furthermore, the team collected the barcode number from the supermarket and input it into a database. We cannot use the barcode from a google database because it had barcodes for supermarket identification but not the calories. Furthermore, we need to consider the data size to make the application accessible. The scan barcode for this scan barcode database explained as follows.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

1. Sari kunyit kuning
2. Singkong kusuka
3. Chiki balls
4. Chitato max
5. Cheetos ayam panggang
6. Jetz
7. Qtela
8. Doritos
9. Bear brand
10. Nutrisari instant drink jeruk peras
11. Oreo ice cream
12. Nuttela
13. Yakult
14. Lactasoy soy milk chocolate 1ltr
15. Pocky
16. Beng-beng max
17. Go potato
18. Malkist abon
19. Lotte choco pie
20. Silverqueen chungky bar
21. Good day coolin
22. Good day tiramisu b btl 250ml
23. Tango wafer
24. Nu green tea
25. Nestle nestum cereal

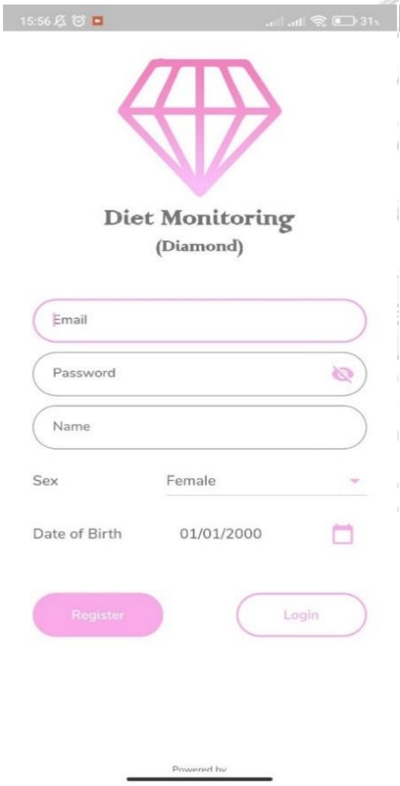
จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

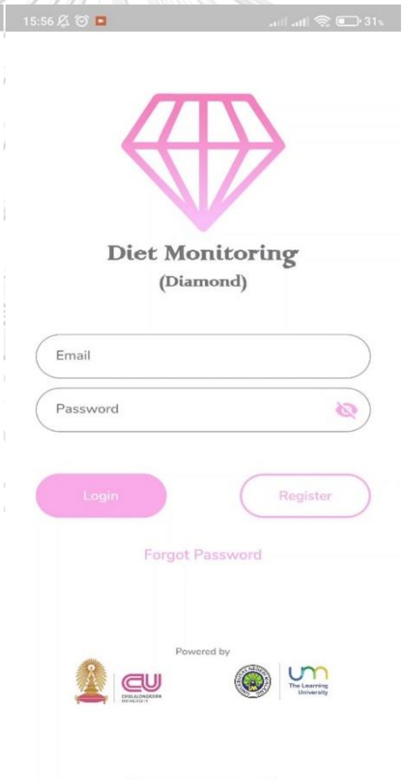
4.3 Diamond application prototype

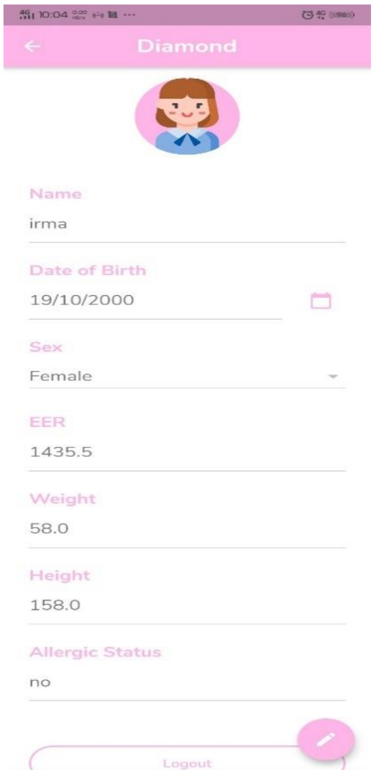
After finishing data base, we focused on developing a prototype of an application. Based on the literature review, we put general features in dietary applications such as profile, energy calculation, meal graph, intake and exercise record, and information. The Diamond application had particular features such as the estimation energy requirement (EER) feature (based on the Indonesian Ministry of Health guideline), meal diary feature (image detection, scan barcode, and manual search), diet reminder feature, and meal graph feature which has menstruation period and sharing result feature.

1. Profile feature

   It has information such as name, date of birth, sex, EER, weight, height and allergic status.







Registration page | Login page | Profil page

2. Estimated Energy Requirement (EER) feature

   This feature included weight, height, and activity level in calculating each person's proper calories per day. After the user input all the items needed, this system calculates the appropriate calories regarding the data. This calorie calculation adopted the Indonesian health ministry formulation to measure the suitable calories for Indonesian people (Indonesia Ministry of Health, 2017). There are formulations input in this EER calculation system:

1) Calculating the Basal Metabolic Rate (BMR) in [kcal/24hrs] with the formulation (Indonesia Ministry of Health, 2017):

   Ideal Weight = (Height (cm)-100) – (10% x (Height (cm)-100))

   For males: 30kkal x ideal weight

   For females: 25kkal x ideal weight

   This research focused on female users.

2) Users choose physical activity level (Roza and Shizgal, 1984)

   1. Sedentary (little or no exercise):

      Calorie-Calculation = BMR x 1.2

   2. Lightly active (light exercise/sports 1-3 days/week):

      Calorie-Calculation = BMR x 1.375

   3. Moderately active (moderate exercise/sports 3-5 days/week):

      Calorie-Calculation = BMR x 1.55

   4. Very active (hard exercise/sports 6-7 days a week):

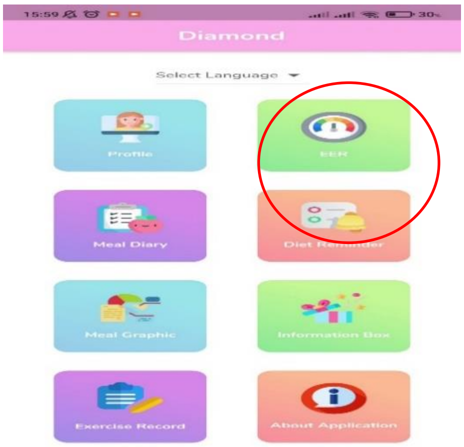
      Calorie-Calculation = BMR x 1.725

   5. If you are extra active (tough exercise/sports & a physical job):

      Calorie-Calculation = BMR x 1.9

The appropriate calories per day showed up after the users input the data needed in the EER features. Hence, the users can change the EER when they want to do exercise such as lightly active or moderate or even very active exercise.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University



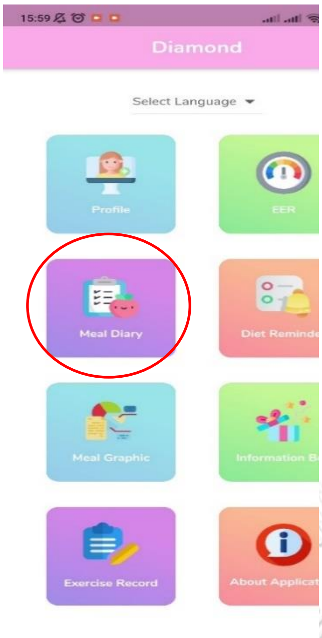
EER's icon

Content of EER

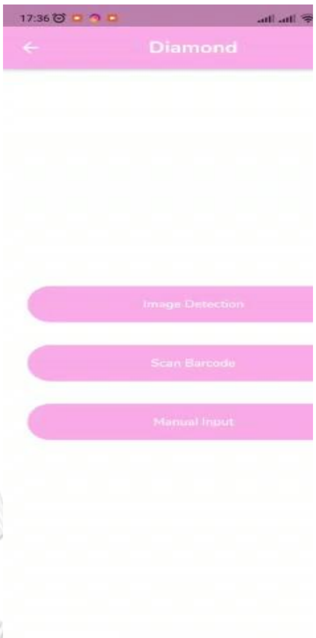
3. Meal Diary Feature

The meal diary feature consisted of image detection, scan barcode and manual search. Image detection is a novelty in this application because only a few applications used image processing as a figure to estimate the food calories. The users can use image detection to know the food calories or a barcode to capture the snack or food calories. If the users can't access the information from the image detection or scan barcode feature, they can use the manual search because it has approximately 700 menus. This feature used general portion and calorie estimation regarding Indonesian food database and do not calculate the portion of food on the plate and how much the user left. However, it was complemented with the "eating decision" button to help users adjust how much they eat and notify them about calories left.

CHULALONGKORN UNIVERSITY



Menu’s display



Content of meal diary

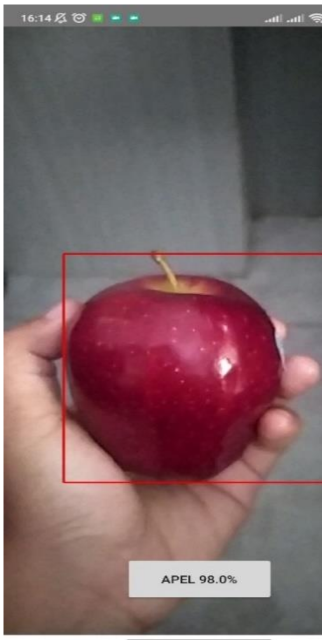
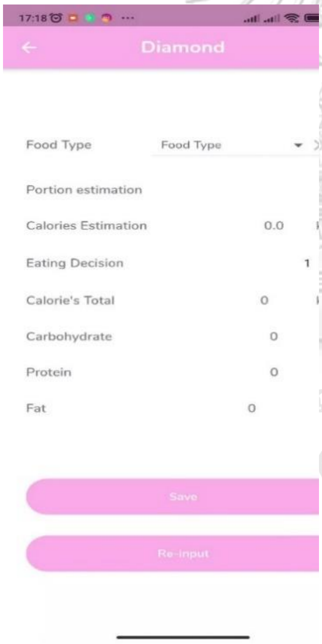
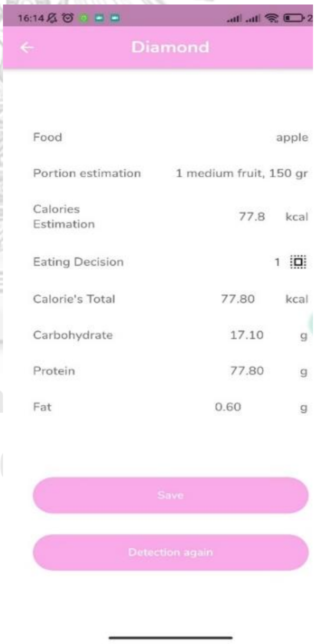


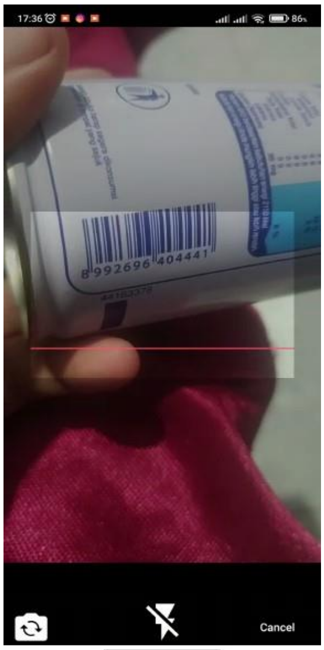
Image detection



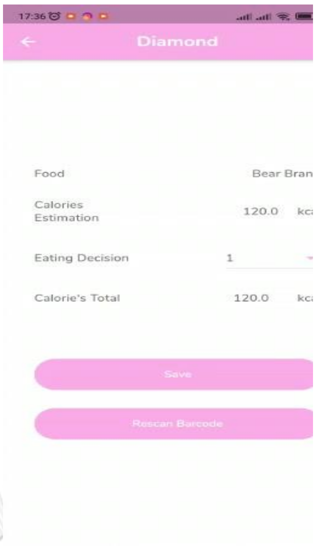
Manual search



Results of meal diary



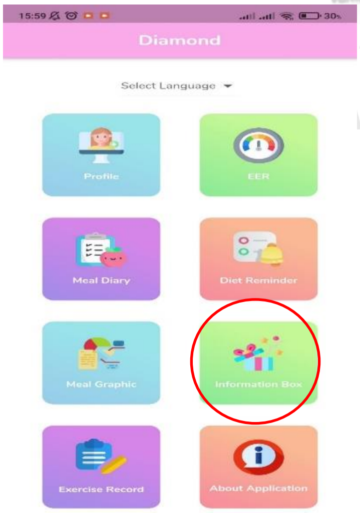
Scanning barcode

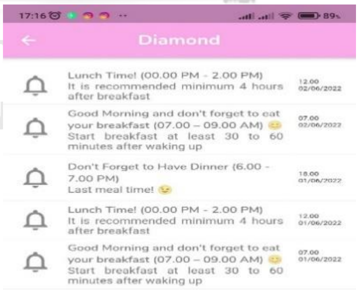


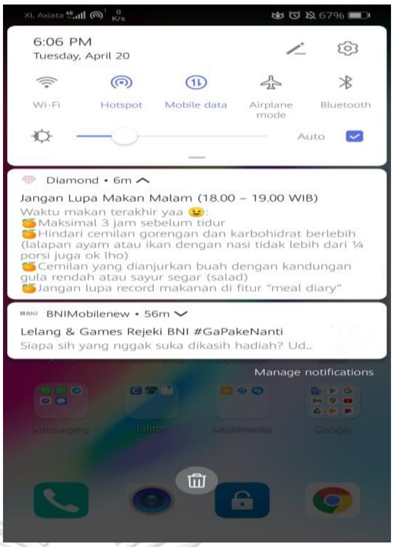
Result of scan barcode

4. Diet Reminder Feature

The Diet reminder feature is one of the essential features in Diamond apps because the user notices how many calories are left and convenient eating time. It helped them control their food consumption and manage their weight. Monitoring and comparing their daily intake with EER help them reduce their weight. In addition, the eating reminder feature pops up three times a day (07.00 am, 12.00 pm, and 6.00 pm) to help users manage their eating time.



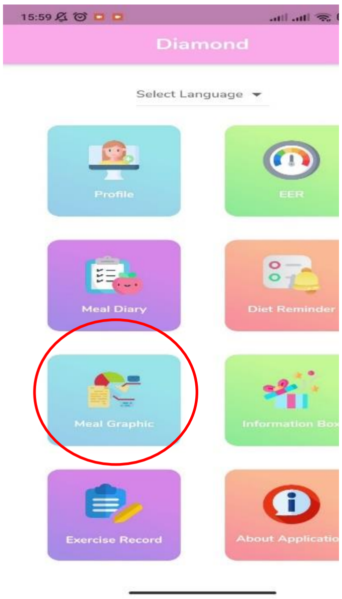




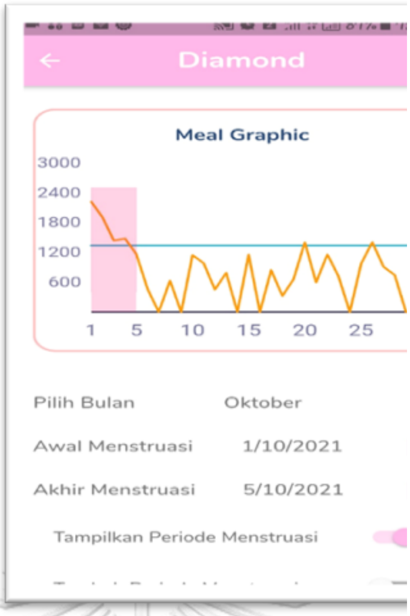
Diet reminder's icon Content of diet reminder

5. Meal Graph Feature

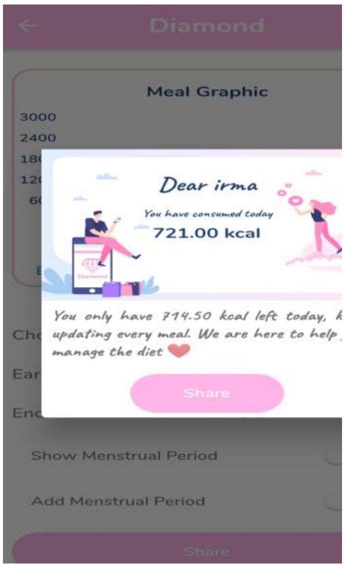
The meal graph's function is a report the user's achievement. It is displayed per day, week and month. The meal graph helped the user evaluate whether their calorie achievements were a success or failure. Users also able to share it to encourage their achievement on social media such as Facebook, Twitter or any other message application. In addition, it has menstruation period that can alarm the users regarding their consumption before and after period. They can evaluate the consumption whether it tend to increase or decrease when the period comes and make decision to the next month regarding this result.



Meal graphic’s icon



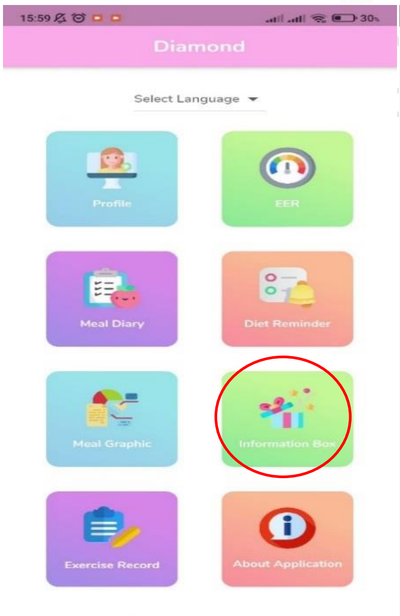
Content of meal graphic



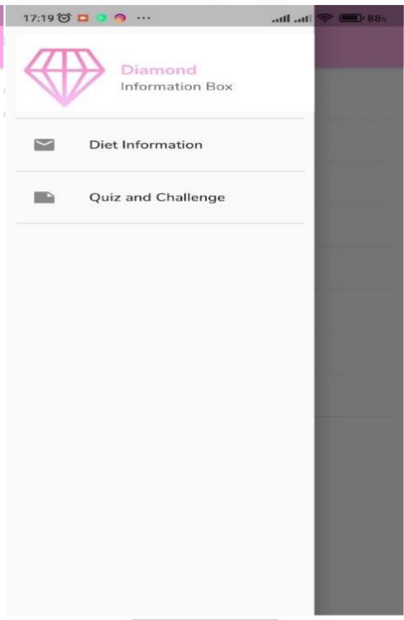
Share page

6. Diet Information Feature

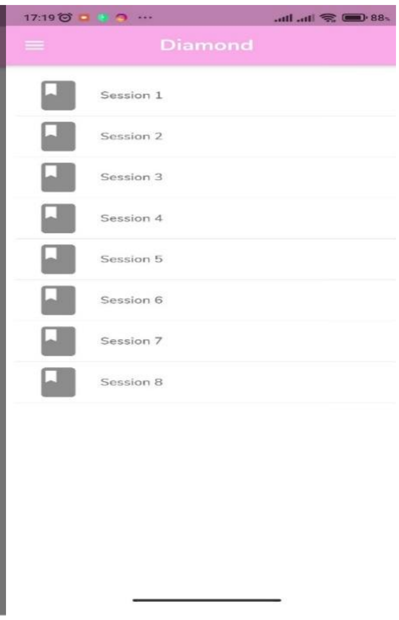
This information helped the users to understand the diet materials refer to the Indonesian reducing obesity guidebook program. It consisted of healthy food, food portions, food substitution, Indonesian nutrient guidelines, and diet advice (appendix 8). In addition, this feature has a quiz and challenge card to attract users and guide their daily diet plan.



Information box’s icon

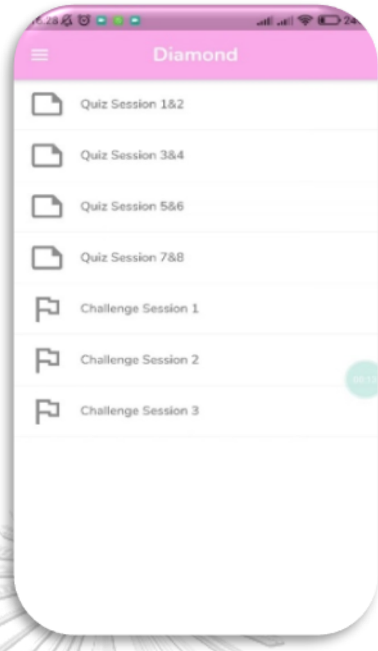


Information box’s menus

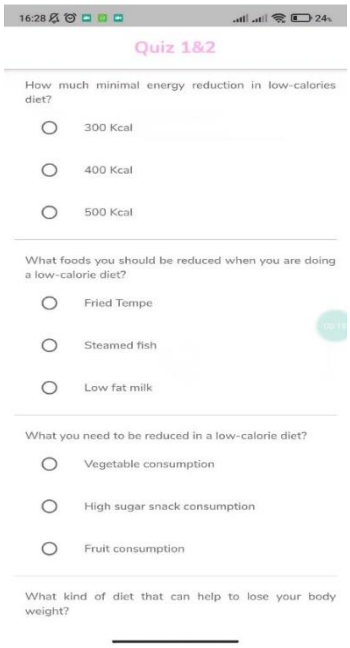


Content of diet information

Diet information



Content of quiz & challenge

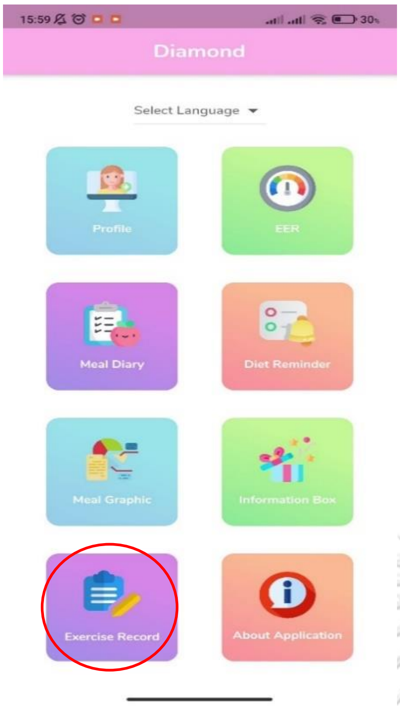


Quiz

Challenge

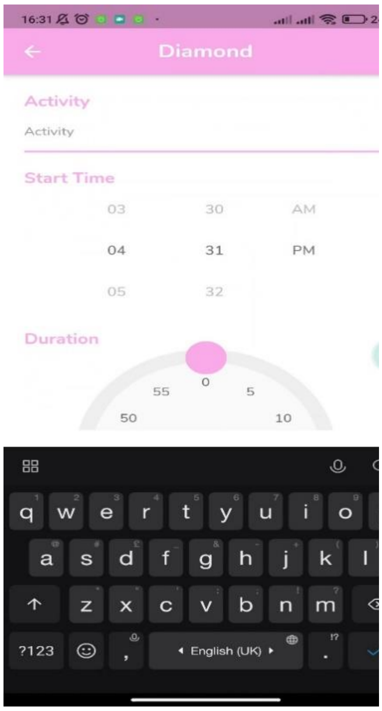
7. Exercise Record Feature

The exercise record was a complementary feature that could help users identify their activity. It is related to the kind of exercise activity, time and duration they exercise. With this feature, the user can manage their EER. For instance, when they want to do a high level of exercise, they can calculate the EER for that day.



Exercise record's icon

Content of exercise record



Exercise record form

In addition, the last menu is about application. It showed the description of application and the team conducted the application

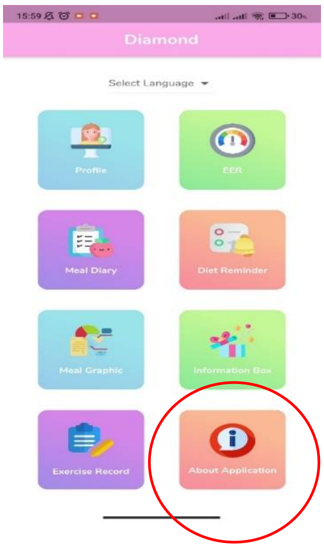


Figure 27. Diamond application prototype

The prototype was validated by three Indonesian experts in the nutrition field. The result was showed in Table 14. Overall, the validators agreed that the Diamond application was acceptable for the system and interface unless the calorie information was difficult to access in the meal diary features and the reminder pop-up was late.

Table 16. Three experts' feedback

No	**Variables**	**Evaluation score (n, %)**				
		1	**2**	**3**	**4**	**5**
1	System aspect					
	a. the app was easy to operate				1 (33.33)	2 (66.67)
	b. the outlook of the apps was attractive				1 (33.33)	2 (66.67)
2	User aspect					
	a. The main menu visually was simple and clear				1 (33.33)	2 (66.67)
	b. The main menu is composed of related submenus				1 (33.33)	2 (66.67)
	c. The menu used the familiar term				1 (33.33)	2 (66.67)
	d. The symbol used easily to understand				1 (33.33)	2 (66.67)
	e. Meal graph				1 (33.33)	2 (66.67)
	f. Information box				2 (66.67)	1 (33.33)

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

No	Variables	Evaluation score (n, %)				
		1	2	3	4	5
	g. Exercise record				1 (33.33)	2 (66.67)
3	Interaction aspect					
	a. All features in apps confirm user needs				1 (33.33)	2 (66.67)
	b. Users can change the input on the profile easily				1 (33.33)	2 (66.67)
	c. The exercise record was easy to use				1 (33.33)	2 (66.67)
	a. Pop-up diet information was an error or loading process				2 (66.67)	1 (33.33)
	b. Estimated Energy Requirement (EER) has a correct formulation				1 (33.33)	2 (66.67)
	c. It is easy to access the calories information from the meal diary features		1 (33.33)	1 (33.33)	1 (33.33)	
	d. a pop-up reminder has delayed notification (it should be at 7 am, 12 pm and 6 pm)		1 (33.33)		2 (66.67)	
	e. meal graphs feature was informative and easy to understand				2 (66.67)	1 (33.33)

In addition, based on open question for suggestions, the experts suggested:

a. The diamond application should have more databases for food databases and data for image processing
b. The eating decision in meal features should be input manually by a user. Then, the estimation will be precisely
c. One expert experienced an error for some foods for image processing when she opened it

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

4.4 Testing step Results

Thirty participants voluntarily participated in Diamond application testing. However, only 25 respondents sent the evaluation of Diamond apps at the end of the period (week 4). The follow-up loss happened on days 6-10 (16.7%). The reason for lost follow-up was their activity on campus (10%) and errors after installing the apps (6.7%). This data was appropriate to used even only 25 participants because we specify the age and the criteria with the application users. This testing period started from 01– 31 August 2021 (four weeks). It showed that 60% of users were satisfied using a Diamond application.

The demographic factors in Table 15 depict that participants age <22 years old felt satisfied with the prototype while those aged>22 years old felt unsatisfied. Then, most participants in both home areas (rural and urban) satisfy with Diamond apps. Most of the respondents lived with their parents. Furthermore, it showed that respondents who used Android 10 agreed that using the Diamond apps prototype was satisfying.

Table 17. Demographic of user testing Diamond Application

Variables	**Diamond apps feedback**	
	Unsatisfied n (%)	**Satisfied n (%)**
Age		
<22 years old	4 (40.00)	9 (60.00)
≥22 years old	6 (60.00)	6 (40.00)
Address		
Rural	5 (55.60)	7 (50.00)
Urban	4 (44.40)	7 (50.00)
Living arrangement		
Living with parents	8 (80.00)	13 (86.70)
Independent	2 (20.00)	2 (13.30)
Type of Android		
Android <9	5 (50.00)	4 (26.70)
Android 10	4 (40.00)	9 (60.00)
Android 11	1 (10.00)	2 (13.30)

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

4.4.1 Engagement testing results

An engagement testing results were analyzed from Firebase analysis. The Firebase program captured the usage of three main features: meal diary, image detection, and meal graph. Then, it consisted of information features and exercise access for other features. There was an increasing trend for accessing meal diary and other features during 4 weeks while image detection and meal graph had declined.

Table 16 depicted that at week 1, 60.00% of participants accessed the meal diary feature at a low level. Then, after four weeks, it rose to 100% of participants at a moderate level. This trend was followed by the meal graph and other pages, such as information features, which reached 8.00% to 52% of participants at a moderate level, respectively. In contrast, image detection gradually decreased from 100% to 0% of participants at an intermediate level after four weeks of installation.

Table 18. Engagement testing application

Feature open	Engagement level			
	Moderate (25%-75%)		Low (<25%)	
	n	%	n	%
Meal diary				
1st week	10	40.00	15	60.00
2nd week	25	100.00	0	0
3rd week	25	100.00	0	0
4th week	25	100.00	0	0
Image detection				
1st week	25	100.00	0	0
2nd week	25	100.00	0	0
3rd week	0	0	25	100.00
4th week	0	0	25	100.00
Meal graph				
1st week	10	40.00	15	60.00
2nd week	25	100.00	0	0
3rd week	25	100.00	0	0
4th week	25	100.00	0	0
Diet Information				
1st week	2	8.00	23	92.00
2nd week	2	8.00	23	92.00
3rd week	15	60.00	10	40.00
4th week	13	52.00	12	48.00

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Table 17 shows the quiz scores in the Diamond application. It depicted that in week 1, most participants got scores in moderate level (44.00%), while in week 2, most of them received scores in low level (52.00%). It means that in week 1 excitement participation trend was higher than in week 2.

Table 19. Quiz testing score

Quiz access	Score					
	High (>80)		Moderate (60-80)		Low (<60)	
	n	%	n	%	n	%
Quiz						
Week 1	8	32.00	11	44.00	6	24.00
Week 2	6	24.00	6	24.00	13	52.00

Furthermore, Table 18 shows a descriptive statistic of users who accessed eating reminders. 68% of respondents were categorized in moderate level for an opened reminder, while the total of reminders for four weeks was 93 times. In addition, the average value of opened reminders is 37.06, while the lowest value is 22.98, and the highest value is 49.98.

Table 20. Frequency's table of opened reminder

Variables	Total Participants (n, %)	Mean	Min	Max	Std. Deviation
Opened reminder		37.06	22.98	49.98	8.93
Rarely (0-31)	8 (32.00)				
Moderate (32-61)	17 (68.00)				
Frequently (62-93)	0 (0.00)				

4.4.2 Feedback Diamond application

Feedback on the Diamond application was received after 4 weeks of installment. The form was sent by WhatsApp to each testing participant. Table 19 describes all participants who agreed that the Diamond application was easy to control, helpful to learn about maintaining a diet, easy to use, and provided understandable information. Contrary to image detection and its calorie information, the participants report some errors and difficulty accessing it. In addition, some participants agreed that the installment of apps needs a long time and admitted errors during the installment.

Table 21. Testing user's feedback for Diamond Application

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

No	Variables	Answer (n, %)			
		Agree	Slightly Agree	Slightly Disagree	Disagree
1	This application was an easy way to control my dietary consumption	13 (52.00)	12 (48.00)		
2	I learned about control dietary consumption during the period I used Diamond apps	15 (60. 00)	10 (40.00)		
3	The function of meal diary helped me to remember the foods I consumed.	12 (48. 00)	13 (52.00)		
4	The image detection feature assisted me in deciding what I wanted to eat.	2 (8.00)	8 (32.00)	4 (16.00)	11 (44.00)
5	The barcode scan in food helped me decide what I wanted to eat.	13 (52.0)	10 (40.00)	2 (8.00)	
6	The application made me aware of managing my meals	13 (52.00)	10 (40.00)	2 (8.00)	
7	This application affected my food	13	8 (32.00)	4 (16.00)	

No	Variables	Answer (n, %)			
		Agree	Slightly Agree	Slightly Disagree	Disagree
	consumption habits	(52.00)			
8	This application was useful for controlling the dietary intake	11 (44.00)	10 (40.00)	4 (16.00)	
9	The application was easy to use	20 (80.00)	5 (20.00)		
10	I was able to get enough information about controlling dietary intake	17 (68.00)	6 (24.00)		
11	It was helpful to control my dietary consumption using the diet reminder	12 (48.00)	12 (48.00)	1 (4.00)	
12	I quickly received the food calories information when I took the photos.	8 (32.00)	10 (40.00)	2 (8.00)	3 (12.00)
13	The diet information provided on the application was easy to understand	22 (88.00)	3 (12.00)		
14	The meal graph provided on the application was helpful	12 (48.00)	12 (48.00)	1 (4.00)	
15	I like using this application	22 (88.00)	2 (8.00)	1 (4.00)	
16	I am satisfied with using this application to control my food intake	12 (48.00)	10 (40.00)	3 (12.00)	
17	I improve my knowledge about maintaining dietary consumption.	12 (48.00)	8 (32.00)	4 (16.00)	1 (4.00)
18	Sometimes, I have a problem remembering to record my dietary intake using meal diary features	12 (48.00)	12 (48.00)	1 (4.00)	
19	Diamond application intervenes in my daily life	8 (32.00)	12 (48.00)	5 (20.00)	
20	It took a long time to apply Diamond application	2 (8.00)	2 (8.00)	13 (52.00)	8 (32.00)
21	It was troublesome to apply Diamond application	1 (4.00)	4 (16.0)	3 (12.00)	17 (68.00)

Moreover, some participants presented the benefit and drawbacks of the Diamond application in the open question column. Table 20 illustrates that the participants were pleased with the display, function, and satisfaction with Diamond features such as estimation calories, meal diary, reminder, meal graph, and box information. In addition, they noted the menstruation period included in the meal graph as an interactive feature in this application.

Table 22. Positive feedback of Diamond Application after four weeks instalment

Aspect	Positive Statement
Display (6 users)	"I like the colour of apps. It's cute." "It has an interesting display."
Operational system (2 users)	"It is not a heavy app and easy to use."

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Aspect	Positive Statement
Function (18 users)	"It helps me to do a healthy diet." "It assists me in managing the food intake."
Estimation of calories (14 users)	"It showed how many calories I would take when I ate the food." "It helped me know how many calories I should take per day."
Meal diary (2 users)	"It is interesting using a picture to know food calories."
Reminder (11 users)	"It helps me to remind my eating time." "I can eat regularly because of the reminder."
Meal graph (3 users)	"It's an interesting graphic." "Easy to resume my intake each day."
Menstruation feature (2 users)	"This menstruation feature, I didn't find in another app." "I can match my food intake with my period time."
Box Information (4 users)	"I like the information box. It is useful information." "It is an interesting quiz"

The limitation and suggestions from the testing users are regarding the feedback questionnaire shown in Table 21. The crucial feedback was the meal diary feature, especially for image detection. There were 18 users to 25 participants who reported errors and misdetection of food and faced difficulty scanning the snack. In addition, there were suggestions related to display and added features to improve the Diamond application. During four weeks of installment, we also upgraded approximately 70 Indonesian cuisines adding to the application to enrich the menus based on the testing user's report.

Table 23. Limitation and suggestion of Diamond Application after 4 weeks

Aspect	Limitation and Suggestion Statement
Display (3 users)	"Layout only one color" "It will be better if this app has a night mode." "I cannot find the back button."
Operational system (2 users)	"Login process takes a longer time." "Instalment apps should be faster."
Meal diary (18 users)	"It should have more food inputted." "Some foods undetected in image detection include fried chicken, martabak

Aspect	Limitation and Suggestion Statement
	telur."
	"I think it will be better if users can change the food inputted grams."
	"Scan barcode cannot use for some snacks."
	"Sharing feature is not working."
Box information (2 users)	"It will be great if you put some suggestions on diet videos."
	"Quiz should be updated."
Suggestion features (1 user)	"It may have a feature to control water intake."

4.5 Maintenance stage results

After receiving feedback from validators and testing users, we tried to manage the shortage of Diamond application prototypes. Table 22 explains the feedback of participants' suggestions and problems during 4 weeks testing stage.

Table 24. Feedback on the maintenance stage

Aspects	**Suggestion Statement**	**Feedback**
Display	1. night mode 2. back button	1. We didn't put various themes in this primary app because we were concerned about the application's size and didn't want to make it a heavy application. 2. This app used a back button from the smartphone.
Operational system	1. login process takes a longer time 2. installment apps should be faster."	For installment, a Diamond application has a size of about 179 MB. The process will take time, depending on the Android type. The older the Android version, the longer the procedure was needed.
Meal diary	1. It should have more food inputted and some foods undetected in image detection, such as fried chicken, Martabak telur 2. It will be better if users can change the grams of food inputted 3. scan barcode cannot use for some snacks 4. sharing feature is not working	1. After the long-running process, image detection achieved 50 menus with reasonable accuracy (>70%). After receiving error feedback, we retraining more picture in 50 menus. However, the application size was still our first consideration if we wanted to add more menus. Our drive was still in 0 payment mode, and we will consider using the payment drive again. After receiving 70 menus, we put more menus in a manual search feature. Therefore, our apps' entire menu is approximately 237 Indonesian local menus. When the user

Aspects	Suggestion Statement	Feedback
		cannot find the food in image detection and scan barcodes, they can find it in the manual search feature. 2. The user can modify the portion in an eating decision. We gave an option for them. We want to design the blank choice so the user can put the portion number in the future. 3. The database for barcode snacks was limited. It had 25 snacks barcode because of the limited data we got. 4. There was a bug in this feature. Therefore, we fixed the bug, and it was used commonly.
Box information	1. It would be great if you put some suggestions for diet videos 2. The quiz should be updated	1. we are concerned about copyright when we insert the link of video, while if we put video, it will need more storage. 2. The quiz was according to two sessions of information. It can be updated in future when the information is updated.
Suggestion features	It may have a feature to control water intake	It was a good point. It can develop in the future

4.6 Final Diamond application

After finishing the maintenance step, the final prototype application was ready to examine in phase II. Phase II aims to assess the effect of the Diamond application on female overnutrition students. The Diamond application is one of dietary application that focus on young age as the users target while intervention program in Indonesia (GENTAS) was implemented on worker population and elementary school students. In addition, this application can promote the program because the information provided in application is from Indonesian obesity guidance book (Indonesian Ministry of Health, 2017). In Phase II, this app link was shared by google drive but not uploaded to Google Play Store because it has limited free users (maximum 70 users). Hence, we want to focus on the participants in phase 2 who should do measurements before and after interventions. The application was uploaded to the google play store after phase II finished and showed the results.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Phase II

4.7 Data analysis of baseline characteristic

Phase II involved approximately 65 respondents for intervention and 63 respondents for a comparison group. However, two respondents from the intervention group decided to uninstall the Diamond application after four weeks. Then after eight weeks, those respondents cannot be contacted by the team to follow up on the outcome measurement. In addition, there was a lack of follow-up in the comparison group (three participants). The analysis of the baseline was divided into five parts of characteristics as follows.

4.7.1 Part 1. Sociodemographic factors between intervention and control group

63 respondents in the intervention and 60 in the control group were analyzed. To know the differences, first we did the normality test to numerical data such as age, living allowance in intervention group (group 1) and the comparison group (group 2). Because the data were >50 then we used the Kolmogorov Smirnov result test.

a. Normality test of Age:

Group 1:

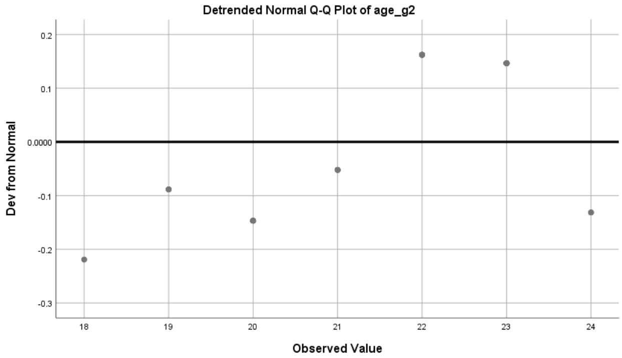
	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
age_g1	.188	63	.000

a. Lilliefors Significance Correction

Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
age_g2	.163	60	.000

a. Lilliefors Significance Correction

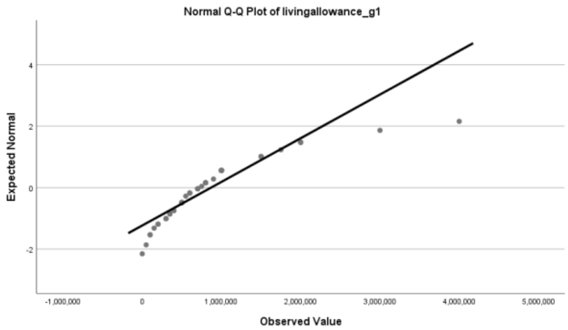


b. Normality test of Living Allowance:

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
livingallowance_g1	.236	63	.000

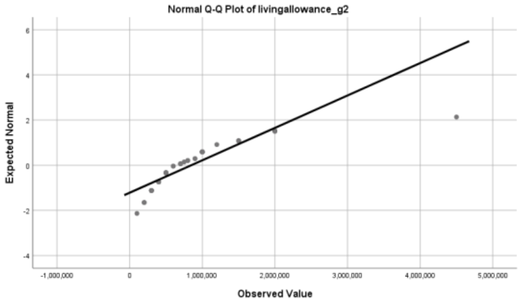
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
livingallowance_g2	.231	60	.000

a. Lilliefors Significance Correction



According to statistical analysis, it showed that age and living allowance were not normal distribution (p-value ≤0.05). Hence, we used Mann Whitney U test to analyze the difference between both groups. Table 25 showed that age and living allowance were homogeneous (p-value 0.25 and 0.80, respectively).

Table 25. Sociodemographic (age and living allowance) between intervention and control group

Characteristics	Group 1 (n=63)	Group 2 (n=60)	p-value
	Median (Iqr)	Median (Iqr)	
Age	22.00	21.50	0.25
Living allowance	$46.64	$43.31	0.80

*p-value was analyzed by Mann Whitney U test (significant when p-value ≤ 0.05).

In addition, for other sociodemographic factors were analyzed by Chi-Square test because those categorical data. Overall, all sociodemographic characteristics between both groups were homogenous (p-value ≤0.05). Table 26 shows that the participant's hometown had insignificant results. It showed that 59.30% of participants lived in a rural area (p-value=0.213). In addition, 96.70% of participants were Muslim (Islam) (p-value=0.054), 97.60% of them had bachelor degree (p-value=0.244), 63.40% of participants had ≥4 years academic (p-value=0.985). In addition, 69.10% of participants had non health major (p-value=0.568), 78.10% of respondents were single (p-value=0.69).

Table 26. Sociodemographic factors between intervention and control group

Characteristics	Total Participants	Group 1 (n=63)	Group 2 (n=60)	p-value

	(n, %)	n	%	n	%	
Hometown						0.213 ^{C}
Rural	73 (59.30)	34	54.00	39	65.00	
Urban	50 (40.70)	29	46.00	21	35.00	
Religion						0.054^{F}
Islam	119 (96.70)	63	100.00	56	93.30	
Non-Islam	4 (3.30)	0	0	4	6.70	
Education						0.244^{F}
Bachelor	120 (97.60)	60	95.20	60	100.00	
Master	3 (2.40)	3	4.80	0	0	
Academic year						0.985 ^{C}
< 4 years	45 (36.60)	23	36.51	22	36.67	
≥ 4 years	78 (63.40)	40	63.49	38	63.33	
Major of study						0.568^{C}
Health	38 (30.90)	18	28.60	20	33.30	
Non health	85 (69.10)	45	71.40	40	66.70	
Relationship status						0.69^{C}
Single	96 (78.10)	45	71.40	51	85.00	
In relationship/ engage/ Married	27 (21.50)	18	28.60	9	15.00	

**Analysis by C*= Chi-Square test and F = Fisher's Exact test *(significant p-value ≤ 0.05)*

4.7.2 Part 2. Genetic factors among intervention and control group

Table 27 depicts the baseline genetic factors between the intervention and control groups. More than half of the participants stated that they had an overnutrition family. 37.40% of participants said their mother experienced overnutrition (either overweight or obesity). Moreover, Chi-square showed no significant difference between the two groups (p-value=0.89). It means both groups have similar genetic factor distribution.

Table 27. Genetic factors between intervention and control group

Characteristic	**Total Participants (n, %)**	**Group 1 (n=63)**		**Group 2 (n=60)**		**p-value**
		n	**%**	**n**	**%**	
Part 2						
Genetic						0.89
No, they aren't	52 (42.20)	26	41.30	26	43.30	
Yes, my mother	46 (37.40)	23	36.50	23	38.30	
Yes, my father	12 (9.80)	6	9.50	6	10.00	
Yes, both of them	13 (10.60)	8	12.70	5	8.30	

*Analysis by Chi-Square test *(significant p-value ≤ 0.05)*

4.7.3 Part 3. Eating self-efficacy among intervention and control groups

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Eating self-efficacy (ESE) was divided to be four parts named negative emotions (4 questions), availability (2 questions), social pressure (4 questions), physical discomfort (4 questions), and positive activity (4 questions). Most of the participants in both groups had a high level of resisting eating when they experienced negative emotions.

Table 28 shows that to respond to negative emotions, most participants in group 1 had high confidence that they could handle this except when frustrated. Then, most participants in group 1 were not confident in handling food availability. For social pressures, they only had a high level of confidence to say no when someone offered them, while for other items, they had less confidence. Lastly, for resisting eating when participants had physical discomfort and positive activity, the participants had a high confidence level except when they were happy (moderate level).

Table 28. Eating self-efficacy in the intervention group

Characteristics	Group 1 (n=63)		
	Less confident (0-3)	Moderate confident (4-6)	High confident (7-9)
Negative Emotions			
Resist eating when nervous	8 (12.70)	12 (19.05)	43 (68.25)
Resist eating when frustrated	24 (38.10)	17 (26.98)	22 (34.92)
Resist eating when feel angry	10 (15.87)	15 (23.81)	38 (60.32)
Resist eating when experienced failure	13 (20.63)	23 (36.51)	27 (42.86)
Availability			
Resist eating on weekend	15 (23.81)	28 (44.44)	20 (31.75)
Resist eating when variant of food available	25 (39.68)	26 (41.27)	12 (19.05)
Social Pressure			
Resist eating when refuse others	9 (14.29)	23 (36.51)	31 (49.21)
Resist eating when felt impolite	24 (38.10)	20 (31.75)	19 (30.16)
Resist eating Others pursuing to eat	16 (25.40)	32 (50.79)	15 (23.81)
Resist eating when others disappointed	23 (36.51)	29 (46.03)	11 (17.46)
Physical Discomfort			
Resist eating when physically down	22 (34.92)	14 (22.22)	27 (42.86)

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Characteristics	Group 1 (n=63)		
	Less confident (0-3)	**Moderate confident (4-6)**	**High confident (7-9)**
Resist eating when had a broken heart	19 (30.16)	16 (25.40)	28 (44.44)
Resist eating when in pain	18 (28.57)	15 (23.81)	30 (47.62)
Resist eating when feeling uncomfortable	9 (14.29)	24 (38.10)	30 (47.62)
Positive Activity			
Resist eating while watched TV	16 (25.40)	22 (34.92)	25 (39.68)
Resist eating while reading	12 (19.05)	22 (34.92)	29 (46.03)
Resist eating before going to bed	8 (12.70)	12 (19.05)	43 (68.25)
Resist eating when feel happy	15 (23.81)	28 (44.44)	20 (31.75)

Table 29 shows that to respond to negative emotions, physical discomfort, and positive activity, most participants in group 2 had high confidence, but they were less confident in handling when food was available. For social pressures, they only had high confidence to say no when someone offered them, while for other items, their confidence was moderate.

Table 29. Eating self-efficacy of a comparison group

Characteristics	Group 2 (n=60)		
	Less confident (0-3)	**Moderate confident (4-6)**	**High confident (7-9)**
Negative Emotions			
Resist eating when nervous	2 (3.33)	7 (11.67)	51 (85.00)
Resist eating when frustrated	15 (25.00)	13 (21.67)	32 (53.33)
Resist eating when feel angry	5 (8.33)	21 (35.00)	34 (56.67)
Resist eating when experienced failure	15 (25.00)	16 (26.67)	29 (48.33)
Availability			
Resist eating on weekend	10 (16.67)	22 (36.67)	28 (46.67)
Resist eating when variant of food available	23 (38.33)	19 (31.67)	18 (30.00)
Social Pressure			
Resist eating when refuse others	8 (13.33)	22 (36.67)	30 (50.00)
Resist eating when felt impolite	22 (36.67)	23 (38.33)	15 (25.00)
Resist eating Others pursuing to eat	18 (30.00)	25 (41.67)	17 (28.33)
Resist eating when others disappointed	21 (35.00)	30 (50.00)	9 (15.00)

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Characteristics	Group 2 (n=60)		
	Less confident (0-3)	**Moderate confident (4-6)**	**High confident (7-9)**
Physically Discomfort			
Resist eating when physically down	12 (20.00)	10 (16.67)	38 (63.33)
Resist eating when had a broken heart	17 (28.33)	12 (20.00)	31 (51.67)
Resist eating when in pain	20 (33.33)	15 (25.00)	25 (41.67)
Resist eating when feeling uncomfortable	9 (15.00)	18 (30.00)	33 (55.00)
Positive Activity			
Resist eating while watched TV	15 (25.00)	16 (26.67)	29 (48.33)
Resist eating while reading	12 (20.00)	18 (30.00)	30 (50.00)
Resist eating before going to bed	8 (13.33)	5 (8.33)	47 (78.33)
Resist eating when feel happy	13 (21.67)	21 (35.00)	26 (43.33)

Furthermore, we classified the eating self-efficacy scores into three categories to know the level of eating self-efficacy. Because more than 20% of cells had an expected count of less than 5, the Chi-Square test cannot be used and is replaced with an alternative test named Fisher's Exact test.

Table 30 describes that most participants in group 1 had a moderate level of eating self-efficacy while group 2 had a high level. Moreover, there was no significant difference between the two groups in each category of eating self-efficacy (p-value=0.48), which indicated that both groups had similar eating self-efficacy characteristics.

Table 30. Comparison of eating self-efficacy categories between intervention and control groups

Characteristics	Group 1 (n=63)		Group 2 (n=60)		p-value
	n	**%**	**n**	**%**	
Eating self-efficacy					0.090
Moderate (0-108)	40	63.49	29	48.33	
High (109-162)	23	36.51	31	51.67	

Analysis by Chi-Square test (significant p-value $\leq$ 0.05)

4.7.4 Part 4. Behaviour factors among intervention and control group

Table 31 compares the baseline behaviour factors between the intervention and control groups. Overall, the statistical test showed no different behaviour factors between both groups (p-value$\geq$0.05). It showed that both groups had exercise activity,

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

and 56.20% of participants had exercised 1-2 times per week. In addition, 25.20% of participants in group 1 had exercised 30-60 minutes, while 19.50% of respondents in group 2 had <30 minutes. Furthermore, most of the participants in both groups had slept 6-8 hours on average per week (60.10%), never smoked (95.10%), and never drank alcohol (98.40%).

Table 31. Behavior factors between intervention and control group

Characteristics	**Total Participants (n, %)**	**Group 1 (n=63)**		**Group 2 (n=60)**		**p-value**
		n (%)	**%**	**n (%)**	**%**	
Part 4						
Exercise activity						0.437^{C}
No	24 (19.50)	14	22.20	10	16.70	
Yes	99 (80.50)	49	77.80	50	83.30	
Exercise per week						1.000^{F}
$\leq$ 4 times per week	115 (93.50)	58	92.10	55	91.70	
> 4 times per week	10 (6.50)	5	7.90	5	8.30	
Exercise time						0.418^{C}
< 30 minutes	74 (60.20)	29	46.00	32	53.30	
$\geq$ 30 minutes	49 (39.80)	34	54.00	28	46.70	
Sleep time per week						0.675^{F}
$\leq$ 8 hours	118 (95.90)	61	96.80	57	95.00	
> 8 hours	5 (4.10)	2	3.20	3	5.00	
Smoke						1.000^{F}
Never Smoke	117 (95.10)	60	95.20	57	95.00	
Ever Smoke	6 (4.90)	3	4.80	3	5.00	
Drinking alcohol						0.236^{F}
Never Smoke	121 (98.40)	63	100.00	58	96.70	
Ever Smoke	2 (1.60)	0		2	3.30	

**Analysis by C=Chi-Square test, F= Fisher's Exact test (significant p-value $\leq$ 0.05)*

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

4.7.5 Food Frequency

The aim of measuring food frequency is to know the pattern of overnutrition in respondents. There were 15 meals favorite menu, 5 snacks, and 5 sweet beverages—all the menus based on the top menus in phase I.

Table 32 compares meal frequency between the intervention and control groups. Generally, both groups showed a similar trend in 15 menus frequency. It showed that most of the participants in both groups consumed most of the food with similar frequency. For consuming fried rice, intervention group participants consumed less than the control group, while, for omelet consumption, group 1 was more frequently consumed it than group 2. Moreover, the statistical analysis showed no difference between the intervention and control groups (p-value ≤0.05).

Table 32. Meals' frequency comparison between intervention and control group

FFQ	Group 1 (n=63)		Group 2 (n=60)		p-value
	n	%	n	%	
Fried rice					0.354^{C}
< 1time per week	57	90.50	51	87.80	
>1 time per week	6	9.50	9	12.20	
Soto (Yellow chicken soup)					0.923^{C}
< 1time per week	56	88.90	53	88.30	
>1 time per week	7	11.10	7	11.70	
Nasi pecel (Rice with vegetables salad and peanut sauce)					0.119^{C}
< 1time per week	59	93.70	51	85.00	
>1 time per week	4	6.30	9	15.00	
Fried chicken					0.950^{C}
< 1time per week	48	76.20	46	76.70	
>1 time per week	15	23.80	14	23.30	
Fried noodle					0.330^{C}
< 1time per week	58	92.10	52	86.70	
>1 time per week	5	7.90	8	13.30	
Meatball soup					0.302^{C}
< 1time per week	59	93.70	53	88.30	
>1 time per week	4	6.30	7	11.70	
Spicy fried tofu and soy bean fermented					0.563^{C}
< 1time per week	42	66.70	37	61.70	
>1 time per week	21	33.30	23	38.30	
Chicken noodle					0.330^{C}
< 1time per week	58	92.10	52	86.70	
>1 time per week	5	7.90	8	13.30	
Chicken porridge					0.236^{F}
< 1time per week	63	100.00	58	96.70	

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

FFQ	Group 1 (n=63)		Group 2 (n=60)		p-value
	n	%	n	%	
>1 time per week	0	0	2	3.30	
Mix vegetables soup					0.431^{C}
< 1time per week	37	58.70	31	51.70	
>1 time per week	26	41.30	29	48.30	
Single vegetable soup					0.675^{F}
< 1time per week	61	96.80	57	95.00	
>1 time per week	2	3.20	3	5.00	
Rames (White rice with assortment of side dishes)					0.218^{C}
< 1time per week	58	92.10	51	85.00	
>1 time per week	5	7.90	9	15.00	
Chicken satay					0.265^{F}
< 1time per week	61	96.80	55	91.70	
>1 time per week	2	3.20	5	8.30	
Rawon (Spicy beef in black nut soup)					0.236^{F}
< 1time per week	63	100.00	58	96.70	
>1 time per week	0		2	3.30	
Omellete					0.314^{C}
< 1time per week	51	81.00	44	73.30	
>1 time per week	12	19.00	16	26.70	

**Analysis by C=Chi-Square test, F= Fisher's Exact test (significant p-value ≤ 0.05)*

Table 33 compares snack frequency between the intervention and control groups. Generally, it showed that both groups had a similar trend in snack frequency. It shows that most of the participants in both groups consumed corn snack, tapioca snack, and chocolate bar 1-3 times per month, while for biscuit and crackers, the intervention group participants had different levels consumed compared to the control group. Moreover, the statistical analysis showed no difference in snack consumption frequency between the intervention and control groups (p-value ≤0.05).

Table 33. Snack frequency comparison between intervention and control group

FFQ	Group 1 (n=63)		Group 2 (n=60)		p-value
	n	%	n	%	
Biscuit					0.900^{C}
< 1time per week	52	82.50	49	81.70	
>1 time per week	11	17.50	11	18.30	
Crackers					0.713^{C}
< 1time per week	60	95.20	56	93.30	
>1 time per week	3	4.80	4	6.70	
Corn Snacks					0.054^{C}
< 1time per week	63	100.00	56	93.30	
>1 time per week	0		4	6.70	
Tapioca snacks					0.506^{C}

FFQ	Group 1 (n=63)		Group 2 (n=60)		p-value
	n	%	n	%	
< 1time per week	57	90.50	52	86.70	
>1 time per week	6	9.50		13.30	
Chocolate bar					0.432^{F}
< 1time per week	61	96.80	56	93.30	
>1 time per week	2	3.20	4	6.70	

**Analysis by C=Chi-Square test, F= Fisher's Exact test (significant p-value $\leq$ 0.05)*

Table 34 compares sweet beverage frequency between the intervention and control groups. Generally, it showed that both groups had a similar trend in snack frequency. It showed that most participants in both groups recently consumed iced or hot tea and fruit juice 1-3 times per month while for iced milk and Iced coffee with milk and topping, both groups never consumed these menus. In addition, iced milk tea with topping consumption showed that intervention group participants had different levels consumed than the control group. Moreover, the statistical analysis showed no difference in snack consumption frequency between the intervention and control group (p-value $\leq$0.05).

Table 34. Sweet drinks frequency comparison between intervention and control group

FFQ	Group 1 (n=63)		Group 2 (n=60)		p-value
	n	%	n	%	
Iced Thai tea&topping					0.200
< 1time per week	62	98.40	56	93.30	
>1 time per week	1	1.60	4	6.70	
Iced or hot tea					0.151
< 1time per week	52	82.50	43	71.70	
>1 time per week	11	17.50	17	28.30	
Iced milk					1.00
< 1time per week	59	93.70	56	93.30	
>1 time per week	4	6.30	4	6.70	
Fruit juice					0.894
< 1time per week	51	81.00	48	80.00	
>1 time per week	12	19.00	12	20.00	
Iced coffee with milk and topping					0.740
< 1time per week	59	93.70	55	91.70	
>1 time per week	4	6.30	5	8.30	

**Analysis by C=Chi-Square test (significant p-value $\leq$ 0.05)*

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

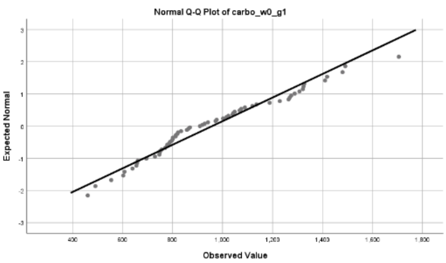
4.7.6 Outcome baseline among intervention and comparison groups

The outcome's baseline consists of dietary intake: carbohydrate, protein, fat, and total calorie, and BMI (weight, height, and BMI scores data). All data was numerical data and we used normality test results to ensure the further test. The normality test results were depicted as follows.

a) Carbohydrate
Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
carbo_w0_g1	.120	63	.025

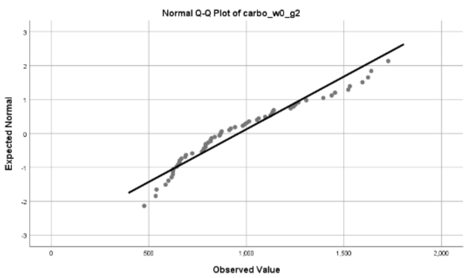
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
carbo_w0_g2	.139	60	.005

a. Lilliefors Significance Correction



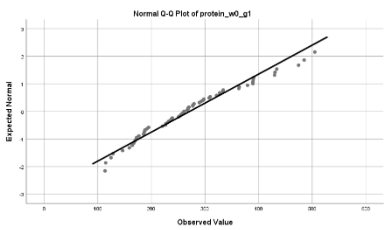
CHULALONGKORN UNIVERSITY

b) Protein
Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
protein_w0_g1	.084	63	.200*

*. This is a lower bound of the true significance.

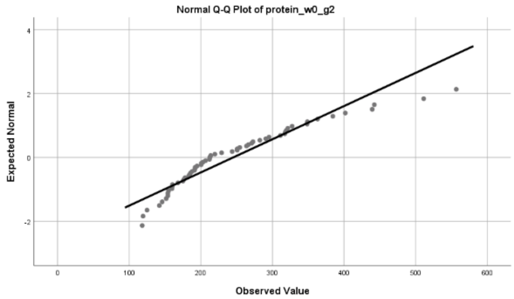
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
protein_w0_g2	.162	60	.000

a. Lilliefors Significance Correction

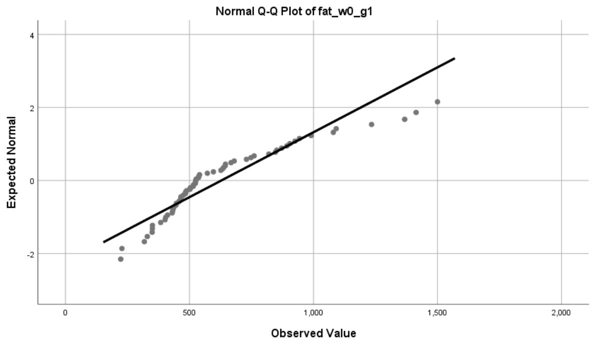


c) Fat

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
fat_w0_g1	.194	63	.000

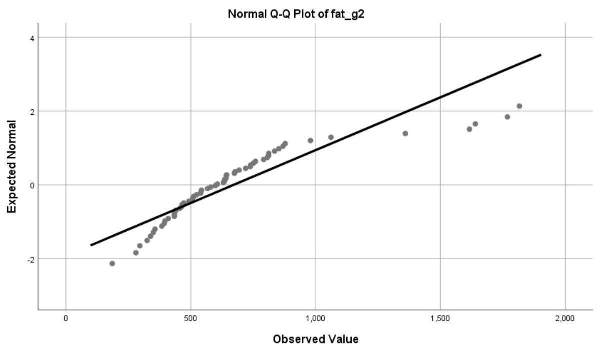
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
fat_g2	.161	60	.001

a. Lilliefors Significance Correction

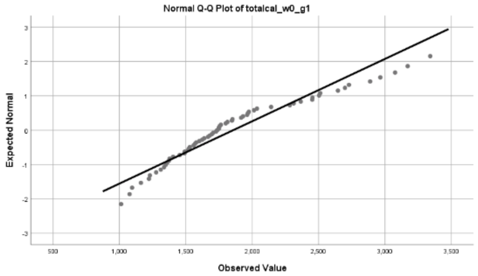


d) Total calories

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
totalcal_w0_g1	.140	63	.004

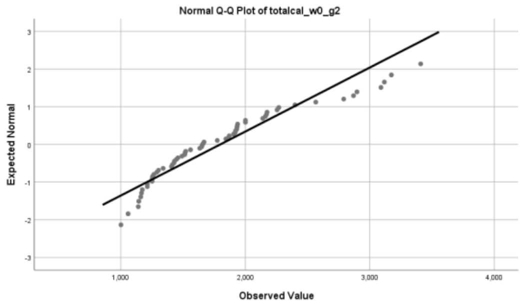
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
totalcal_w0_g2	.124	60	.023

a. Lilliefors Significance Correction



จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

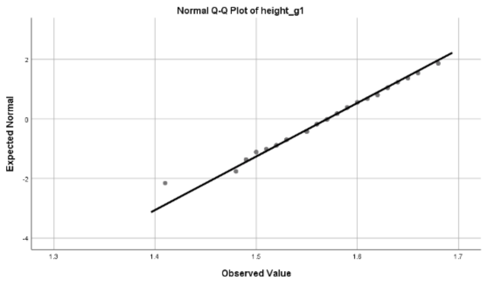
e) Height

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
height_g1	.088	63	.200*

*. This is a lower bound of the true significance.

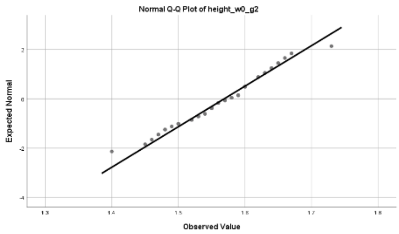
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
height_w0_g2	.112	60	.058

a. Lilliefors Significance Correction

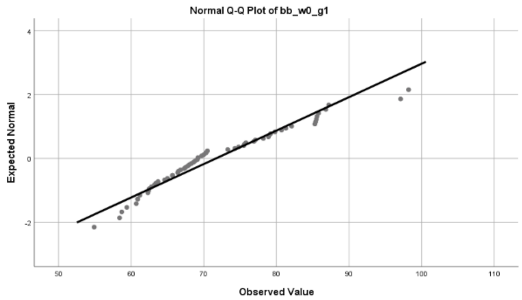


f) Weight

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bb_w0_g1	.152	63	.001

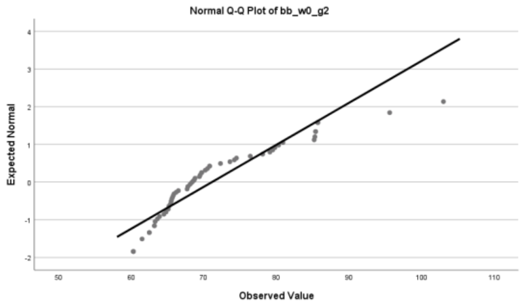
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bb_w0_g2	.198	60	.000

a. Lilliefors Significance Correction

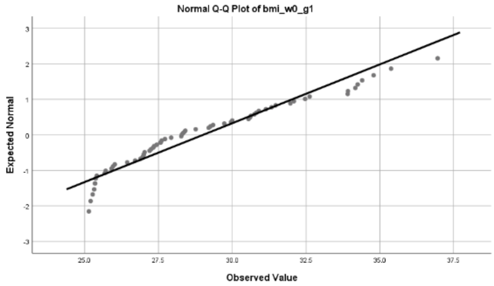


g) BMI

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bmi_w0_g1	.134	63	.006

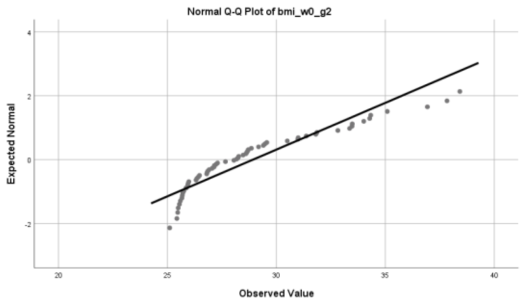
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bmi_w0_g2	.158	60	.001

a. Lilliefors Significance Correction



จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Based on the normality test, it showed that the height used Independent T-Test to analysis the difference between two groups while other outcomes such as dietary intake components and weight and BMI used Mann Whitney U-Test because the data were not normal. Table 35 depicts the height baseline between the intervention and control groups had similar characteristics (p-value>0.05).

Table 35. Height comparison between intervention and control group

Characteristics	Group 1 (n=63)		Group 2 (n=60)		95% CI		p-value
	Mean±SD	Median (Iqr)	Mean±SD	Median (Iqr)	Lower	Upper	
Height, m	1.57±0.06	1.57	1.57±0.06	1.58	1.56	1.58	0.888

* Analysis by Independent T-Test (significant p-value ≤ 0.05)

Then, Table 36 depicts the dietary intake, weight and BMI baseline comparison between the intervention and control groups. Dietary intake had carbohydrate, protein, fat, and total calorie, while BMI had weight and BMI scores. Overall, both groups had similar outcome characteristics (p-value>0.05).

Table 36 shows carbohydrate consumption median in group 1 was 227.320 g while group 2 was 217.043 g (p-value=0.763). The consumption protein median for group 1 was 65.223 g and group 2 was 53.181 g (p-value=0.287). In addition, the median fat consumption and total intake for group 1 were 58.353 g and 1736.49 Kcal, while for group 2 were 56.582 g and 1657.34 Kcal. T-Test analysis showed that total calorie had a p-value >0.05 and Mann-Whitney test results showed no significant difference in the median of carbohydrate, protein, fat weight, height, and Body Mass Index (BMI). BMI between the intervention and control groups was 28.29 and 28.11 (p-value=0.277).

Table 36. Dietary intake, weight and BMI baseline comparison between intervention and control group

Characteristics	**Group 1 (n=63) Median (Iqr)**	**Group 2 (n=60) Median (Iqr)**	**p-value**
Dietary intake			
Carbohydrate, g	227.320	217.043	0.763
Protein, g	65.223	53.181	0.074
Fat, g	58.353	56.582	0.287
Total calorie, Kcal	1736.49	1657.34	0.405
Weight, kg	69.20	68.40	0.702
BMI, kg/m^2	28.29	28.12	0.277

* Analysis by Mann Whitney U test (significant p-value ≤ 0.05)

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

4.8 The output of intervention and control groups after a finished program

After the intervention (installing the Diamond application) for 8 weeks, the outcomes (dietary intake and BMI) were measured again. The results of outcome measurement were explained in three parts as follows.

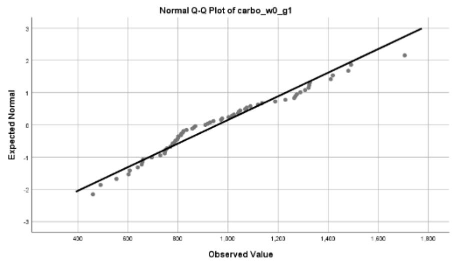
4.8.1 Comparison within group in intervention group

The normality test for data outcome in week 0 and week 9 in intervention group were depicted as follows.

a) Carbohydrate
Week 0:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
carbo_w0_g1	.120	63	.025

a. Lilliefors Significance Correction

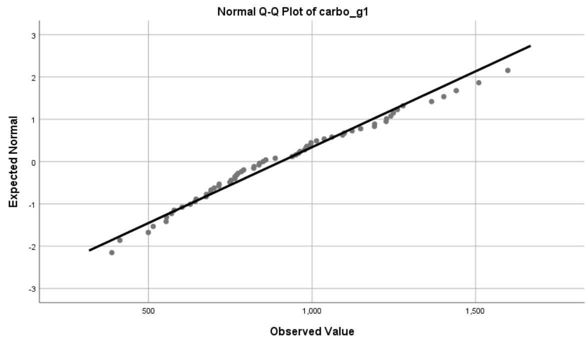


Week 9:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
carbo_g1	.090	63	.200*

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction



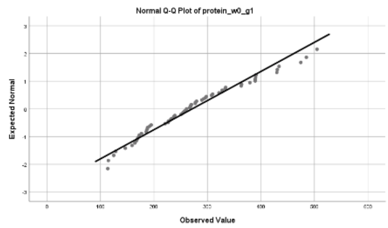
b) Protein

Week 0:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
protein_w0_g1	.084	63	.200*

*. This is a lower bound of the true significance.

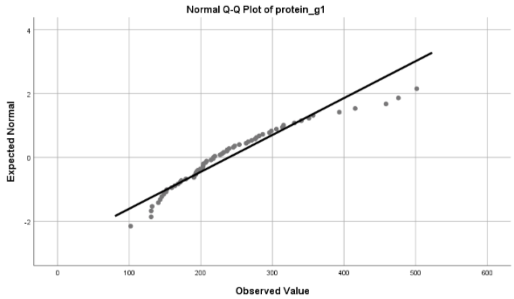
a. Lilliefors Significance Correction



Week 9:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
protein_g1	.118	63	.030

a. Lilliefors Significance Correction

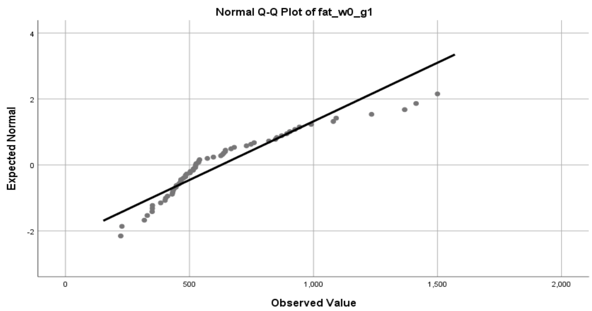


c) Fat

Week 0:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
fat_w0_g1	.194	63	.000

a. Lilliefors Significance Correction

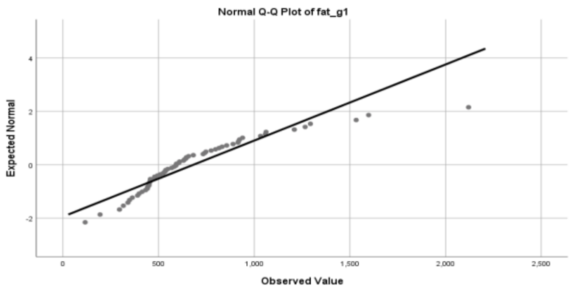


จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Week 9:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
fat_g1	.164	63	.000

a. Lilliefors Significance Correction

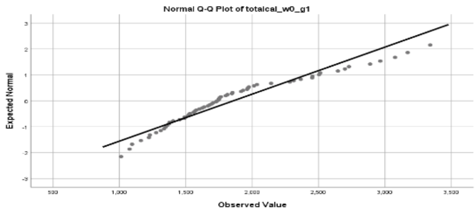


d) Total Calories

Week 0:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
totalcal_w0_g1	.140	63	.004

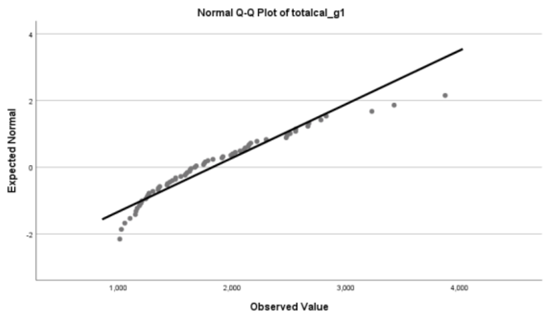
a. Lilliefors Significance Correction



Week 9:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
totalcal_g1	.115	63	.039

a. Lilliefors Significance Correction



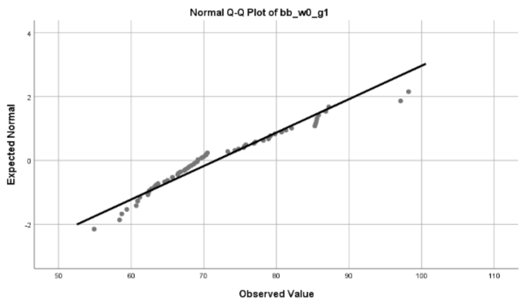
e) Weight

Week 0:

จุฬาลงกรณ์มหาวิทยาลัย

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bb_w0_g1	.152	63	.001

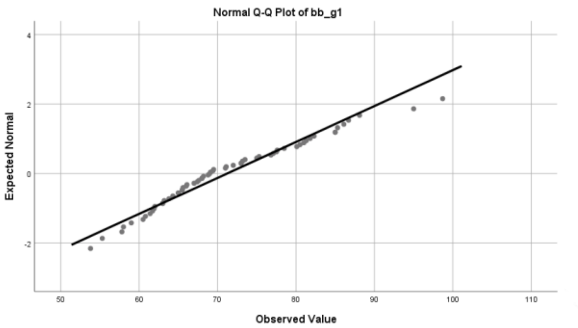
a. Lilliefors Significance Correction



Week 9:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bb_g1	.126	63	.015

a. Lilliefors Significance Correction

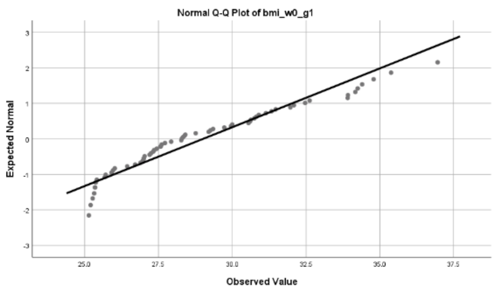


f) BMI

Week 0:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bmi_w0_g1	.134	63	.006

a. Lilliefors Significance Correction



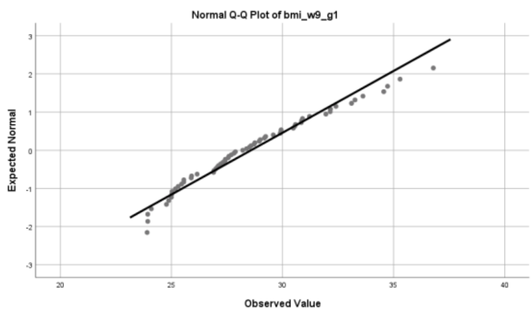
Week 9:

CHULALONGKORN UNIVERSITY

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bmi_w9_g1	.082	63	.200*

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction



Because all outcome data were not normal distribution then we used Wilcoxon Signed Rank Test to examine the difference before and after intervention. Table 37 shows dietary intake before and after intervention among the intervention group. Overall, it showed that participants in the intervention group had significantly different results in protein compared before and after an intervention. After 8 weeks of intervention, there was a decreasing trend in the percentage mean of carbohydrates consumption (227.320 g to 212.664 g), protein (65.223 g to 54.395 g), and total calorie (1736.49 kcal to 1671.86 kcal), while the percentage mean of fat rose from 58.353 g to 65.870 g in the second measurement. In addition, the weight and BMI also reduced slightly Furthermore, the statistical analysis showed that protein, weight, and BMI significantly differed after 8 weeks of intervention (p-value $\leq$0.05).

Table 37. Outcome comparison within the intervention group

Characteristics	**Week 0 Median (Iqr)**	**Week 9 Median (Iqr)**	**p-value**
Dietary intake			
Carbohydrate, g	227.320	212.664	0.096
Protein, g	65.223	54.395	**0.039***
Fat, g	58.353	65.870	0.123
Total calories, Kcal	1736.49	1671.86	0.494
Weight	69.20	69.00	**0.006***
BMI, kg/m^2	28.29	28.13	**0.005***

* Analysis by Wilcoxon signed-rank test (significant p-value $\leq$ 0.05)

4.8.2 Comparison within group in control group

The normality test for data outcome in week 0 and week 9 in control group were depicted as follows.

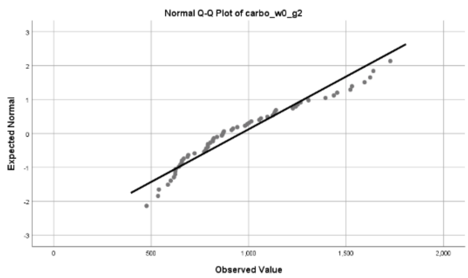
a) Carbohydrate

Week 0:

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNI

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
carbo_w0_g2	.139	60	.005

a. Lilliefors Significance Correction

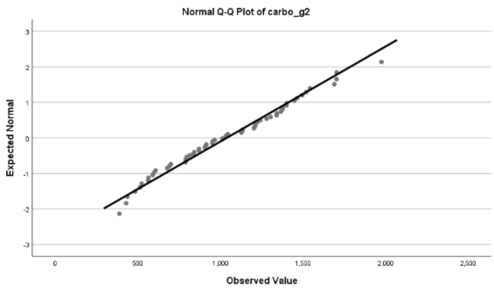


Week 9:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
carbo_g2	.070	60	.200*

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

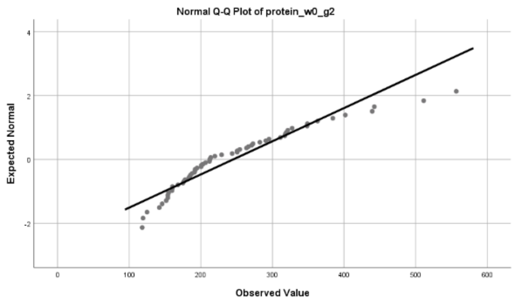


b) Protein

Week 0:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
protein_w0_g2	.162	60	.000

a. Lilliefors Significance Correction

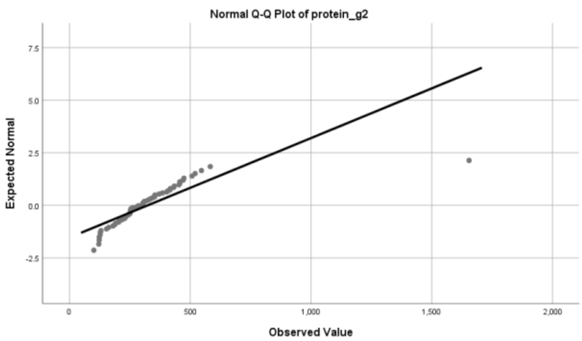


Week 9:

CHULALONGKORN UNIVERSITY

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
protein_g2	.156	60	.001

a. Lilliefors Significance Correction

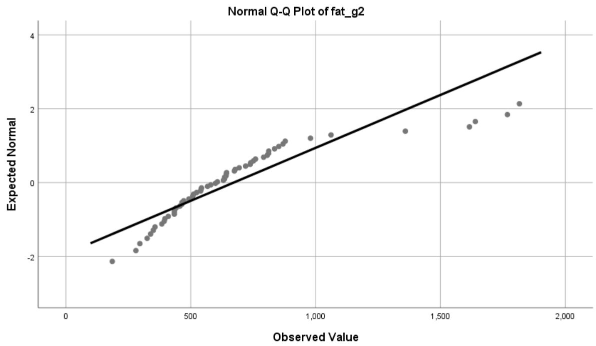


c) Fat

Week 0:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
fat_g2	.161	60	.001

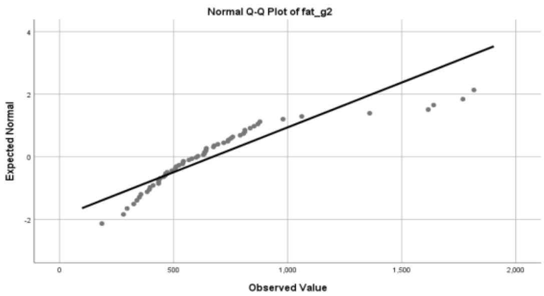
a. Lilliefors Significance Correction



Week 9:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
fat_g2	.161	60	.001

a. Lilliefors Significance Correction

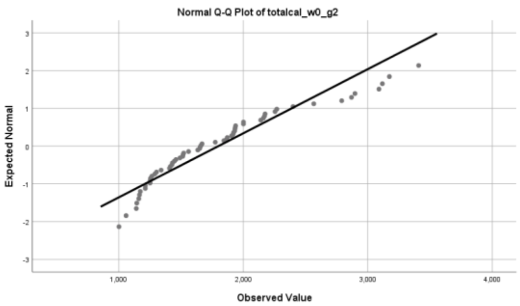


d) Total Calories

Week 0:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
totalcal_w0_g2	.124	60	.023

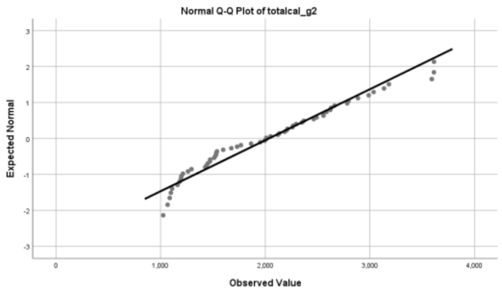
a. Lilliefors Significance Correction



Week 9:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
totalcal_g2	.126	60	.020

a. Lilliefors Significance Correction

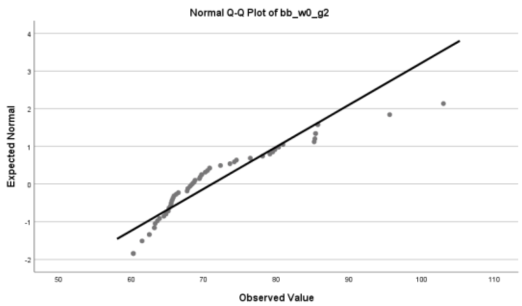


e) Weight

Week 0:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bb_w0_g2	.198	60	.000

a. Lilliefors Significance Correction

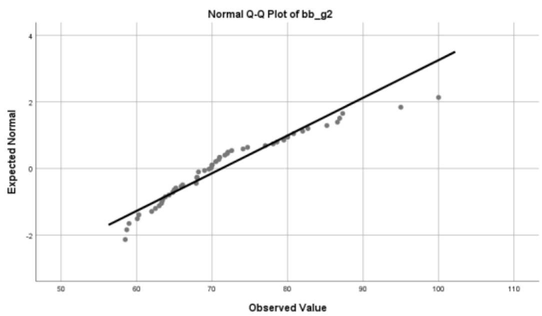


Week 9:

CHULALONGKORN UNIVERSITY

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bb_g2	.162	60	.000

a. Lilliefors Significance Correction

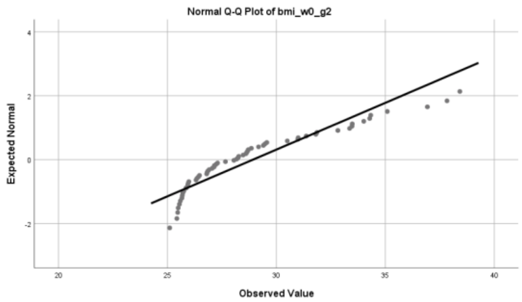


f) BMI

Week 0:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bmi_w0_g2	.158	60	.001

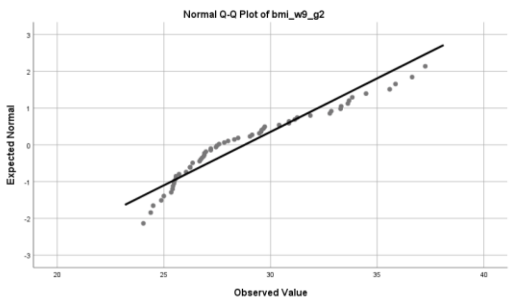
a. Lilliefors Significance Correction



Week 9:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bmi_w9_g2	.153	60	.001

a. Lilliefors Significance Correction



Because all outcome data were not normal distribution then we used Wilcoxon Signed Rank Test to examine the difference before and after intervention. Table 38 shows dietary intake and BMI before and after intervention among the control group. Overall, after eight weeks intervention, respondents in group 2 had significantly different results in fat, protein and total calorie.

After 38 weeks of intervention, for carbohydrates percentage consumption, the median lightly raised from 217.043 g to 254.990 g. This trend was similar with protein (56.582 g to 73.199), fat (53.281 g to 66.970 g) and total calorie (1657.34 Kcal to 2008.27 Kcal). Furthermore, the statistical analysis showed that the p-value for protein and total calorie was $\leq$0.05. In addition, the median value of BMI was

28.11 kg/m^2 and 27.88 kg/m^2, week 0 and week 9, respectively (p-value<0.000). All results were statistically significantly different (p-value≤ 0.01).

Table 38. Outcome comparison within the comparison group

Characteristics	Week 0 Median (Iqr)	Week 9 Median (Iqr)	p-value
Dietary intake			
Carbohydrate, g	217.043	254.990	0.162
Protein, g	56.582	73.199	**0.037***
Fat, g	53.181	66.970	**0.001***
Total calorie, Kcal	1657.34	2008.27	**0.006***
Weight	69.20	69.75	0.497
BMI, kg/m^2	28.11	27.88	0.561

* Analysis by Wilcoxon signed rank Test (significant p-value ≤ 0.05)

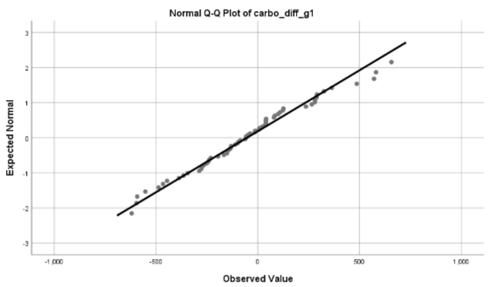
4.8.3 Comparison between intervention and control group

The normality test for data outcome in week 0 and week 9 in control group were depicted as follows.

a) Carbohydrate
Group 1:

	Kolmogorov-Smirnov^a		
	Statistic	df	Sig.
carbo_diff_g1	.087	63	.200*

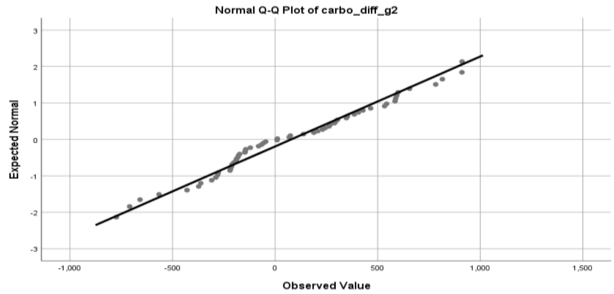
*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov^a		
	Statistic	df	Sig.
carbo_diff_g2	.107	60	.084

a. Lilliefors Significance Correction

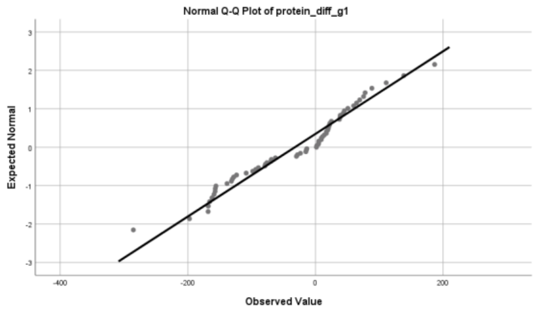


b) Protein

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
protein_diff_g1	.149	63	.001

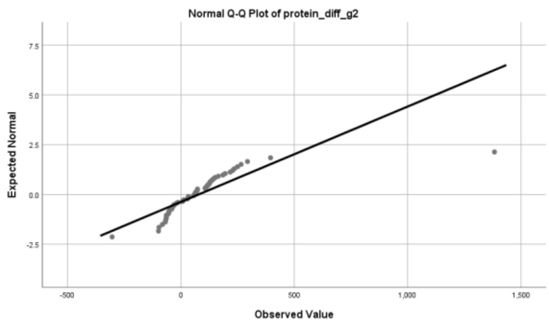
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
protein_diff_g2	.181	60	.000

a. Lilliefors Significance Correction

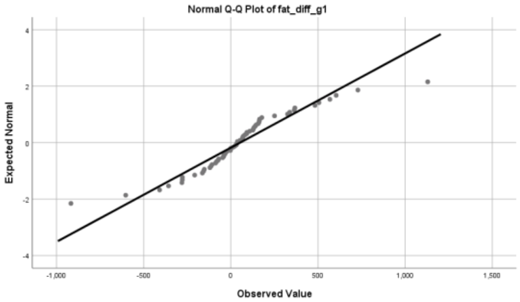


c) Fat

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
fat_diff_g1	.165	63	.000

a. Lilliefors Significance Correction

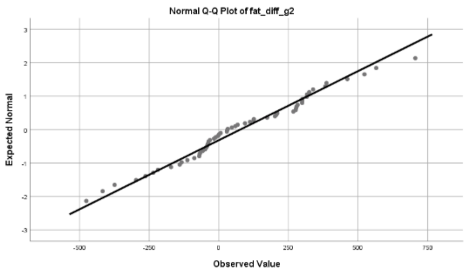


Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
fat_diff_g2	.090	60	.200*

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction



CHULALONGKORN UNIVERSITY

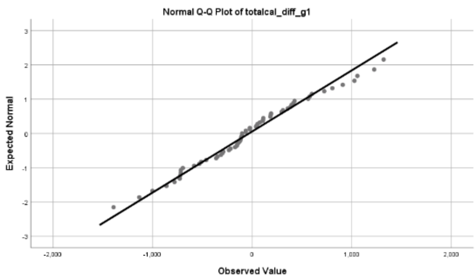
d) Total Calories

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
totalcal_diff_g1	.082	63	.200*

*. This is a lower bound of the true significance.

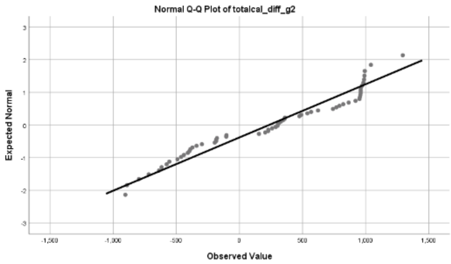
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
totalcal_diff_g2	.112	60	.057

a. Lilliefors Significance Correction

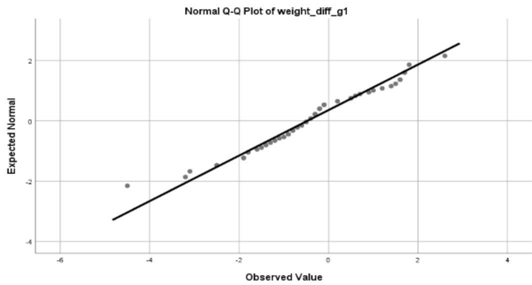


e) Weight

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
weight_diff_g1	.119	63	.026

a. Lilliefors Significance Correction

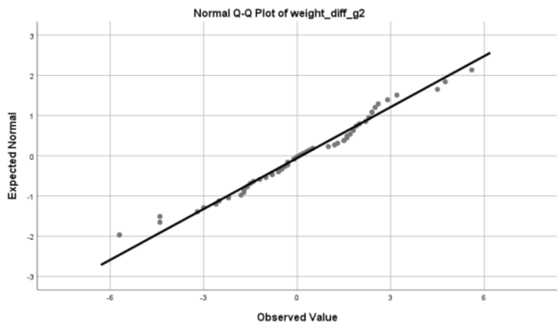


Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
weight_diff_g2	.085	60	.200*

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction



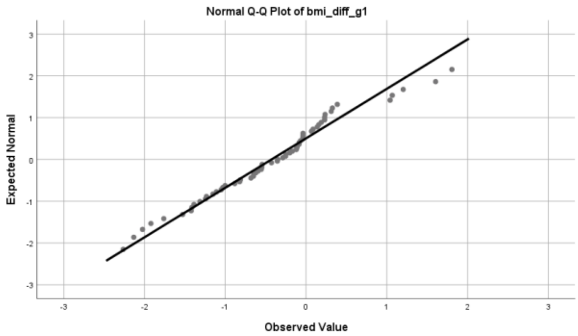
f) BMI

Group 1:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bmi_diff_g1	.091	63	.200*

*. This is a lower bound of the true significance.

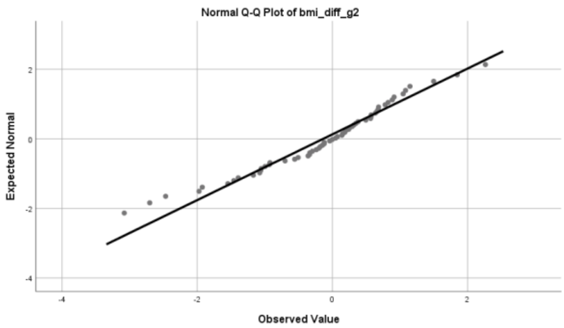
a. Lilliefors Significance Correction



Group 2:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
bmi_diff_g2	.116	60	.043

a. Lilliefors Significance Correction



CHULALONGKORN UNIVERSITY

Table 39 describes the changing value of carbohydrate and total calorie between the intervention and control groups. All data in this section were normal distribution. Overall, carbohydrate and total calorie changing values were significantly different between the intervention and control groups (p-value≤0.05). The percentage mean and SD difference value of carbohydrate at -52.82±288.09 g and 78.09±405.33 g (p-value<0.042) and total calorie at -31.70±561.22 Kcal and 233.79±613.73 Kcal (p-value=0.014), respectively.

Table 39. Carbohydrate and Total calorie changing value comparison between intervention and control groups

Characteristics	Group 1 (n=63)		Group 2 (n=60)		95% CI		p-value
	Mean+SD	Median (Iqr)	Mean+SD	Median (Iqr)	Lower	Upper	
Carbohydrate, g	-13.21+72.02	-14.38	19.52+101.33	10.20	-64.29	-1.164	**0.042***
Total calorie, Kcal	-31.70+561.22	-100.93	233.79+613.73	303.38	-475.27	-55.72	**0.014***

* Analysis by Independent T-Test (significant p-value ≤ 0.05)

Furthermore, Other variables such as protein, fat and BMI used Mann Whitney U test to examine the different changing between two groups. Table 40 represents the difference in protein, fat, weight and BMI between the intervention and control groups. Generally, the result showed that protein, weight and BMI were significantly different between the intervention and control groups. with the percentage mean difference value of carbohydrate at -13.205 g and 19.523 g (p-value<0.042), the median difference value of protein at 0.368 g and 15.049 g (p-value<0.000) and total calorie at -31.70 Kcal and 233.79 Kcal (p-value=0.014), respectively. While the fat median showed no significant differences between groups. The changing median of fat in both groups were 4.176 g and 3.457 g (p-value=0.649), respectively.

Overall, the difference between BMI and weight for both groups had significantly different. Group 1 had a changing median weight value of -0.50 kg while BMI was -0.35 kg/m^2. Then, group 2 had a changing median weight value was 0.05 kg and BMI was 0.02 kg/m^2. In addition, statistical results showed that both variables (weight and BMI) had p-value=0.006 and 0.008, respectively (p-value>0.05).

Table 40. Dietary intake (Protein, fat), weight and BMI comparison between intervention and control group

Characteristics	Group 1 (n=63) Median (Iqr)	Group 2 (n=60) Median (Iqr)	p-value
Dietary intake			
Protein, g	0.37	15.05	**<0.000***
Fat, g	4.176	3.347	0.649
Weight, kg	-0.50	0.05	**0.006***
BMI, kg/m^2	-0.35	0.02	**0.002***

* Analysis by Mann Whitney test (significant p-value ≤ 0.05)

4.9 Compared to the Dietary Reference Intake (DRI)

Comparing the results with DRI will ensure that this research's reducing dietary intake is proper or adequate with nutrient intake standards. Each component of dietary intake per group was explained in detail as follows.

Carbohydrate Consumption

a. Intervention group

Pie charts showed a difference in carbohydrate consumption distribution from week 0 to week 9 among the intervention group. Participants who consumed carbohydrates more than Acceptable Macronutrient Distribution Range (AMDR) (>65%) reduced from 6% in week 0 to be half in week 9, and participants who had carbohydrate intake <45% increased from 19% to 22% during 8 weeks, while the distribution for participants who had normal portion remained stable in 75%.

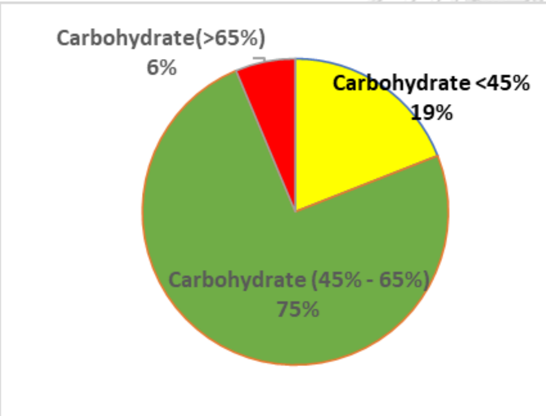


Figure 28. Carbohydrate consumption distribution in intervention group in week 0

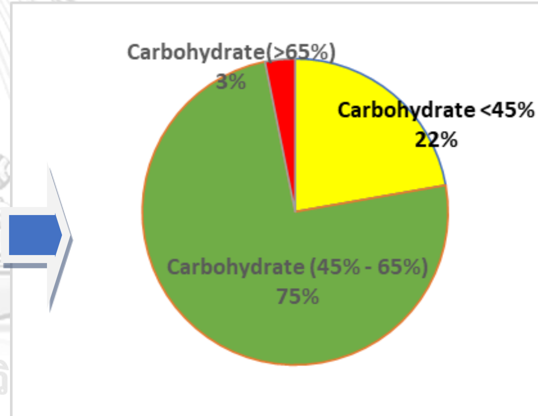


Figure 29. Carbohydrate consumption distribution in intervention group in week 9

b. Control group

Pie charts showed a different carbohydrate consumption distribution from week 0 to week 9 among the comparison group. Participants who consumed carbohydrates more than AMDR (>65%) slightly reduced from 12% in week 0 to 8% in week 9. This trend was followed by participants who had normal portions declining from 73% in week 0 to 68% in week 9, while participants who had carbohydrate intake <45% increased from 15% to 24% during 8 weeks.

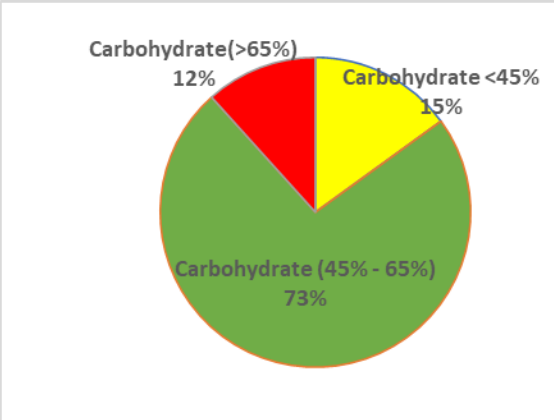


Figure 30. Carbohydrate consumption distribution in control group in week 0

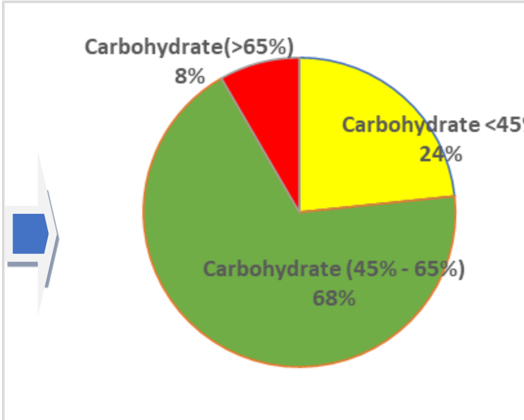


Figure 31. Carbohydrate consumption distribution in control group in week 9

Fat consumption

a. Intervention group

These graphs depict the intervention group's fat consumption distribution from week 0 to week 9. Participants who consumed fat over AMDR (>35%) increased from 38% in week 0 to 56% in week 9. In contrast, participants who consumed fat in normal portions (20% - 35%) went down approximately 18% during 8 weeks, while the distribution for participants who had less fat intake (<20%) remained stable at 3%.

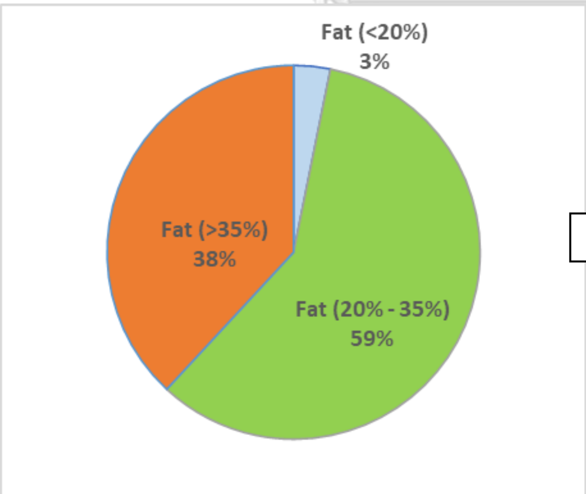


Figure 32. Fat consumption distribution in intervention group in week 0

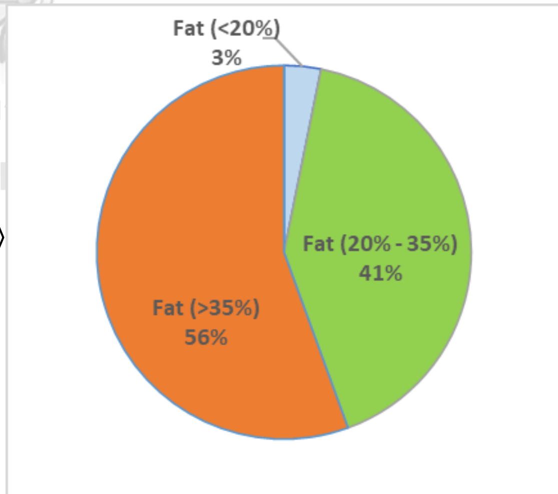


Figure 33. Fat consumption distribution in intervention group in week 9

b. Control group

These graphs depicted a different fat consumption distribution from week 0 to week 9 among the comparison group. Participants who consumed fat over AMDR (>35%) increased from 31% in week 0 to 33% in week 9. In contrast, participants who had less fat intake (<20%) went down approximately 2% during 8 weeks, while participants who consumed fat in normal portion (20% - 35%) distribution had remained stable at 62%.

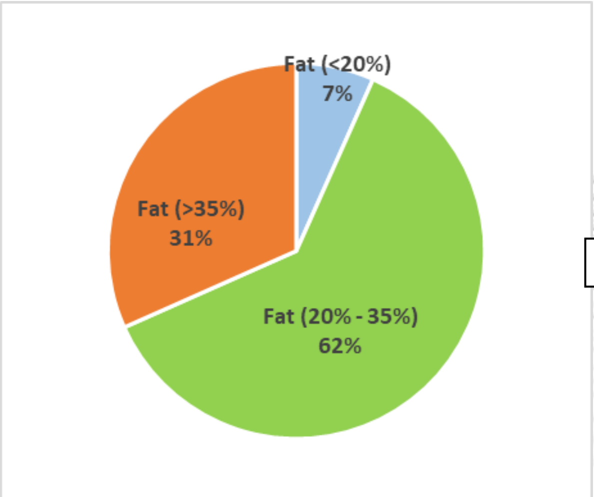


Figure 34. Fat consumption distribution in control group in week 0

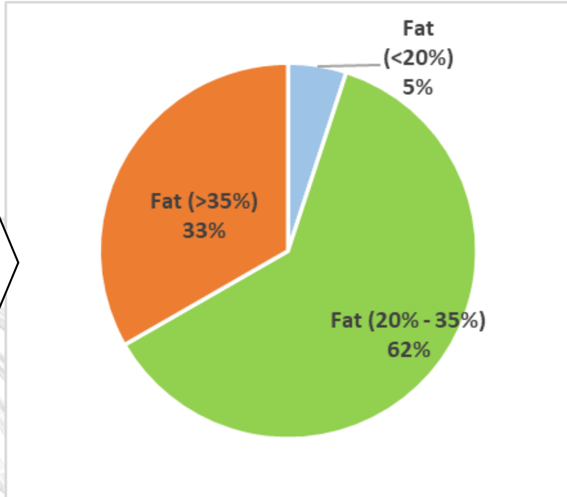


Figure 35. Fat consumption distribution in control group in week 9

Protein consumption

a. Intervention group

Pie charts represent that there was different protein consumption distribution from week 0 to week 9 among the intervention group. Participants who consumed protein less than AMDR (<10%) increased from 8% in week 0 to 13% in week 9. In contrast, participants who consumed protein in normal portions (20% - 35%) lightly decreased from 92% to 87% at the end of the intervention period, while there was no distribution for participants who had protein consumption (>35%) during 8 weeks intervention.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

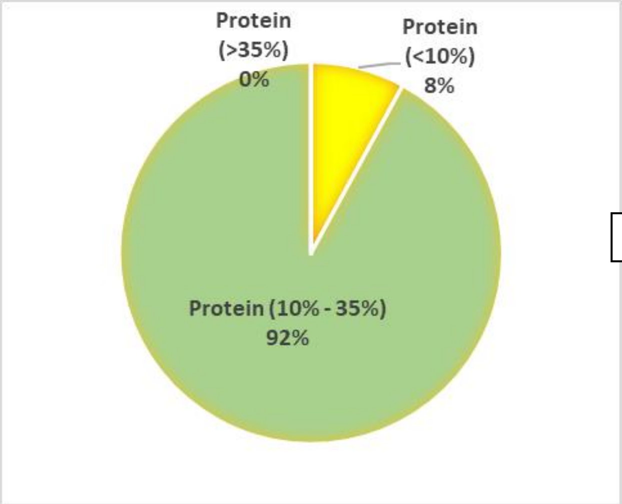


Figure 36. Protein consumption distribution in the intervention group in week 0

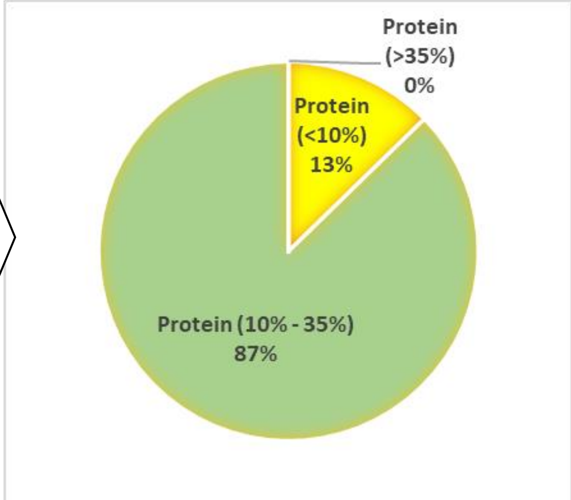


Figure 37. Protein consumption distribution in the intervention group in week 9

b. Control group

Pie charts depict the comparison group's different protein consumption distributions from week 0 to week 9. Participants who consumed protein in normal portions (10%-35%) increased from 83% in week 0 to 90% in week 9, followed by participants who consumed protein consumption (>35%), which also increased by 2% during 8 weeks of intervention. In contrast, participants who consumed protein <10% had decreased from 17% to 8% at the end of the intervention period.

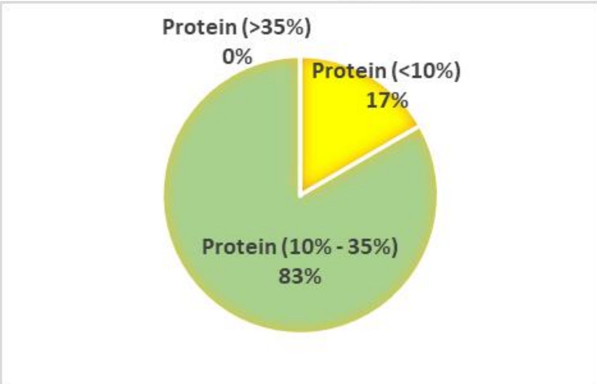


Figure 38. Protein consumption distribution in the control group in week 0

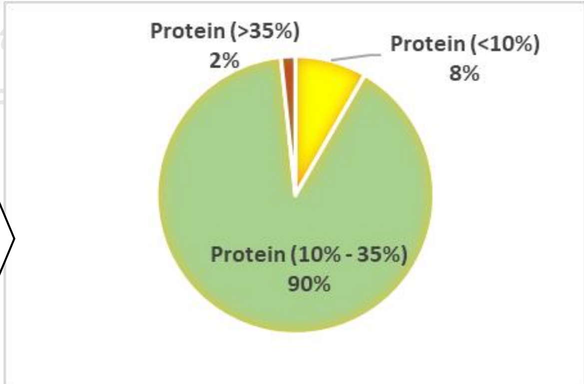


Figure 39. Protein consumption distribution in the control group in week 9

Calorie intake

a. Intervention group

The pie charts show the intervention group's total calorie consumption distribution from week 0 to week 9. The participants who consumed more than recommended calories for Indonesian female in19-29 years old (> 2250 Kcal) had lightly decreased from 24% in week 0 to 21% in week 9. While participants who consumed calories as RDA increased from 76% to 79% at the end period.

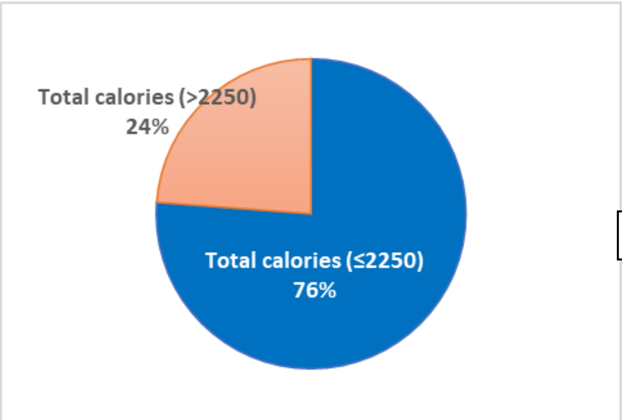


Figure 40. Total calorie consumption distribution in the intervention group in week 0

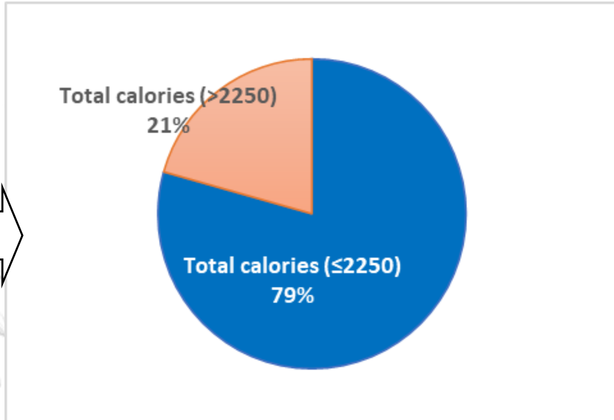


Figure 41. Total calorie consumption distribution in the intervention group in week 9

b. Control group

The pie charts display the total calorie consumption distribution from week 0 to week 9 among the control group. The participants who consumed more than Indonesian recommended calories consumption for female in 19-29 years old (>2250 Kcal) remained stable at 18% during 8 weeks, followed by participants who consumed <u><</u>2250 Kcal.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

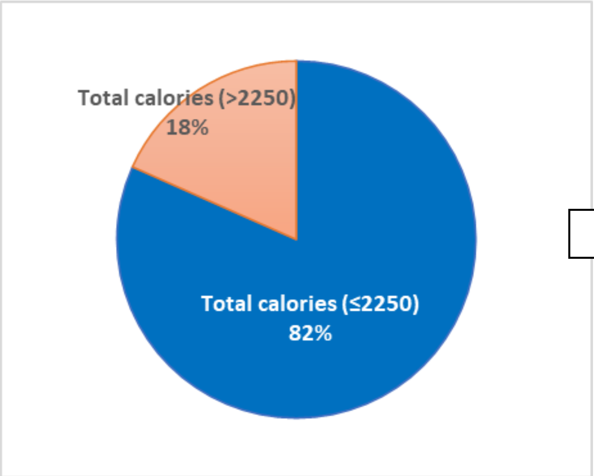


Figure 42. Total calorie consumption distribution in the control group in week 0

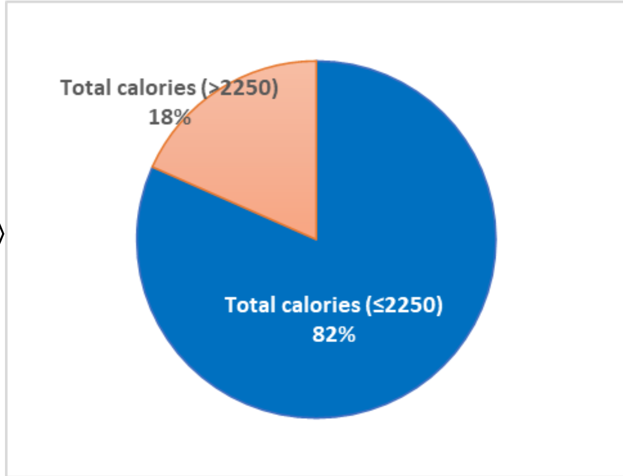


Figure 43. Total calorie consumption distribution in the control group in week 9

4.10 Engagement of Diamond application and its association with outcome

Regarding the results of Firebase Analysis (program to monitoring users of Diamond application activity), participants' activities in an application can be analyzed and classified into three categories. Table 28 shows Diet Monitoring (Diamond) application engagement levels among the intervention group (63 participants). The engagement level is based on the percentile of data. Overall, after 8-weeks using a Diamond application, most participants achieved a high level of opening reminders and meal diary features, while for quiz participation and quiz mean score.

จุฬาลงกรณ์มหาวิทยาลัย

Table 39 depicts those participants distributed equally at all levels. Users had a high level for an opening reminder (42.90%) and meal graph (36.50%). It shows that the participants were enthusiastic about using the Diamond application to assist them in managing their weight. While participants had lower levels for quiz participation and quiz mean score. It peaked at 52.40% and 63.50%, respectively.

Table 41. Engagement of Diamond application level

Engagement component	Participant's number	
	n	%
Opening reminder		
(≤60.79)	10	15.90
(60.80-77.05)	26	41.30
(>77.05)	27	42.90
Meal diary		
(≤51.02)	20	31.70
(51.03-77.05)	20	31.70
(>77.05)	23	36.50
Quiz participation		
(≤25.00)	33	52.40
(25.01-75.00)	4	6.30
(>75.00)	26	41.30
Quiz mean score		
(≤25.00)	40	63.50
(25.01-50.57)	16	25.40
(>50.57)	7	11.10
Engagement score		
(≤49.40)	21	33.30
(49.41-74.12)	21	33.30
(>74.12)	21	33.30

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

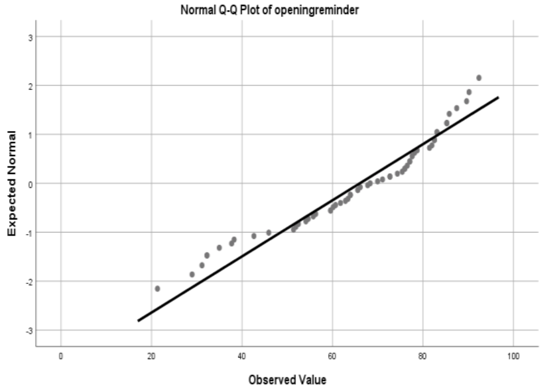
Furthermore, we analyzed the correlation between engagement and the outcome of this study.

1. Engagement Variables

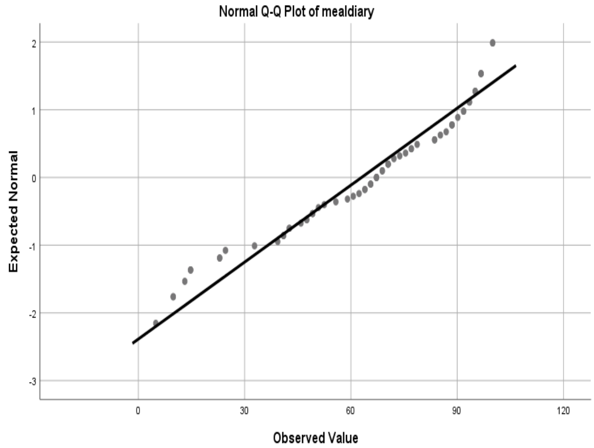
	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
openingreminder	.117	63	.031
mealdiary	.101	63	.175
meanofscore	.198	63	.000
quizparticipation	.268	63	.000
engagement	.101	63	.185

a. Lilliefors Significance Correction

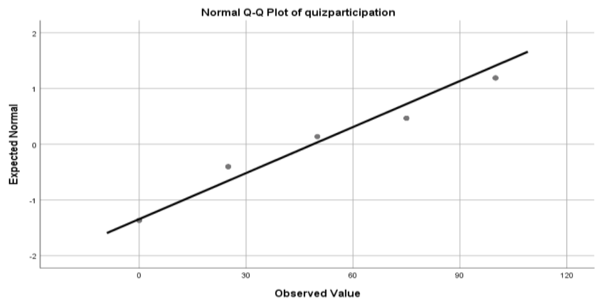
a) Opening Reminder



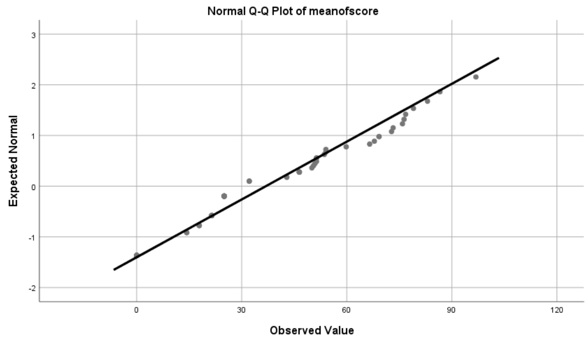
b) Meal Diary



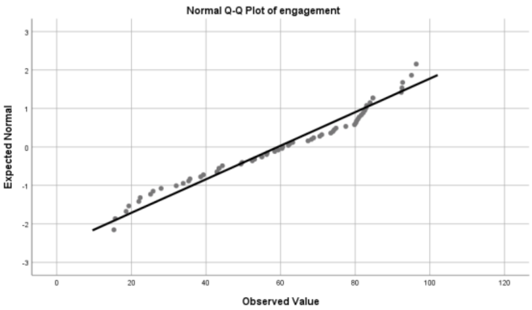
c) Quiz Participation



d) Mean score of Quiz



e) Engagement



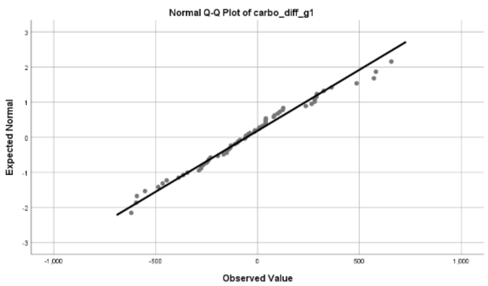
2. Difference of Dietary Intake and BMI

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
selisihcarbo_g1	.087	63	.200*
selisihfat_g1	.165	63	.000
selisihprotein_g1	.149	63	.001
selisihtotalcal_g1	.082	63	.200*
selisihbb_g1	.119	63	.026
selisih_bmi_g1	.091	63	.200*

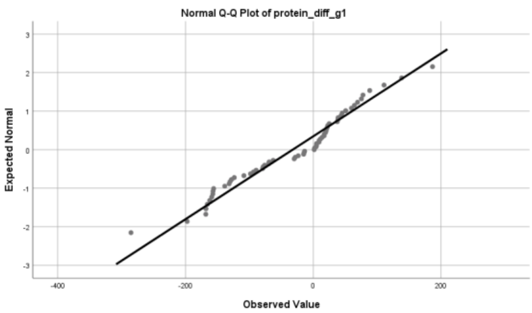
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

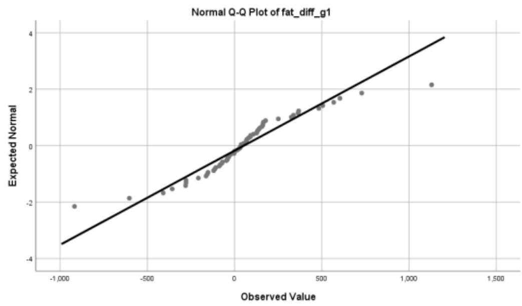
a) Carbohydrate



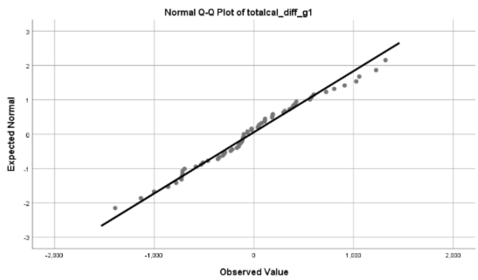
b) Protein



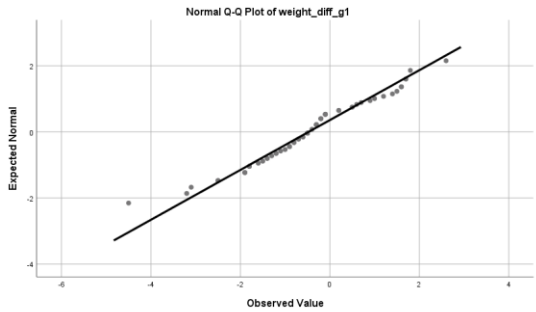
c) Fat



d) Total calories

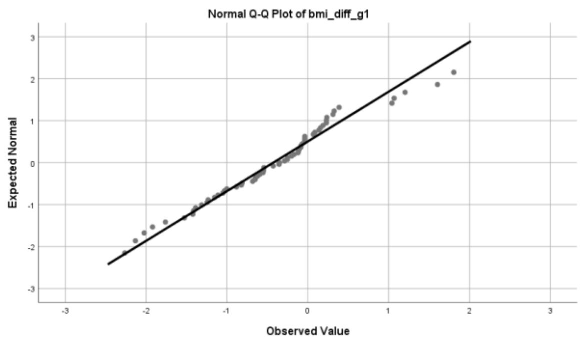


e) Weight



f) BMI

จุฬาลงกรณ์มหาวิทยาลัย



After the normality test, it showed that the analysis divided to Pearson correlation test and Spearman correlation test. Table 42 displays the correlation between engagement components (meal diary and engagement) and dietary intake (carbohydrate, total calorie) and BMI among Diamond application users. The data in this session were normal distribution so we used Pearson correlation test to examine the correlation between variables. Generally, meal diary feature had correlation with total calorie (p value=0.013), while other components were experienced differently. It showed that even low correlation, the meal diary had negative correlation with fat consumption. The more the users used the meal diary, the less they consumed food calories.

Table 42. Correlation between the engagement of Diamond Application with dietary intake

Variable	R	95%CI		p-value
		Lower	Upper	
Carbohydrate				
Meal Diary	-0.384	-2.509	.415	0.157
Engagement	0.182	-1.109	2.255	0.498
Total Calories				
Meal Diary	-0.658	-24.932	-3.038	**0.013***
Engagement	0.397	-2.876	22.322	0.128
BMI				
Meal Diary	0.059	-0.016	0.019	0.830
Engagement	0.071	-0.018	0.023	0.796

*Analysis by Pearson test (Significant p-value ≤0.05)

In addition, Table 43 represented the Spearman correlation of a diamond application engagement with dietary components (fat, protein), weight and BMI among the intervention group. Overall, there was correlation between meal diary and fat (p value=0.020) while for other variables there were no correlation. It can be seen that even low correlation, the meal diary had negative correlation with fat consumption. The more the users used the meal diary, the less they consumed fat.

Table 43. Correlation between engagement components with weight and BMI

Variable	R	p-value
Carbohydrate		
Opening reminder	-0.207	0.104
Quiz participation	-0.045	0.729
Mean score of quiz	-0.004	0.975
Fat		
Opening reminder	-0.207	0.104
Meal diary	-0.292	**0.020***
Quiz participation	-0.044	0.735
Mean score of quiz	-0.020	0.874
Engagement	-0.189	0.138
Protein		
Opening reminder	-0.204	0.109

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Variable	R	p-value
Meal diary	-0.193	0.129
Quiz participation	0.153	0.318
Mean score of quiz	0.128	0.232
Engagement	-0.036	0.778
Total Calorie		
Opening reminder	-0.230	0.070
Quiz participation	0.001	0.993
Mean score of quiz	0.043	0.738
Weight		
Opening reminder	0.130	0.310
Meal diary	0.031	0.811
Quiz participation	-0.097	0.450
Mean score of quiz	-0.099	0.438
Engagement	-0.032	0.806
BMI		
Opening reminder	0.158	0.216
Quiz participation	0.026	0.837
Mean score of quiz	0.040	0.755

*Analysis by Spearman Rho Test (Significant p-value ≤0.05)

Furthermore, using percentiles, we classified three categories of engagement components and categorized outcomes as two categories (mean score). Then, we analyzed it using binary logistics to know the association of engagement components and outcomes. There were five outcomes associated with engagement determinants as follows.

a. Engagement components associated with carbohydrate

Table 44 shows an association between engagement determinants with carbohydrates. Generally, it showed a significant association between quiz mean scores with carbohydrates (p-value=0.045) with odd ration 2.157. It means that the higher score of quiz the odd to being carbohydrate reduce 2.157 times compared with users had low score in quiz participation.

Table 44. Association between engagement determinants with carbohydrates

Variable	β	OR	95%CI		p-value
			Lower	Upper	
Opening reminder	0.503	1.654	0.347	7.872	0.528
Meal diary	0.172	1.188	0.229	6.160	0.837
Quiz participation	1.390	1.390	0.048	335.415	0.538
Mean score of quiz	-2.157	-2.157	0.014	0.954	0.045*

Variable	β	OR	95%CI		p-value
			Lower	Upper	
Engagement	-1.624	-1.624	0.008	4.791	0.318

**Analysis by binary logistic (significant p-value ≤0.05)*

b. Engagement components associated with fat

Table 45 shows an association between engagement determinants with fat. This table showed that there was not any significant association between all components with fat intake.

Table 45. Association between engagement determinants with fat

Variable	β	OR	95%CI		p-value
			Lower	Upper	
Opening reminder	-0.116	0.891	0.214	3.708	0.873
Meal diary	0.286	1.331	0.273	6.483	0.723
Quiz participation	0.231	1.260	0.019	83.572	0.914
Mean score of quiz	-0.420	0.657	0.097	4.469	0.668
Engagement	1.514	4.543	0.275	75.119	0.290

**Analysis by binary logistic (significant p-value ≤0.05)*

c. Engagement components associated with protein

Table 46 shows an association between engagement determinants with protein. This table showed that there was not any significant association between all components with protein intake.

Table 46. Association between engagement determinants with protein

Variable	β	OR	95%CI		p-value
			Lower	Upper	
Opening reminder	0.370	1.447	0.302	6.928	0.644
Meal diary	1.280	3.598	0.536	24.153	0.188
Quiz participation	1.298	3.664	0.000	-	1.000
Mean score of quiz	-0.694	0.500	0.057	4.402	0.532
Engagement	19.674	350066049.5	0.000	-	0.999

**Analysis by binary logistic (significant p-value ≤0.05)*

d. Engagement components are associated with total calorie

Table 47 shows an association between engagement determinants with total calorie. This table showed no significant association between all components and total calorie intake.

Table 47. Association between engagement determinants with total calorie

Variable	β	OR	95%CI		p-value
			Lower	Upper	
Opening reminder	0.130	1.139	0.259	5.017	0.863
Meal diary	0.679	1.972	0.372	10.444	0.425
Quiz participation	1.421	4.140	0.065	263.071	0.502
Mean score of quiz	-1.710	0.181	0.024	1.357	0.096
Engagement	-0.330	0.719	0.048	10.8333	0.812

**Analysis by binary logistic (significant p-value ≤0.05)*

e. Engagement components associated with BMI

Table 48 shows an association between engagement determinants with BMI. This table showed no significant association between all components with BMI.

Table 48. Association between engagement determinants with BMI

Variable	β	OR	95%CI		p-value
			Lower	Upper	
Opening reminder	-0.810	0.445	0.106	1.874	0.270
Meal diary	0.113	1.120	0.226	5.552	0.890
Quiz participation	-2.520	0.080	0.001	5.535	0.243
Mean score of quiz	-0.521	0.594	0.082	4.306	0.606
Engagement	1.321	3.748	0.214	65..675	0.366

**Analysis by binary logistic (significant p-value ≤0.05)*

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

CHAPTER V
DISCUSSION

5.1 Phase I discussion

5.1.1 Demographic factors associated with BMI among female university students

There were three factors associated with BMI among this research survey participants. First, age is significantly associated with weight, a component of BMI. From adolescence to old age, the weight will be prone to increase, and without any control, it can lead to overweight or obesity (Poobalan Amudha and Aucott, 2016). Another research stated that it is normal when you get older, and your body changes, such as changes in area and amount of body fat. The changes were followed by behavioral changes in diet and physical activity (Alberga et al., 2012). In addition, The overnutrition predominance among preschool kids was lower than among youngsters (Shan et al., 2010). The next factor associated with BMI in this study was living arrangement. Similar to this study, university students in India who stayed apart from their parents or guardians were associated with obesity (Pengpid Supa and Peltzer, 2014). They related a high frequency of eating out with an unhealthy diet pattern, such as irregular eating and less nutritious food consumed (Hu et al., 2016, Llanaj et al., 2018). Commonly junk food was their first option, and this kind of food can cause weight gain and contribute to a high BMI if consumed excessively (Larson Nicole I et al., 2016). Then the third factor was the length of stay. Length of stay in the study has a significant relationship with BMI. It supported by a study in Japan, the physical activity of first and second-year students (<3.5 years) was higher than the following year's students or those who are ≥3.5 years (Wei Chang-Nian et al., 2012). This condition can lead to increased BMI.

Although the Chi-square result showed no association between major study and BMI among participants, the preliminary study showed that participants in health science who experienced overnutrition were less than non-health science students. It showed that health knowledge, mainly regarding nutrition, controlled BMI (Yahia Najat et al., 2015). Furthermore, living allowance was proven to be not associated with BMI. However, according to research conducted by (Kolawole Afolabi Kamaldeen et al., 2017) and (Li Lian et al., 2017), living allowance is a risk factor for an unhealthy diet and obesity. Living allowance is one reason university students choose food to eat, and fast food is their favorite because the prices are friendly for university students (Ukegbu et al., 2019).

5.1.2 The mobile application usage among female university students

Based on the survey, most Indonesian female young adults used Android. Android was a favorite because of the fast system upgrade, and Android wins in some aspects (Barea Abimael et al., 2013, Sheikh Aijaz Ahmad et al., 2013) and the more affordable price with exclusive features (Soegoto Herman, 2019). Then, Android is also accompanied by various model choices because Android is not limited to one smartphone brand, while IOS is only for Apple (Al-Qershi Fattoh et al., 2014). Like some countries such as Turkey, the USA, and South Korea, most students were Android users (Kocakoyun Senay and Bicen, 2017, Heejin Kim et al., 2020). In addition, the results depicted that they used smartphones for approximately 9 hours per day. According to (Twenge Jean M et al., 2018) research, the duration of smartphone use was divided into three parts: low usage (0-3 hours), moderate usage (4-7 hours), and high usage (>7 hours). It shows that the use of smartphones in Indonesia was relatively high. Research conducted by (Alosaimi Fahad D. et al., 2016) showed that adolescence in Saudi Arabia has a duration of smartphone usage almost the same as adolescents in Indonesia, which is >8 hours. The higher phone usage will impact psychological disorders, such as smartphone dependence (Bae Sung Man, 2017). Also, other psychological problems that will arise due to the higher use of smartphones are depression, anxiety, and dysfunction during the day (Demirci Kadir et al., 2015). In addition, it also causes disturbances in sleep quality and increases sedentary life (Schweizer Angélick et al., 2017).

Furthermore, the survey results showed having games and e-commerce applications were associated with BMI. Frequently opening e-commerce applications can lead to excessive use of smartphones and buying activities, especially food. So it can be said that there is an increasing trend in screen-based sedentary behavior. These results lead to unhealthy behavior, such as reduced physical activity. Then this trend will impact weight gain (Costigan Sarah A. et al., 2013).

Regarding the frequency of activity, respondents with less editing video experienced obesity compared with participants who frequently edited video. Adolescents who frequently edit videos will increase their smartphone usage and spend time on it. For some people, extended smartphone usage will impact the pleasure of playing with smartphones and the inability to control desires (Bian Mengwei and Leung, 2015). In this case, adolescents do not want to fulfill their nutritional/food desires. So, they choose to work with their smartphones than eat.

Contrary to editing video cases, this study also found that participants who frequently listened to music, played games, watched movies, played social media, and searched entertainment news experienced overnutrition. These activities belong to modern indoor activities carried out by sitting continuously/sedentary, possibly associated with the lack of outdoor physical activity (Thivel et al., 2013). In addition, this passive activity also encourages excessive consumption of food without feeling hungry. With this new trend, students who engage in sedentary activities will increase and result in overnutrition (Ojiambo et al., 2012).

5.1.3 The food trend and dietary habits among female university students

Study results showed that most participants had approximately two meals per day and skipped breakfast. People skip breakfast because they are in a hurry when going to a place/event, have low income, have essential tasks that must be completed immediately, and lack information about the importance of breakfast for daily activities (Jackson, 2013). The environment that does not support breakfast culture is also why people ignore breakfast (Rani Rekha et al., 2021). The low economic level and the low level of education make a family not have breakfast regularly (Doku David et al., 2013). Having breakfast can reduce body weight because breakfast causes a feeling of fullness, reducing the desire to overeat after breakfast (Jackson, 2013). It was also agreed by (Rani Rekha et al., 2021) that breakfast could affect BMI and reduce obesity. Evidence obtained in Croatia is that adolescents who eat breakfast have lower body fat than adolescents who skip breakfast (Sila Sara et al., 2019). In line with some of these opinions, the research stated people who skip breakfast tend to be overweight. The researcher also stated that adolescents who skip breakfast have lower performance at school or university than adolescents who have breakfast (Lee Hae Jeong et al., 2019). In addition, skipping breakfast also causes reduced nutrition for the body (Jackson, 2013). Breakfast is the first nutrient consumption in a day after a long period of not eating (Rani Rekha et al., 2021). In mental health, skipping breakfast also impacts increased stress, mood swings, and depression, which can increase suicidal ideas (Lee Hae Jeong et al., 2019).

The following results were related to the favorite menu. It showed that most participants like to eat nasi pecel (rice with vegetables salad and peanut sauce) and chicken porridge for breakfast. The components at breakfast are not much different from other meals because rice is the main component in the meal. Indonesia is the country with the highest rice consumption globally (Anggraeni Wiwik et al., 2017). Research on Java Island, which has the highest population density in Indonesia, showed that rice is their primary source of carbohydrates. Eating means consuming rice. When you consume bread, potato, or other sources of carbohydrates, it does not count as meals. This condition contributed to the condiment of meals (Widyanti Ari et al., 2014).

Moreover, favorite lunch menus were rice with fried chicken, soto (yellow chicken soup), and meatball soup. Based on the Indonesian Food Composition table, the nutrition for the 1 portion of rice (100 grams) and fried chicken (100 grams) menu is approximately 518 calories consisting of 160.8 calories of carbohydrates, 188.1 calories of fat, and 152.8 calories of protein (Indonesia Ministry of Health, 2020). While, 241 grams of soto, on average, consisted of 312 calories, including 134.28 calories of fat and 96.04 of protein. Then, one portion of meatball soup consisted of 444 calories (2.44 kcal of carbohydrates, 259.74 kcal of fat, and 169.56 kcal protein) (fatsecret, 2022). According to the Indonesian Minister of Health Regulation Number 41, the year 2014 concerning Guidelines for Balanced Nutrition classified food as low-fat, moderate fat, and high level of fat. Foods that consist of more than 150 calories, 13 grams of fat (117 kcal), and 7 grams of protein (28 kcal) are included in high-fat foods (Ministry of Health Republic of Indonesia, 2014). Hence, all respondents' favorite dishes are high-fat foods based on these groups. Other research in Southeast Asia, such as the Philippines and Malaysia, has the same habits as

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Indonesia. High carbohydrates and fats are the primary consumption in their diet, both in rural and urban areas (Lipoeto Nur Indrawaty et al., 2013). Then, dinner's favorite menus were fried rice, rice with fried chicken, and meatball. This trend didn't differ from the overnutrition participants' favorite menu results. We can conclude that the female university students likes to eat high carbohydrates and fat whenever meals time. Diseases that arise due to excess calorie consumption are obesity and metabolic function disorder (Lucan Sean C and Dinicolantonio, 2015). In addition, insulin resistance is a form of metabolic disorder, increasing the risk of type 2 diabetes, hypertension, dyslipidemia, and liver function disorder (Boden Guenther et al., 2015).

Data obtained based on the National Socio-Economic Survey (SUSENAS) March 2020 shows that the Indonesian population consumes an average of 2112.06 kcal energy, above the calories consumed per day (Statistics Indonesia, 2020). The Ministry of Health Regulations of the Republic of Indonesia Number 28 in 2019 concerning the Recommendation of Nutritional Adequacy Rate stated that the average energy adequacy rate for a female aged 19-29 years old is 2250 kcal per day (Indonesia Ministry of Health, 2019). However, it noted that each person's energy needs could be calculated independently according to conditions and age using a predetermined formula.

Furthermore, the survey showed that most participants like to consume snacks 1-2 times per day for snack consumption. Their favorite menus were biscuits or pastry, crackers, and bread. It is slightly different with overnutrition participants because they like tapioca meatballs as their snack. Snacking with excessive frequency and inadequate nutritional quality can lead to obesity because there can be excess energy intake and weight gain (Bellisle France, 2014). So, due to obesity, other diseases can appear soon. Snacks are better consumed between the two main meals time, between breakfast and lunch (10 a.m.) and between lunch and dinner (4 p.m.), but the American Heart Association added after dinner (between 7 p.m. and 9 p.m.) (Marangoni Franca et al., 2019). Snacks can be served by steaming, frying, roasting, or boiling with a composition of ingredients following the recommended calories. Then, there is no overconsumption of the nutrients contained in the snack (Karina Sa'diah Multi and Amrihati, 2017). In addition, a good snack should consider carbohydrates, fat, fibre, sugar, and salt (Azadbakht Leila et al., 2016, Correa-

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Burrows Paulina et al., 2017). This survey has similar results with adolescents' study in the US that described their snack consumption as 1-2 times per day, with pastry, bread, and crackers still the adolescent's choice for daily snacks (Slining Meghan M. et al., 2013). In addition, research in Kuala Lumpur and Brazil also describes that other foods containing carbohydrates are also in the adolescent's choice as a snack every day and can even replace their meals (Boon Teo and Sedek, 2012).

Furthermore, the survey results showed that Indonesian female university students like to consume sweet beverages. Most of them like to drink iced Thai tea (milk tea) and put topping such as wiped cream or jelly on the top of the ice. This trend was similar to the preference of overnutrition respondents. The sweet beverages trend was also experienced in Taiwan, this research found that 87.7% of adolescents consume sweet beverages (Lin WT. et al., 2013). In addition, studies conducted in Cook Island and Tuvalu, which are included in the pacific island countries, also stated that 64% and 55% of female adolescents consumed sweet beverages in the form of soft drinks at least once a day (Kessaram Tara et al., 2015). One glass of iced milk tea (16 Oz) without any topping has touched 302 calories (around eight teaspoons of sugar) (fatsecret, 2022). According to the Indonesian recommendation of sugar consumption, consuming sugar should be no more than 50 grams per day (approximately four tablespoons) (Indonesia Ministry of Health P2TM, 2018). A study said cardiometabolic disorders could occur with too many sugar-sweetened beverages (SSB) (Chan Te Fu et al., 2014). Just like the body when it is excess of other nutrients, excessive consumption of sweet beverages also impacts very drastic weight gain (Ebbeling Cara B. et al., 2012). Another research stated that respondents with higher consumption of sweet drinks tend to experience higher systolic blood pressure, fasting blood sugar, and BMI than respondents who do not consume sweet beverages in excess (Mirmiran Parvin et al., 2015). In addition, excessive sugar consumption increases the risk of coronary heart disease by 16% (Huang Chen et al., 2014).

5.2 Designing wireframes and development path

The survey showed that the respondents need a user-friendly application. There are common concerns to conventional computer program engineering and mobile application development (MAD), such as equipment gadget integration, execution, unwavering quality, capacity confinements and security issues (Flora Harleen K et al., 2014). In any case, MAD presents a few extra prerequisites such as potential interaction with other applications, integration with gadget sensors, local and half breed (portable web) applications. In expansion, the key traits that characterize a fruitful versatile app are usefulness, unwavering quality, adaptability, openness, transportability, effectiveness, viability, convenience, and responsiveness, and iterated in line with clients' prerequisites (Flora Harleen K et al., 2014). Most smartphone users proposed that versatile apps expend less computing control and ought to run quickly.

Mobile app companies and individual app developers must consider consumer friendliness and purpose. Cell app builders might also want to leverage the potential of apps for challenge performance so that users can maintain to apply apps. Customers tend to choose a simplicity-driven technology with maximized performance (Kang Seok, 2014). A study examined the impact of client satisfaction, the amount of support used, and particular features on smartphone users' decisions to retain or leave. Client preferences were the determining factor for those who chose to keep the services when service fulfillment and exchange prices did not significantly impact (Keramati Abbas and Ardabili, 2011).

Furthermore, one of the services that need to consider is application size. Fact, Google Play Store enforces a compressed download size restriction of 150 MB or less for apps posted with app bundles. It was an excellent idea to use the guidelines described on this to reduce your app's download size as much as feasible. For apps that publish to Google Play Store by importing signed APKs, compressed downloads are constrained to 100 MB or less (Ershov Daniel, 2018, developer android team, 2022). However, the Diamond application had approximately 178 MB then we needed to resize it when we decided to upload it to Google Play Store.

Another survey results were the food database. Based on those databases, we identified the calories for each food database from the Nutrisurvey- Indonesian menus database and "panganku" from the Indonesia Ministry of health. NutriSurvey is a free software to analyze nutrients and calculate energy necessities, make plans of diets, diet records, meals frequency, a search for nutrients in foods, and cope with recipes.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

However, the nutrition estimations did not update every time. NutriSurvey was used by German, French, Bolivian, Brasilian, Egypt, Guatemala, India, Indonesian, Kenya, Mexico, Mali, Peruvian, Senegal, Thai, and Vietnamese to estimate the nutrition (nutrisurvey team, 2010). The NutriSurvey food database comes from the U.S. Department of Agriculture (USDA) and Indonesia database to make sure that dietary content material of species of fruits and veggies particular to South East Asia was documented correctly (Wallace Lauren J. et al., 2014)

The second source we used to make the Diamond food database was Panganku.org. This website under the Indonesian Ministry of Health contains Indonesian meals. It can be accessed freely by anyone who needs food information. Panganku.org consists of about 1146 foodstuffs, even limited updates (Indonesia Ministry of Health, 2020, Kumala Febriandrini, 2021, Mahdum Maulana et al., 2020). The last source of the calories database was FatSecret. FatSecret is a calorie-counter app that empowers nourishment and works out logging combined with a peer-back arrangement to strengthen users' weight-loss goals. FatSecret was established in 2007 in Melbourne, Australia. Since Admirable 2009, the company has worked on the FatSecret Stage API, which permits its worldwide food and nutrition database (Radcliffe Erin et al., 2021). The website that informed the food calories, FatSecret, also had an application to manage weight loss programs (Payne Jason E. et al., 2021).

The next step for developing a Diamond application is to establish the features. The Diamond application's main feature was Convolutional Neural Network (CNN). CNN is a deep learning method that identifies objects (Mane and Kulkarni, 2020). Distinctive challenges such as partial/full impediment, shifting brightening conditions, postures, scale, etc., must be dealt with while performing the object detection (Pathak Ajeet Ram et al., 2018). Image detection successfully detected facial expression recognition, disease detection in plants, and car detection; meanwhile, food detection was limited (Agrawal Abhinav and Mittal, 2020, Benjdira Bilel et al., 2019, Sharma Parul et al., 2020).

Food object recognition systems present an attractive and useful research field since they enable objective measurements of eating activity. This feature is helpful and welcome in many dieting-related instances, especially for managing health conditions or analyzing research subjects' eating patterns (Knez Simon and Šajn,

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

2020). Similar to this project, a study in South Korea developed Korean food image detection and recognition model for mobile devices to accurately estimate dietary intake. Their complex food recognition model, K-food, had higher test accuracy (91.3%) and faster recognition time (0.4 ms) than those of the other networks (Park Seon-Joo et al., 2019).

Another research supported the Diamond application was a mobile application that was made to recognize food items of multi-object meals from a single image in real-time and then return the nutrition facts with components and approximate amounts. Their work is organized into two parts. First, they build a deep convolutional neural network merging with YOLO, a state-of-the-art detection strategy, to achieve simultaneous multi-object recognition and localization with nearly 80% mean average precision. Second, they adapt their model into a mobile application with extending functions for nutrition analysis. After inferring and decoding the model output on the app side, they present detection results that include bounding box position and class label in real-time or local mode. However, this mobile application only has Chinese food databases (Sun Jianing et al., 2019).

Concern about image detection, its connected with the accuracy of image detection. Low accuracy in food image recognition increased retention (Ma Juncheng et al., 2018, Ming Zhao-Yan et al., 2018). Food photographs' accuracy is crucial for numerous fitness-orientated programs conducted with calorie estimation, meal journaling, and automated nutritional control. However, it was challenging because: (1) food pictures have their kind of residence. They don't have any specific spatial layout. In addition, food condiments had many forms and were distributed randomly on a plate. Moreover, cooking methods also affect the appearance of meal condiments. These factors make high challenges compared with other objects such as homes and trees. (2) food photo belongs to the exceptional-grained category. similarly, the image of the meal encounters the same trouble as the nice-grained category, which includes subtle variations among different meal types. (3) There are many massive-scale meal pictures with many categories. In laptop vision, it was possible to have a large-scale food dataset (Min Weiqing et al., 2019).

Traditional nutritional evaluation strategies are time-ingesting, pricey, and vulnerable to errors. This new technology offered a reliable and handy dietary

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

assessment. However, this technology has emerged during the last decade and has many benefits. Traditional system learning techniques use uncooked information to enter or cope with classification responsibilities with limited capabilities. At the same time, deep learning methods can research representational features from datasets in the system and reveal more effective ability than traditional methods (Lu Ya et al., 2018, Zhou Lei et al., 2019).

5.3 Diamond application prototype

This application has four main features: estimation energy requirement (EER), meal diary, diet reminder, and meal graph. In addition, it has a profile, exercise record, and information box. The dietary application was a common tool to manage weight. Commonly, the capabilities of cellular nutritional applications were also labeled into six components: food plan, anthropometric parameters, social, activity, medical parameters, and critical parameters. The most feature available in dietary mobile applications were weight, top, age, gender, goals, energy wanted calculation, weight loss plan diary, meals database with calories, calories burned, and calorie consumption (Villasana María Vanessa et al., 2019). Other important features were the availability of professional consultation and the potential to sync with other health and fitness apps, gadgets, and computer systems to allow easy assessment and sharing of information and support for social networking (Schumer Harleigh et al., 2018).

Discussing applications, there were approximately 3.7 billion apps downloaded in 2017. 325,000 mobile health (mHealth) apps were available in app stores related to health and fitness (Vasiloglou Maria F. et al., 2021). The statistic shows the results of a survey in the United States in March 2017 by age. U.S. adults were asked if they would be willing to use an app to track and monitor their diet and nutritional intake. According to the survey, 26% of those aged 18 to 29 regularly use apps to track their diet and nutrition, which increased to 44% in 2020 (Kunst Alexander, 2019). While in Indonesia, Statista Global Consumer Survey depicted that in 2020 there were 57% of health application users (Pusparisa Yosepha, 2020).

Furthermore, considering a dietary application, many mobile nutrition self-tracking apps had been evolved and brought into the marketplace. The large variety of nutrients and weight loss plan apps and their numbers of downloads indicate the first-rate hobby in eating regimen tracking and assessment (Ahn Jeong Sun et al., 2019, Vasiloglou Maria F. et al., 2021). In Indonesia, as far as researchers know, there are 4 diet applications, namely Hitung Kalori – Daftar Kalori Makanan Terlengkap; GGL; Fita. Sehat Makin Nikmat; dan OCD App – Obsessive Corbuzier's Diet (OFFICIAL). The diet application includes calorie calculation features, workout and physical activity guides, Body Mass Index checks, and healthy menu recommendations. However, they used manual input for dietary journals and limited local food databases.

The benefit of real-time diet records is that it was designed to capture all food and drinks consumed without recalling the event later. Despite this benefit, the critical restriction of unexpected mobile device applications is that there are no unannounced testing occasions. Self-observing dietary admission can be impacted by psychosocial and behavioral determinants that present reactivity and assessment bias, including eating practices (dietary limitation or disinhibition), body image, social allure, or anxiety and depression (Maurer J. et al., 2006). Furthermore, with picture-assisted weight loss plan facts, there was a potential of entry bias via research workforce viewing pictures or for intentional or accidental reporting errors (e.g. wrong report of piece sizes) by using individuals, assuming food sources are overlooked from the pictures or the pictures are not taken at multiple meal points (e.g. before and after a meal) (Schembre Susan M. et al., 2018). However, the Diamond app had an eating decision option to ensure the users how much they consumed and to estimate the calories precisely.

Moreover, diet/nutrition app usage has proven associated with diet-related behaviour change. The study results by (West Joshua H. et al., 2017) demonstrate that using nutrient apps was associated with dietary practice. Further, it also confirmed that dietary app utilization improved desire, motivation, and ability to enhance their nutritional consumption. Altogether nutrition application usage was associated with enhancing self-efficacy or reinforcing one's conviction that one can engage in healthful nutritional practices.

Food plan and nutrients apps are famous applications in the health and fitness apps categories. Findings of the study confirmed that nutrition-facts apps might be adequate in overcoming what users understand as a personal restriction in moving toward healthy food. This is especially evident amongst users, strengthening their motivation and planning action in choosing healthy eating. Importantly, applying nutrient apps reduces the notion of the obstacles to healthy meals. The apps assisted users in improving their self-confidence in choosing healthy food and their subjective knowledge of healthy food (Samoggia Antonella and Riedel Bettina, 2020).

We involved three nutrient experts to review the prototype to validate application features and contain application. This validation technique aims to determine the relevance and usefulness of the proposed prototype. Internal validation addresses the integrity and usefulness of the prototype. Integrity refers to the legitimate model of the issue or prototype; the prototype's usefulness indicates how powerful the prototype can assist designers in understanding the variables related to designing and the process. In addition, outside validation of the prototype related to the outcomes of prototype usage concerning the excellent of educational design merchandise was made and the advantages to users or corporations (Suartama I. Kadek et al., 2019).

Further, this testing stage showed that participants agreed Diamond application was accessible and easy to use. Commonly, users examined the benefits and drawbacks of fitness-associated cellular apps primarily based on an evaluation across several standards such as price, app rating by the general public, workout and food record function, the capacity to percentage information on social networks, and compatibility with diverse cellular smartphone fashions (Pais Sarita et al., 2018). Considering about these, the Diamond application was matched with the criteria for software performance such as 1) Users' satisfaction, a Diamond application provided the apps to manage their diet with easy features such as estimation calories, food calories information, and image detection. In addition, it furnished with diet information to upgrade their diet knowledge; 2) Compatibility, less error report to input data and instalment of application proved that the Diamond apps were compatible with the Android user's used; 3) Functionality, a Diamond application has four main features such as estimation requirement energy, meal diary, meal graph and a reminder to assist users managing their weight; 4) Security, user's received inform concern before instalment the application that informed them, the data we received

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

only use for research and confidentiality 5) Accessibility, Diamond application will launch in Google Play Store after finished the report; 6) Easy to learn and use; 7) Information quality, Diamond application was validate with three nutrition expert and provide food and information database based on Indonesia Ministry of Health; 9) Responsiveness, Diamond application armed with sharing to social media whether user's want to share their achievement (Rajak Manindra and Shaw Krishnendu, 2019).

However, there were some concerns, such as the database for meal diary features and estimation portion. In general, the food database of the dietary apps assists the user in knowing the nutritional information and proposes the possibility of adding a variety of foods to consume (Schumer Harleigh et al., 2018). A study conducted by (Darby Alaina et al., 2016) which covered an evaluation of dietary apps, showed that in 42 applications surveyed, thirteen were positioned as poor (31 %). These findings showed that customer-oriented dietary apps will face challenges in entering food consumption and will lead to inaccurate nutrient intake estimation (Griffiths Carly et al., 2018). To increase engagement users to dietary apps, one of the way, applications should provide a high-accuracy of food database meanwhile, it is important to foster more thorough applications with various qualities but reliable to be useful for dietary direction (Braz Vitória Negri and de Moraes Lopes Maria Helena Baena, 2019).

In addition, determining the portion size is another challenge in nutritional tracking. The diamond application lets users input their estimation portion to calculate the estimation of food calories they take. However, the testing feedback suggested giving an open option to input the portion. Other studies stated that people commonly poorly predicted portion sizes, and 49% of errors in energy assessments were reported from dietary records on-device applications associated with inaccuracies in estimating portion sizes (Beasley Jeannette et al., 2005, Chen Juliana et al., 2019). To solve this problem, the Image-recognition era and algorithms using 3D ought to doubtlessly support automated estimations of portion sizes (Chen Juliana et al., 2019, Ming Zhao-Yan et al., 2018).

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

5.4 Testing stage results

This testing stage showed an increasing trend to use the meal diary feature during four weeks. The achievement of self-tracking in mobile phones depended on the extent to which they felt facilitated. For instance, this activity was important for improving engagement in healthy behavior change and resultant health results and weight control. Similar to study results in the U.S, members of the meal diary usage more consistently enrolled entire days of nutritional data. It was possible because the app's technology provided a less troublesome technique for tracking information. In addition, because people regularly use smartphones for the other functions, they provide, using cell phones as the dietary records may show less difficulties, and a more scalable intervention method than manual monitoring methods (Wharton et al., 2014). Furthermore, we tried to update the database every time the users reported the food. Regular updates (in content material and data information) and push notifications in an application have been defined as ways to improve and spark the interest and utilization of the application (Sandborg et al., 2021).

Contrary to image detection and meal graph feature, the user declines to open these features during four weeks. The photo-detection algorithms for predicting dietary composition are not imprecise. This condition may be possible because the single global model for studying the images comes from customers who may have extraordinary dietary choices and habits. Consistent with these results, evaluation of the usage of failure photos can improve food detection accuracy for the consumer (Aizawa et al., 2013). A study based on US research stated that low accuracy in meals photograph detection made customers revert to search entering feature (Lim et al., 2017). Research suggested that reducing the burden related to manually logging weight loss programs may increase engagement, the attraction of applications, and the probability of repeated use (Bardus et al., 2016b). In reality, lowering customers' burdens, such as the cost of installing the application, may certainly impact higher users' commitment and effectiveness (Laranjo et al., 2021).

Furthermore, this study showed that application users who opened eating reminders for four weeks were at a moderate level. The eating reminder feature was made to help users be alert about eating time to manage their diet and achieve what they want. Because daily meals are the basis on which different modifications in

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

consuming was built, reminders have been provided in the application to prompt customers to consistently eat and log their meals three times a day (Tregarthen et al., 2015). Moreover, an application that provided notifications (i.e., reminders and prompts) scored significantly higher in engagement (Bardus et al., 2016b).

Similar to this, other research stated that mobile phone applications designed to assist consuming with extra attentiveness raised participants' attention in their dietary habits and might employ this information to caution their eating choice. Generally, respondents misplaced 1.5 kg weight after a 4-weeks trial. Users' tasks and reminders were appropriate tools to engage customers with smartphones in a brief time period (Freyne et al., 2017).

Moreover, this testing stage had feedback from users after four weeks of using Diamond application. It showed that most respondents agreed that this application was easy and helped them manage their diet. They appreciated the estimated calories feature that informed them about their estimated calories needed per day and the menstruation period in the meal graph feature. Based on the fact that the engagement of health technologies usage is determined by users' perceived quality of knowledge, the continuing usage benefit, and consideration of feasibility alternatives to using the technology (Adu et al., 2018).

Dietary self-monitoring in a mobile application may allow for real-time documentation of food intake combined with the convenience of automatically calculating the caloric compared with a manual search in calorie books. Users can decide on foods consumed automatically and generate an estimation of calorie intake. To further simplify and decrease the time required to self-screen nutritional consumption, a few apps now include barcode scanning, use meals or portion classification access in preference to specific object entry, or have customers take meal pictures. Smartphone apps may also permit extra proximal recording of nutritional consumption records, associated with more weight loss (Turner-McGrievy et al., 2013, Pellegrini et al., 2015).

Other research confirmed that customers who gave positive feedback for weight reduction monitoring apps which has features to track their meals consumption; use food scanners, and get admission to meals databases within the apps; and consider the apps to be handy, user-pleasant, and easy to apply general.

Weight reduction turned into other crucial subject matter, performing in 10% of user evaluations (Zečević et al., 2021). Applications which are able to recognize the meal objects correctly and generate the nutritional evaluation record effectively provide more advantages for customers, such as a brief perception of healthy nutrition and guidance in their daily life to enhance body fitness and wellbeing (Jiang et al., 2020).

However, the testing users found that even its interesting image detection feature had some problems, such as errors when it was used or undetected the food they captured. In meal photograph detection, CNN-primarily based techniques have accomplished outstanding improvement recently, and a few cell phone applications appoint them. Nevertheless, in most calorie estimations, the estimated calories are only associated with the estimated meals classification, and those applications frequently require customers to join data including size or quantity, some issues related to difficulties, and subjective assessment. Presently, no applications that may estimate food calories precisely exist (Ege et al., 2019). Supported this finding, a study at Bern University showed that users of image-based apps reported the error and misleading of food images in capturing procedures (Vasiloglou et al., 2021). The current image recognition systems cannot fully recognize and process mixed physical photos, such as cooked foods, compound foods such as salads and sandwiches, and liquid foods (Shen et al., 2020).

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Food and beverage photograph detection and recognition were challenging because of food and drinks characteristics. Meals are generally deformable items, making the method of defining their structure tough. Moreover, a few meals could have an excessive intra-class (similar meals appear very different) and low inter-class (different meals look very similar) variance, making specifying the meal type even more challenging. The problem with drink detection is that there is only a restrained amount of information that may be gained using pictures of drink objects; such data is the drink's color, whether the drink is well-lit, and the drink's density. These limitations make food and beverages picture recognition a mainly challenging computer vision trouble (Mezgec and Koroušić Seljak, 2017). Furthermore, picture quality from the camera's smartphone depends on specific camera types, lighting situations, and orientations. As a result, the poor performance of meal detection models is highly liable to photograph distortions (Tahir and Loo, 2021).

Other evaluations confirmed that performance in terms of accuracy was discovered to differ extensively between platforms ranging from 9% to 63% for top 1 accuracy while for top 5, the accuracies ranged from 24% to 88% (Van Asbroeck and Matthys, 2020). An excessive variance in the range of recognized dish components among the platforms was observed for combined dishes. Foodvisor and Calorie Mama API recognized mixed food components in maximum scale (71% and 70%, respectively) even as Google vision API only recognized 17% of the important components of mixed dishes. None of the platforms could identify the respective portion size of the different meals and drinks. Those outcomes revealed certain platforms perform poorly while others perform adequately.

Automatic meal portion estimation techniques are classified into single-view-picture and multi-view-photo techniques. As mentioned, most multi-view picture techniques are more accurate than a single view. However, multi-view-photo methods required complicated processing and pictures from distinctive angles, ensuing in a discounted consumer retention rate. Moreover, most single and multi-view techniques require calibration objects every time (Tahir and Loo, 2021).

Other researchers reviewed three preceding works and proposed new works. Presently, “DepthCalorieCam” is the most promising approach. However, big-scale “Calorieannotated” 3D food volume records are needed to increase the device into massive-scale categories, which could be very luxurious and time-consuming. Further, the rice grain-primarily based method is likewise promising for food containing white steamed rice (Ege et al., 2019).

In addition, the database scan barcode was limited. Therefore, the users cannot find the food they want. A research team collected a database in the Diamond application, we can add more, but it needed more funding. Another matter they reported was download installment process of the application for some users takes longer (179 MB). The download time depended on the internet connection. More than one determinant affects the velocity and quality of internet connections, such as transfer technology, place, the number of people who share the connection, and the tool used are just a few of those factors. Further, there also are variations between a fixed network and a cellular network that impact download time (Traficom.fi, 2021).

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Furthermore, the installment process apps rely on the kind of Android used. Android is an open-source project. Any hardware company can construct a tool that runs the Android running system. But, a device is "Android compatible" only if it may effectively run apps written for the Android execution environment. Only devices which are Android compatible include Google Play Store. We assure that customers who deploy this app use an Android-compatible device (developer.android.com, 2021).

Overall, the testing user agreed that this prototype is appropriate for managing the diet. Four key excellent-of-experience factors have an impact on engagement and satisfaction with application usage: (1) ease of installation and use (2) individual interface attractiveness, (3) accessibility, and (4) non-public tailoring. Five specific app features have been highlighted as beneficial: an in-intensity food database, a meals scanner, notifications and reminders, provision of dairies, and online contact to assist the program. Another factor is the aspect that refers back to a product's physical characteristics, including a screen display, button, and indicator. It refers to the performance accomplished to satisfy consumer delight (Baharuddin et al., 2013).

5.5 Maintenance and final application

To improve the limitation in the testing stage, we upgraded the system such as the barcode and food database, as soon as possible when the respondents reported the lack of a database. Preferably, study weight loss plan-tracking apps need a user-friendly interface and experience with an intensive and reliable food composition database (FCD). The continuous update of massive meal product databases remains a key challenge for weight-reduction plan-monitoring apps. Access to high-quality-controlled meals product databases is essential not only for dietitians, nutrition researchers, and health experts for dietary assessment functions but also for users of weight loss program apps who previously indicated their need for accurate food information and complained about missing or incorrect meals products. Consequently, easy-to-navigate food databases, in which the number of meal entries is not overwhelming, are needed to facilitate proper food selection (Maringer et al., 2019, Shinozaki and Murakami, 2020). In addition, other research showed that users are commonly satisfied with the apps' capability, while a richer database would make it

Chulalongkorn University

easier for them to make choices, and they might experience more stimulated than if they needed to look for substitutes or go through long processes to add a product (Zečević et al., 2021).

In addition, related with display. The original application has only one mode (bright mode). One user's testings suggested adding a dark mode to this app. Pedersen's research showed that there were no significant differences in productivity and error quantity between users who used light mode and dark mode (Pedersen et al., 2020). Light mode usually leads to higher performance in users with normal vision. Those findings are high-quality, defined by the fact that, with advantageous contrast polarity, there is more general light, so the student contracts more. As a result, fewer spherical aberrations, more intensity of area, and a better ability to attend to details without tiring the eyes (Budiu, 2020).

Video inbox information, we consider copyright when we insert the video's link. If we want to insert the copyright we need in our program, we need permission from the owner. Hence it will not be against the legal procedure. In short, the owner can take legal action against an illegal publication. They can choose between being awarded actual damages, or statutory damages, as determined by a judge (Bybyk, 2019). However, in the future, we will consider collaborating with other sources to improve the application.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

5.6 Phase II discussion

5.6.1 Baseline characteristics of participants

Four parts of baseline data were measured before the intervention program. The baseline was analyzed for the difference between the intervention and comparison group, with a p-value ≤ 0.05. Overall, research participants in both groups had similar characteristics in sociodemographic, genetic, eating self-efficacy, and behavior factors. Sociodemographic determinants were age, hometown, religion, education, academic year, study major, relationship status, and living allowance. In addition, genetic factors showed that both groups had the similarity of this determinant. Hence, no adjustment was made for these factors.

Eating Self-Efficacy (ESE) had 18 item questions and was divided into five parts named negative emotions (4 item questions), availability (2 item questions), social pressure (4 item questions), physically discomfort (4 item questions), and positive activity (4 item questions). Using all the items to calculate eating self-efficacy levels showed that participants in the intervention group had less confidence than the control group. However, statistically, there were no differences in eating self-efficacy levels between both groups. The level of ESE will impact to adhering to the diet. A high level of ESE was identified as a target for long-term weight management in non-surgical weight-loss interventions. A study depicted patients who progressed their ESE the most additionally experienced the highest weight-loss and weight problems-particular QOL 5 years postoperatively (Flølo Tone Nygaard et al., 2019). Furthermore, individuals' high self-efficacy stages in making healthier selections immediately impact nutrition. Nutritional self-efficacy is a mediator between preferred foods, meal choices, and eating patterns (Cuadrado Esther et al., 2018).

Eating self-efficacy can be described as the belief in the personal potential to self-regulate consumption, and previous literature indicates the relevant conditions. It can provide assignment self-regulation of consuming, are associated with internal states (e.g., emotional or inner/physical) or outside contexts like social activities or conditions wherein meals are effortless. Since the perception of one's capacity to adjust a selected behavior is one of the simplest predictors of that behavior, it is potential that during emotional and social conditions, the self-efficacy beliefs to self-regulate eating can even affect eating behaviors (Lombardo Caterina et al., 2021).

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Behavior factors had six-item questions: exercise activity, exercise per week, exercise time, sleep time per week, smoking and drinking alcohol, and food frequency. Exercise activities, frequency of exercise, sleep time, smoking, and drinking alcohol variables showed that both participants' groups had similar levels and comparable. Rising data recommended that adequate sleep can be beneficial in weight reduction. Experimental sleep research has identified the correlation between inadequate sleep and accelerated obesity danger. The results showed that insufficient sleep influenced appetite-regulating hormone changes, increased appetite, unhealthy food consumption, and little or no exchange in caloric consumption (Anothaisintawee Thunyarat et al., 2018).

In addition, observational research continuously depicted an inverse association between current cigarette smoking and body weight, followed by weight gain after smoking cessation. Ironically, smokers had been pronounced to present with higher waist circumference than people who never smoke. Then, an analysis indicated that every preferred deviation increment in body mass index elevated the risk of being a smoker (Carreras-Torres Robert et al., 2018). Another study displayed that people who never smoked significantly associated with body weight loss (Nakatsuka Yoshinari et al., 2018). The next factor showed that a relationship between consuming alcohol and obesity is linear with non-drinkers with a low risk of overnutrition. Current research shows that light-to-moderate alcohol consumption is not associated with adiposity gain, while heavy consumption is more constantly associated with weight gain (Traversy and Chaput, 2015).

Although the intervention or comparison group had a different exercise time level, the statistical results showed they significantly had similar characteristics. Exercise training (ET) and physical activity (PA) are related to reduced cardiovascular (CV) risk, improved cardiometabolic chance factors, and facilitated weight reduction by creating a negative energy balance. Even though the minimal guidelines for cardio PA (150 min of moderate or 75 min of vigorous physical activity per week) can improve CV health, these ranges are generally insufficient for clinically significant weight reduction or weight maintenance without caloric limitation. The moderate and high intensities were 60-65% and 70-85% of age-predicted heart rate max, respectively. The energy expenditure for the slight and high duration was 1,000 and 2,000 kcals per week, respectively. Retrospective analyses confirmed that respondents who maintained the weight reduction at 24 months (based on LTPA questionnaires) had more PA energy expenditure (≥2000 kcals per day [around 11% weight loss] vs. <1000 kcals/week [approximately 3% weight loss]) and amount of ET time per week (≥300 min/week [11% weight loss] compared to <150 min/week [3% weight loss]) (Swift Damon L et al., 2018).

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

5.6.2 Baseline outcomes of participants

Four components were measured in dietary intakes: carbohydrate, protein, fat and total calorie, and BMI. Both groups had a similarity of baseline in dietary intake and BMI. By ensuring our groups have a similar baseline in nutritional consumption and BMI, we can increase our belief that any distinction we see is because of the treatments and not group variations and confounding factors (Rohmann Jessica, 2017).

This result reported that some participants only consumed a small portion (<1500 kcal on average) even though they were categorized as overnutrition. It might be happening because obesity is a genetic factor, hormone issue, or lack of transparency in data collection (Centers for Disease Control and Prevention, 2013, Ioannidis John P. A., 2016). We conducted a nutritional evaluation survey using the 24-hour recall method for three times. Traditional weight-loss program assessment approaches such as the 24-hour self-reported recall are burdensome, afflicted by bias, and inaccurate in estimating energy consumption. Even though we completed that 24 h-recall with three measurements in a week (72-hour food recall), this method still has drawbacks such as memory dependence, requires intensive interviewer effort because it can decrease motivation to collect accurate information and can regulate consuming behaviours if recalls are scheduled in advance (Alshurafa Nabil et al., 2019). Research confirmed that the approach with the lowest total amount and the bottom level of variation was discovered to recall methods, with underestimations of EI ranging between 8–30%. This variation could be attributed to recall bias, duration of the reporting period, and use of visible aids to estimate portion size (Burrows Tracy L. et al., 2019). Some of the factors above are why the examination outcomes display that some participants only consumed a small portion.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Furthermore, BMI also had a similar character in the intervention and control groups. Guidelines from the UK and America recommend that a minimum weight reduction of between 5 and 10% is sufficient to have a medical impact on outcomes. Treatment approaches to achieve weight loss should include dietary and lifestyle changes, such as increased physical activity, pharmacological intervention, and bariatric surgery for patients with extreme obesity and comorbidities (Kim Ju Young, 2021). These interventions further affect the risk of obesity-associated outcomes to drive weight loss. Indeed, a systematic review has shown that improved physical activity as an adjunct to dietary interventions resulted in enhanced weight loss and improved circulating lipid levels and blood pressure (Haase Christiane Lundegaard et al., 2021).

For patients with higher BMI levels (>40 kg/m2), the capability to lose the same proportion of weight with lifestyle intervention is equal to that of those with lower BMI levels, and there is equal benefit in terms of risk factor improvement with modest weight reduction (Ryan Donna H. and Yockey, 2017).

5.6.3 Effect of Diet Monitoring (Diamond Applications)

After eight weeks of the intervention program, the results showed that participants in the intervention group slightly declined in carbohydrate, protein, and total calorie contrary to fat, which had an increasing trend. An energy deficit is an essential factor in weight reduction. A low-calorie diet involves an intake of 1,000–1,500 calories per day; deficiencies of 500–750 calories per day have been used for weight loss and are recommended by many weight problem societies and guidelines (Kim Ju Young, 2021). Low-calorie diets typically limit carbohydrates, neither of which has been determined to be more important for weight reduction if only a calorie deficit occurs. Low-carbohydrate (low-carb) diets have been widely used not most effective for weight reduction but also for managing T2DM; many randomized controlled trials have been performed (Kim Ju Young, 2021). One of the goals of the diet monitoring program is to control daily energy intake. This study's findings align with the results by (Turner-McGrievy et al., 2017), which depicted that participants in the intensive intervention group experienced a reducing trend in their calorie intake and weight after six months compared with the control group.

This study finding depicted that participants in the intervention group had reduced protein intake. It happened because the participants were more focused on how many calorie they took than each dietary component of their food. Hence, they reduced their total calorie at the end of the intervention, but they experienced lower and higher values in some dietary components. Recent research showed that decreased protein consumption is essential for durability/metabolic health. An inadequate protein intake genuinely increases the progress of sarcopenia. A protein deficiency can cause loss of muscle mass, which in turn cuts strength, makes it more challenging to maintain stability, and slows metabolism. It may also lead to anemia, while body cells do not get sufficient oxygen, making them tired (Kitada Munehiro et al., 2019, Capurso Cristiano et al., 2020).

Sufficient protein consumption is essential in calorie control for maintaining muscle mass regardless of diet (Kim Ju Young, 2021). This research finding depicted that most participants consumed protein less than 15%. Based on the Acceptable Micronutrient Distribution Range (AMDR) and compared with Indonesian standard (60 g) for protein intake, this result was categorized as sufficient consumption (10%-35%), this results showed approximately (53.18 to 65 g) (Kristi Wempen, 2016). Different from previous studies indicated that obese people who lost a clinically significant quantity of weight (≥5%) with 12 months of Alternate-Day Fasting (ADF) augmented their nutritional protein consumption in a way that could have raised fullness and reduced starvation. These behavioral enhancements may help participants have higher adherence to their rapid-day calorie purposes, contributing to their weight reduction achievement with ADF (Kroeger Cynthia M. et al., 2018). In a single research of overweight and obese women, researchers evaluated dieters who consumed excessive protein (30%), a high dairy weight loss program, and decreased protein (15%), lower dairy diet. The high protein group misplaced more body fat and gained lean muscle than the women who consumed the low protein diet. The low protein group mislaid weight and lost greater lean muscle mass (Gordon et al., 2008).

Next, the Diamond application study showed that intervention participants increased their fat consumption during 8-weeks. Low-carbohydrate high-fat (LCHF) diets are a surprisingly contentious current subject matter in nutrients. A few agreed that those diets successfully treat type 2 diabetes mellitus (T2DM), obesity, and metabolic syndrome. Others believed that it would be conflicted with the current globally established nutritional recommendations that suggested low-fat high-carbohydrate (LFHC) diets lower the risk of cardiovascular disease (Noakes Timothy David and Windt, 2017). An excessive amount of fat in a weight-reduction plan, particularly saturated fat, can enhance cholesterol, increasing the chance of coronary heart disease. Non-weight reduction and weight managing trials, for which there were no low-carbohydrate comparisons, had comparable consequences for low-fat vs. moderate fat interventions and were advanced compared with "ordinary diet". Weight reduction trials accomplishing a more distinction in fat consumption at follow-up significantly preferred the higher fat nutritional interventions, as indicated by a difference of ≥5% of calories from fat (Tobias Deirdre K. et al., 2015). Similar to this

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

study, a study in the Mediterranean confirmed that after 5-years of nutritional intervention, respondents in the weight loss plan group raised their consumption of fibre and total fat because of higher consumption of MUFAs (from olive oil) and PUFAs (from tree nuts and oily fish) and decreased their intake of total carbohydrates, SFAs, and cholesterol (all $p<0.05$). In conclusion, this Mediterranean diet group accomplished a high level of adherence in the short term that was managed in the long term (Quintana-Navarro Gracia Maria et al., 2020, Garcia-Ortiz Luis et al., 2018). In this study, we cannot conclude that the participants consumed SFA or MUFAs because we did not measure it. Hence, we need to aware that increasing fat consumption especially in SFA will impact to high risk of communicable disease such as stroke and heart attack (Lucan and Dinicolantonio, 2015).

Moreover, the study results showed that after 8 weeks, BMI had a reducing trend among intervention participants. The present trial's evidence reported $\sim$550 kcal/day reductions in energy consumption, which would equate to $\sim$ 4 kg weight reduction over eight weeks, though only $\sim$3 kg was misplaced (Cienfuegos Sofia et al., 2020). The amount of weight lost at 8 weeks predicts the long-term reaction. Consequently, weight reduction goals or plans to adjust a program must be based around this time frame (Severin Richard et al., 2019).

Well-known determinants of weight reduction ability include weight-reduction plan adherence, sex, physical activity, age, and particular medicines. Nevertheless, following management for each of these, differences in weight reduction appear to persist in response to behavioral, pharmacological, and surgical treatments. Adaptation to strength deficit includes complicated feedback mechanisms and inter-individual variations probably to rise up from a host of poorly described genetic determinants, in addition to differential responses in neurohormonal mechanisms (including gastrointestinal peptides), metabolic efficiency and ability of tissues, non-exercise activity thermogenesis, thermogenic response to food, and in the gut microbiome. A better knowledge of the determinants concerned with inter-individual variability in reaction to treatments will guide more customized strategies for obesity treatment (Dent Robert et al., 2020).

Diet can be accomplished via various modalities, but maintenance of lost weight is more demanding for a long-time period. Interventions of weight problems usually result in early rapid weight reduction followed by a weight plateau and progressive regain. Treatment of obesity requires ongoing medical attention and weight maintenance-particular counseling to assist sustainable, healthful behaviors and high-quality weight regulation (Hall Kevin D. and Kahan, 2018).

In addition, comparison groups experienced a rising trend in all dietary intake components while having slightly decreasing BMI after 8 weeks. Similar to previous studies about the excessive-intensity intervention, participants decreased their BMI standard deviation to 0.12, and the comparison group reduced it to 0.1 after 12 months. Nevertheless, in follow-up information 5-years after the trial, the BMI standard deviation scores for both the intervention and control groups increased. This trend could happen because the control group depends on their self-control without external counseling and support compared to the intervention group with support (Trepanowski John F. et al., 2017).

Another study confirmed that individuals who volunteered for randomized trials to examine the effectiveness of weight reduction packages and were distributed to the control group were approximately 1 kg lighter on average at the first year of follow-up. Weight change during that 12 months varied substantially among studies (Johns David J. et al., 2016). However, most research would predict weight reduction within the control group. There was advice that more intensity of trustworthy recommendations on weight loss was related to more significant weight loss, but this proof was not strong. The reliance on information from cohort research aiming to set up the natural weight records of the general population can be complicated in uncontrolled program reviews. Program reviews consist of only people who want to lose weight and, therefore, are more motivated than the general population. This result was found in individuals who volunteered to participate in studies to test weight reduction interventions but were assigned to a control group. The weight loss estimate observed here may enable researchers to present the effects of irregular evaluations of treatment programs to put the weight reduction accomplished in context (Johns David J. et al., 2016).

Other studies confirmed that we found a significantly lower nutritional indiscretion from baseline to 6 months within the control group, even though these were much smaller than within the intervention group. In the control group, there was no correlation between BMI exchange from baseline to 6 months and dietary indiscretions at 0, 3 or 6 months (correlation tests: P=0.38; 0.88 and 0.57, respectively) (Wright N. et al., 2017). In future, this group would possibly experience weight gain because of uncontrolled weight-reduction plans/eating styles. Generally, after doing activities, the appetite will increase. People who cannot manage their diet/fulfil unbalanced dietary consumption and exercise can have weight problems (Afriani Anjani et al., 2021).

Furthermore, the changing value in dietary intake between the Diamond application and comparison groups showed that carbohydrate, protein and total calorie significantly differed between the intervention and control groups. It had similar results to research that depicted individualized dietary assistance improved daily energy and dietary intakes and diminished the threat of adverse medical outcomes at 30 days (primary outcome) and all-cause mortality with improvements in functional status and quality of life without an apparent growth in negative side consequences from the intervention (Schuetz Philipp et al., 2019).

Then, the BMI changing value was significantly different between both groups. Supporting this result, previous research conducted by (Cho Yongin et al., 2019) also confirmed that the nutritional intervention group had a lower BMI. The meta-analysis results displayed that BMI was substantially decreased within the intermittent fasting diet (IFD) group after the weight loss plan intervention through 0.75 kg/m2 (95% CI, −1.44 to −0.06; p = 0.033). In addition, the randomized controlled trials dietary program findings confirmed that the control group raised BMI after six years of follow-up (p=0.023). All schools in the intervention group had advantageous outcomes while it applied for a minimum of a whole school year (the maximum extended length was years), and all research pronounced BMI or BMI Z score as the significant final results (Bleich Sara N. et al., 2018).

5.6.4 Engagement of Diamond application

Mobile Health (mHealth) applications can be used for nutritional evaluation and self-monitoring, allowing for real-time reporting of meal intakes. The study depicted a correlation between “meal diary” features usage, fat, and total calorie intake among the Diamond application participants. Similar to a previous study conducted a pilot study to estimate the potential efficacy of a dietary intervention using KELA.AE (Kidney Education for Lifestyle Application), an Arabic, culturally specific, educational, and self-monitoring app developed in a person-centered, theory-based approach depicted after the intervention, twenty-three subjects experienced increasing mean energy intakes (Fakih El Khoury Cosette, 2020).

Similar research results were found in a study that showed participants in both groups reported a statistically significant decrease in energy intake at two follow-up assessments compared with baseline (Xu Zidu et al., 2020). At 6 months, a significantly larger decrease was observed in the installment application group in carbohydrate intake, fat, and total energy, accompanied by an increase in moderate-intensity physical activity than the control group.

In addition, a systematic review confirmed that cellular app-based interventions could advertise numerous healthful behaviors, including food plans and physical activity. Most of the app interventions reviewed targeted tracking health status and behavior exchange and presenting feedback or health-related data (Paramastri Rathi et al., 2020). In addition, practical feedback on the mobile application as a calorie tracker due to its convenience. With the application, customers can get notifications because of the reminder, and there is no purpose for them not to track their meals since they have a smartphone and the application with them (Vica V. et al., 2019).

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Mobile applications for weight control frequently have comparable features, including self-tracking of diet, physical activity recorder, and permitting users to set goals in particular time frames. Further, some of them had remarked on daily activities and reminders to input information into the application in in-app reminders or messages. Supporting these results, dietary mobile individuals in Canada perceived their consuming behavior and weight control to be better following application use. Self-motivation was essential for effective application use and behaviour change, especially since these applications required effort and organization. That adherence was often challenging to hold (Lieffers et al., 2018).

Further, the usage of the meal diary application raised users' attention to what they were consuming. This result is consistent with previous research, in which recording food plans or activities has caused raised consciousness and, in a few instances, exchange in behavior (Jimoh Florence et al., 2018). mHealth (including dietary cellular apps) is not a mediator that immediately impacts weight reduction, consisting of calorie limit or exercise; instead, it acts as a mediator to stimulate diet and exercise programs in obese adults. The hope is an exchange in users' meal intake behavior (Park Seong-Hi et al., 2019). Making long-time period consuming-related behavioral adjustments to promote health is complicated. We need to find methods to support people in making the changes. Long-term modifications appear to be associated, for example, with maintaining an individual's autonomy and internal motivation (Järvelä-Reijonen Elina et al., 2018). A study showed that both groups accomplished advanced compliance that persisted to increase after 3 months besides low app adherence participants, who introduced a slight lower after 3 months. Using an app requires the customers to spend time entering data about their meal behavior every day. This could represent a barrier, particularly for those less stimulated to change their living behavior, favoring the discontinuation of app use (Garcia-Ortiz Luis et al., 2018).

Systematic reviews and meta-analyses have proven that the efficacy of conventional and technology-based weight-loss interventions is most significant during the prior 6 months, which might be because of a well-documented decline in engagement with intervention modalities. Many determinants may have caused a decreased effectiveness for long-period effects. This differential efficacy might suggest research with long-term follow-ups, lower preservation of changes, or general weight-loss effectiveness (Villinger Karoline et al., 2019). Further, the cause for the inconclusive long-term results is probably the lack of systematic follow-up and tracking, which are essential factors of effective health behavior exchange (Lunde Pernille et al., 2018).

On the opposite, long-term impact, a couple of previous research pronounced phone-based programs that lower BMI considerably for quick-period results in youngsters. A study confirmed that the mean Body Mass Index (BMI) was reduced significantly by 0.56 kg/m2 from baseline to 2-month follow-up within the intervention group. Nutritional mobile apps are successful self-tracking tools that assist in weight reduction in a short period. On the other hand, more studies were needed to complete different dietary results (Likhitweerawong Narueporn et al.,

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

2020). Moreover, studies should compare the long-period results of nutritional mobile apps, as well as examine their features and dependability (Fakih El Khoury Cosette, 2020)

However, the application's engagement did not prove that it correlates significantly with dietary intake. This result, similar to research, depicted no association between the entire frequency of self-tracking weight and weight regain during a 9-month examination following a 3-month weight-reduction plan. Although determined that more consistency of self-tracking weight (described as the number of weeks that users self-weighed as a minimum of 6 or 7 days per week) was related to less weight regain (Brockmann Andrea N. et al., 2020).

The engagement was strongly associated with subjective quality, a dimension of future app use. The higher motivation and engagement, the more likely participants might use the app. It highlights an important difference between the two populations: motivation. In the RCTs, one variable researcher has been unable to manage motivation. Although in surveys, all respondents expressed their preference to lose weight, not all are ready to make an effort to make it happen. An assessment of incomplete information in diet and weight reduction research depicted that people who dropped out had a higher starting BMI and proclaimed poorer health than individuals who finished the study, probably indicating differing motivation levels (Bardus Marco et al., 2019, Ghelani Drishti P. et al., 2020).

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Dietary monitoring applications can effectively create weight reduction in a successful weight loss intervention but increase further questions about how users' engagement can be measured and how engagement can be associated with weight reduction. Variations in the association of monitoring frequency to lose weight and low app engagement from the intervention group highlight the need for further studies that offer insight into how app use is measured and associated with weight loss (Dunn Caroline Glagola et al., 2019).

CHAPTER VI
CONCLUSIONS

6.1 Conclusion

Phase I

The survey involved 217 female university students who met the inclusion and exclusion. There were five parts to the results.

1. The Survey results showed that the average age of survey participants was 21.51 ± 1.37. Half of the participants lived independently and had a stay in Malang City of approximately 1-5 years. And it found that 12.8% of participants were overnutrition.
2. The majority of participants used Android, approximately 64-128 GB and 4G type. In addition, most of the respondents used smartphones for about 9 hours per day. Most participants liked the entertainment features on their smartphones, while game and health applications had fewer users.
3. Most of the respondents had twice meals a day, preferred to skip breakfast. This survey collected approximately 121 food menus, 27 snacks, and 22 sweet drinks. Furthermore, more than half of the participants like to drink sweet beverages for sweet drinks.
4. The second stage was designing wireframes. We used the Flutter program and Yolo to conduct the application and image detection feature. In addition, we used Nutrisurvey- Indonesian food database, the Indonesian Ministry of Health database, and fact secret to estimate the food calories.
5. Diet Monitoring (Diamond) application has particular features such as estimation energy requirement (EER) based on Indonesian Ministry of Health guidelines, eating reminder, scan barcode, image detection, menstruation period, sharing result features while profile, exercise record and information box were supporting features.
6. The testing stage showed that 25 participants were involved and felt satisfied with the apps. They agreed that the Diamond application was easy to control the diet, helpful to learn about maintaining a diet, and easy to use and understandable

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

information. However, the participants report some image detection errors and difficulty accessing calorie information.

7. Managing limitations in a testing stage and upgrading the system and database in the Diamond application for the final prototype was done in maintenance stage.

Phase II

This phase analysis 63 participants intervention group and 60 participants in a control group to know the effect of Diamond Application.

1. The baseline showed that sociodemographic factors, overnutrition genetic factors, eating self-efficacy, and behaviour factors had similar characteristics for both groups. This trend also occurred in the outcome baseline (dietary intake and BMI). All baseline variables differed significantly at a p-value $\leq$0.05 between the intervention and control groups.
2. Comparing before and after intervention in the intervention group showed a slightly decreased trend in carbohydrate, protein, total calorie, and BMI, while fat experienced a different trend. Statistical analysis showed that protein and BMI had significant differences at p-value $\leq$0.05.
3. In the control group, the comparison between week 0 and week 9 showed that all dietary intake components experienced a slight increase while the BMI decreased. Fat, protein and total calorie significant different results at p-value $\leq$0.05 after eight weeks of intervention.
4. Comparing the intervention and control group after 8 weeks of intervention showed that carbohydrate, protein, total calorie, and BMI (p-value$\leq$0.05) had a significantly different result.
5. The engagement correlation result showed that assessing “meal diary” feature correlated with fat intake and total calorie (p-value $\leq$0.05). This result showed that the more participants assess the meal diary feature, the less they consume fat and total calorie. While, for binary logistic, it showed that the mean quiz score was associated with carbohydrate intake (p-value $\leq$0.05).

6.2 The benefit of study and application

Phase I

1. This study provided the food database that frequently consumed by female students.
2. This study assisted to promote the knowledge and practice from Indonesian local food calories estimation and Indonesian obesity guidebooks program which can be access in website.
3. Diamond application have users' friendly interface. It can be seen from the simple menu and steps to install and operate the app.
4. Diamond application provided approximately 50 menus that were successfully detected by image processing (CNN technology) with adequate accuracy and 700 Indonesian cuisines as databases to assist the management diet of overnutrition female university students.

Phase II

This study proved that Diamond application can facilitate overnutrition in female university students to manage their food consumption, especially fat and total calorie intake.

6.3 Limitation of study and application

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Phase I

1. Diamond apps depend on the qualification of Android. Even though it can be used in Android 6.5, we still received misdetection in image detection features for some menus while others are doing well. However, we provide a manual search menu to handle this problem.
2. Limitation of food database for image detection and scan barcode may affect the user's enthusiasm to use the Diamond application. However, it can be solved if we had funding support to enlarge the database for diary meal feature.

Phase II

1. Sample size and conventional sampling may limit the generalization of our findings. Because of quasi-experiments, the recruitment of participants was limited by each university group. However, we tried to optimize social media such as Instagram, Facebook and WhatsApp.
2. Because of the covid situation, dietary intake measurement was collected regarding the participants' free schedule by phone. There was a possibility of bias about remembering food and size portions even though we tried to use a pdf book to show the household measurement to the user to anticipate the wrong size portions and briefing the research assistant on how to be proactive and use interview guidelines. For BMI, we scheduled the participants depending on their academic schedule (approximately two weeks after intervention).
3. The study only focused on dietary consumption for 8 weeks intervention while the exercise activities did not measure. Even we measured in baseline, it is possible that the intervention and comparison groups changed their physical activities.

6.4 Recommendation

There was four level of suggestion that we can provide after this research as follows.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Personal level (users of Diamond Application)

1. Diamond Application users should optimize the food and calories reminder features in this application because one of the important keys to managing the intake is consistency to input the food consumption then, the apps will help to give you consideration about how many calories are left on that day.
2. The Diamond application was appropriate to educate the users who don’t know how estimated food calories. When they sustain using this application, they will receive information about many estimation food calories which they never thought. Then, they can manage their food intake till they are independent to live without the tools.

3. Diamond Applications or other dietary applications are tools that assist the user in managing their intake. However, the users' patients and self-efficacy were the essential factors correlated with the success of the user goals such as lost weight or proportional body.
4. To maintain a proportional weight, the users should also consider exercise and water consumption. Decreasing the total intake of calories does not mean the fat in the body is reduced. Therefore, users need to do physical exercise, consume more fiber, and drink water to burn their fat deposits and maintain their long-term fat loss.

Community level

1. Enlarge the sample sizes in other population should be involved to investigate the effect of the Diamond application, such as other provinces with different food characteristics (in Sumatra Province, most people like to eat fatty food, while for Central Java Province prefer sugary food). In addition, not only women but all gender should be considered.
2. The diamond application should consider the undernutrition population in young adults. While the overweight will lead to degenerative diseases, the undernutrition will affect the deficiency of nutrients needed, which can influence their productivity. Hence, this population can use the application to investigate the effect of apps to achieve a normal level of BMI.

CHULALONGKORN UNIVERSITY

Institutional level

This study provided the upgraded database of food estimation and significant results between dietary application, dietary intake, and BMI. Hence, the nutrition department in universities or other stakeholders concerned with the nutrition issue can use these study results as pilot studies and develop an advanced intervention to prevent malnutrition.

Further research

1. Further study for dietary application should provide more food image detection and high accuracy of the database. Then, it should validate the food database based on ingredient. Hence, it will have some option of estimated

calories information based the ingredient of food. In addition, it should add more features such as video or diet preference food information and calculating the exercise calories linked to calories intake.

2. Diamond application should upgrade the features for alarm the high fat and allergic food to ensure the users to avoid the food that might harm to their diet or their health.
3. In the future, a Diamond application should investigate for a longer time, such as 3 or 6 months and find the association with other health outcomes such as waist circumference and body fat mass.
4. In future, Diamond application can collaborate with Department of Health to upgrade the information related with dietary issues. This application can assist the promotion of obesity guideline books to new generation which attached to mobile.
5. Near future, Diamond application can upgrade not only Indonesian cuisines but also international menu databases to improve the users' engagement.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

REFERENCES

Adu, m. D., malabu, u. H., malau-aduli, a. E. O. & malau-aduli, b. S. 2018. Users' preferences and design recommendations to promote engagements with mobile apps for diabetes self-management: multi-national perspectives. *Plos one,* 13**,** e0208942.

Afriani anjani, ginting, s. & anggita, g. The effect of aerobic exercise on body weight and body fat percentage. Proceedings of the 5th international conference on sports, health, and physical education, ismina 2021, 28-29 april 2021, semarang, central java, indonesia, 2021/10/19/ 2021. Semarang, central java, indonesia: eai.

Agrawal abhinav & mittal, n. 2020. Using cnn for facial expression recognition: a study of the effects of kernel size and number of filters on accuracy. *The visual computer,* 36**,** 405-412.

Ahn jeong sun, kim dong woo, kim jiae, park haemin & lee jung eun 2019. Development of a smartphone application for dietary self-monitoring. *Frontiers in nutrition,* 6**,** 149.

Aizawa, k., maruyama, y., li, h. & morikawa, c. 2013. Food balance estimation by using personal dietary tendencies in a multimedia food log. *Ieee transactions on multimedia,* 15**,** 2176-2185.

Al-hazzaa, h., abahussain, n., al-sobayel, h., qahwaji, d. & musaiger, a. 2012. Lifestyle factors associated with overweight and obesity among saudi adolescents. *Bmc public health,* 12**,** 354.

Al-qershi fattoh, al-qurishi, m., rahman, s. M. M. & al-amri, a. Android vs. Ios: the security battle. 2014 world congress on computer applications and information systems (wccais), 17-19 jan. 2014 2014. 1-8.

Alberga, sigal, r., goldfield, g., prud' homme, d. & kenny, g. 2012. Overweight and obese teenagers: why is adolescence a critical period? *Pediatric obesity,* 7**,** 261-273.

Almatsier, s. 2010. *Prinsip dasar ilmu gizi,* jakarta, pt gramedia pustaka utama.

Alosaimi fahad d., alyahya, h., alshahwan, h., al mahyijari, n. & shaik, s. A. 2016. Smartphone addiction among university students in riyadh, saudi arabia. *Saudi medical journal,* 37**,** 675-683.

Alshurafa nabil, lin, a. W., zhu, f., ghaffari, r., hester, j., delp, e., rogers, j. & spring, b. 2019. Counting bites with bits: expert workshop addressing calorie and macronutrient intake monitoring. *Journal of medical internet research,* 21**,** e14904.

Alves, h. J. & boog, m. 2007. Food behavior in student residence halls: a setting for health promotion. *Scielo public health,* 41**,** 197-204.

American college health, a. 2007. American college health association national college health assessment spring 2006 reference group data report (abridged). *Journal of american college health,* 55**,** 195-206.

Ames, g. E., heckman, m. G., grothe, k. B. & clark, m. M. 2012. Eating self-efficacy: development of a short-form wel. *Eating behaviors,* 13**,** 375-378.

Anggraeni wiwik, andri, k. B., sumaryanto & mahananto, f. 2017. The performance of arimax model and vector autoregressive (var) model in forecasting strategic commodity price in indonesia. *Procedia computer science,* 124**,** 189-196.
Anirudh. 2020. *Firebase analytics in flutter* [online]. Available: https://medium.com/flutterdevs/firebase-analytics-2044e865efc4 [accessed].
Annesi, j. J. 2007. Relations of changes in exercise self-efficacy, physical self-concept, and body satisfaction with weight changes in obese white and african american women initiating a physical activity program. *Ethnicity and disease,* 17**,** 19.
Anothaisintawee thunyarat, lertrattananon, d., thamakaison, s., thakkinstian, a. & reutrakul, s. 2018. The relationship among morningness-eveningness, sleep duration, social jetlag, and body mass index in asian patients with prediabetes. *Frontiers in endocrinology,* 9**,** 435.
Association of internet service provider indonesia 2019. National survei on penetration & profile internet user in indonesia 2018. Jakarta: asosiasi penyelenggara jasa internet indonesia.
Azadbakht leila, hajishafiee, m., golshahi, j. & esmaillzadeh, a. 2016. Snacking behavior and obesity among female adolescents in isfahan, iran. *Journal of the american college of nutrition,* 35**,** 405-412.
Bae sung man 2017. The relationship between the type of smartphone use and smartphone dependence of korean adolescents: national survey study. *Children and youth services review,* 81**,** 207-211.
Baharuddin, r., singh, d. & razali, r. 2013. Usability dimensions for mobile applications-a review. *Res. J. Appl. Sci. Eng. Technol,* 5**,** 2225-2231.
Bandura, a. 1977. Self-efficacy: toward a unifying theory of behavioral change. *Psychological review,* 84**,** 191.
Bardus, m., van beurden, smith & abraham 2016a. A review and content analysis of engagement, functionality, aesthetics, information quality, and change techniques in the most popular commercial apps for weight management. *Bmc journal,* 13**,** 1-9.
Bardus, m., van beurden, s. B., smith, j. R. & abraham, c. 2016b. A review and content analysis of engagement, functionality, aesthetics, information quality, and change techniques in the most popular commercial apps for weight management. *International journal of behavioral nutrition and physical activity,* 13**,** 35.
Bardus marco, ali, a., demachkieh, f. & hamadeh, g. 2019. Assessing the quality of mobile phone apps for weight management: user-centered study with employees from a lebanese university. *Jmir mhealth and uhealth,* 7**,** e9836.
Barea abimael, ferre, x. & villarroel, l. Android vs. Ios interaction design study for a student multiplatform app. 2013 berlin, heidelberg. Springer berlin heidelberg, 8-12.
Beasley jeannette, riley, w. T. & jean-mary, j. 2005. Accuracy of a pda-based dietary assessment program. *Nutrition,* 21**,** 672-677.
Béjar, l. M., reyes, ó. A. & garcía-perea, m. D. 2018. Electronic 12-hour dietary recall (e-12hr): comparison of a mobile phone app for dietary intake assessment with a food frequency questionnaire and four dietary records. *Jmir mhealth and uhealth,* 6**,** e10409.

Bellisle france 2014. Meals and snacking, diet quality and energy balance. *Physiology and behavior,* 134**,** 38-43.
Benjdira bilel, khursheed, t., koubaa, a., ammar, a. & ouni, k. Car detection using unmanned aerial vehicles: comparison between faster r-cnn and yolov3. 2019 1st international conference on unmanned vehicle systems-oman (uvs), 2019 2019. Ieee, 1-6.
Bhuiyan, m. U., zaman, s. & ahmed, t. 2013. Risk factors associated with overweight and obesity among urban school children and adolescents in bangladesh: a case–control study. *Bmc pediatrics,* 13**,** 1-6.
Bhupathiraju, s. N. & hu, f. B. 2016. Epidemiology of obesity and diabetes and their cardiovascular complications. *Circulation research,* 118**,** 1723-1735.
Bian mengwei & leung, l. 2015. Linking loneliness, shyness, smartphone addiction symptoms, and patterns of smartphone use to social capital. *Social science computer review,* 33**,** 61-79.
Bleich sara n., vercammen, k. A., zatz, l. Y., frelier, j. M., ebbeling, c. B. & peeters, a. 2018. Interventions to prevent global childhood overweight and obesity: a systematic review. *The lancet diabetes & endocrinology,* 6**,** 332-346.
Boden guenther, homko, c., barrero, c. A., stein, t. P., chen, x., cheung, p., fecchio, c., koller, s. & merali, s. 2015. Excessive caloric intake acutely causes oxidative stress, glut4 carbonylation, and insulin resistance in healthy men. *Science translational medicine,* 7**,** 1-10.
Boon teo & sedek, r. 2012. Association between snacking patterns, energy and nutrient intakes, and body mass index among school adolescents in kuala lumpur. *American journal of food and nutrition,* 2**,** 69-77.
Boushey, c., harray, kerr, d., schap, paterson, aflague, bosch ruiz, ahmad & delp 2015. How willing are adolescents to record their dietary intake? The mobile food record. *Jmir mhealth uhealth,* 3**,** e47.
Branje, s. & koper, n. 2018. Psychosocial development. *In:* bornstein, m. H. (ed.) *The sage encyclopedia of lifespan human development.* Sage publications, inc. .
Braz vitória negri & de moraes lopes maria helena baena 2019. Evaluation of mobile applications related to nutrition. *Public health nutrition,* 22**,** 1209-1214.
Braz, v. N. & lopes, m. H. 2019. Evaluation of mobile applications related to nutrition. *Public health nutrition,* 22**,** 1209-1214.
Breton, e. R., fuemmeler, b. F. & abroms, l. C. 2011. Weight loss—there is an app for that! But does it adhere to evidence-informed practices? *Translational behavioral medicine,* 1**,** 523-529.
Brindal, e., hendrie, g. A., freyne, j. & noakes, m. 2018. Incorporating a static versus supportive mobile phone app into a partial meal replacement program with face-to-face support: randomized controlled trial. *Jmir mhealth uhealth,* 6**,** e41.
Brockmann andrea n., eastman, a. & ross, k. M. 2020. Frequency and consistency of self-weighing to promote weight-loss maintenance. *Obesity (silver spring, md.),* 28**,** 1215-1218.
Brown, t. & summerbell, c. 2009. Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: an update to the obesity guidance produced by the national

institute for health and clinical excellence. *Journal of obesity reviews,* 10**,** 110-141.

Budiu, r. 2020. Dark mode vs. Light mode: which is better? *Nielsen norman group*.

Burrows tracy l., ho, y. Y., rollo, m. E. & collins, c. E. 2019. Validity of dietary assessment methods when compared to the method of doubly labeled water: a systematic review in adults. *Frontiers in endocrinology,* 10.

Bybyk, a. 2019. How to copyright a video: quick guide. *Ultimate live streaming hub – restream blog*.

Byrne, s., barry, d. & petry, n. M. 2012. Predictors of weight loss success. Exercise vs. Dietary self-efficacy and treatment attendance. *Appetite journal,* 58**,** 695-698.

Capurso cristiano, bellanti, f., lo buglio, a. & vendemiale, g. 2020. The mediterranean diet slows down the progression of aging and helps to prevent the onset of frailty: a narrative review. *Nutrients,* 12**,** 35.

Carreras-torres robert, johansson, m., haycock, p. C., relton, c. L., smith, g. D., brennan, p. & martin, r. M. 2018. Role of obesity in smoking behaviour: mendelian randomisation study in uk biobank. *Bmj,* 361**,** k1767.

Casperson, s. L., sieling, j., moon, j., johnson, l., roemmich, j. N. & whigham, l. 2015. A mobile phone food record app to digitally capture dietary intake for adolescents in a free-living environment: usability study. *Jmir mhealth uhealth,* 3**,** e30.

Centers for disease control and prevention, c. 2013. *Genes and obesity* [online]. Office of science (os), office of genomics and precision public health. Available: https://www.cdc.gov/genomics/resources/diseases/obesity/obesedit.htm [accessed 3 april 2022 2022].

Chan te fu, lin, w. T., huang, h. L., lee, c. Y., wu, p. W., chiu, y. W., huang, c. C., tsai, s., lin, c. L. & lee, c. H. 2014. Consumption of sugar-sweetened beverages is associated with components of the metabolic syndrome in adolescents. *Nutrients,* 6**,** 2088-2103.

Chaput, j.-p., lambert, m., gray-donald, k., mcgrath, j. J., tremblay, m. S., o'loughlin, j. & tremblay, a. 2011. Short sleep duration is independently associated with overweight and obesity in quebec children. *Canadian journal of public health,* 102**,** 369-374.

Chen, j.-l. & wilkosz, m. E. 2014. Efficacy of technology-based interventions for obesity prevention in adolescents: a systematic review. *Adolescent health, medicine and therapeutics,* 5**,** 159.

Chen, j., cade, j. E. & allman-farinelli, m. 2015. The most popular smartphone apps for weight loss: a quality assessment. *Jmir mhealth uhealth,* 3**,** e104.

Chen juliana, berkman william, bardouh manal, ng ching, yan kammy, allman-farinelli & margaret 2019. The use of a food logging app in the naturalistic setting fails to provide accurate measurements of nutrients and poses usability challenges. *Nutrition,* 57**,** 208-216.

Cho yongin, hong, n., kim, k.-w., cho, s. J., lee, m., lee, y.-h., lee, y.-h., kang, e. S., cha, b.-s. & lee, b.-w. 2019. The effectiveness of intermittent fasting to reduce body mass index and glucose metabolism: a systematic review and meta-analysis. *Journal of clinical medicine,* 8**,** 1645.

Cienfuegos sofia, gabel, k., kalam, f., ezpeleta, m., wiseman, e., pavlou, v., lin, s., oliveira, m. L. & varady, k. A. 2020. Effects of 4- and 6-h time-restricted feeding on weight and cardiometabolic health: a randomized controlled trial in adults with obesity. *Cell metabolism,* 32**,** 366-378.e3.

Collins, c. E., watson, j. & burrows, t. 2010. Measuring dietary intake in children and adolescents in the context of overweight and obesity. *International journal of obesity,* 34**,** 1103-1115.

Correa-burrows paulina, rodríguez, y., blanco, e., gahagan, s. & burrows, r. 2017. Snacking quality is associated with secondary school academic achievement and the intention to enroll in higher education: a cross-sectional study in adolescents from santiago, chile. *Nutrients,* 9.

Costigan sarah a., barnett, l., plotnikoff, r. C. & lubans, d. R. 2013. The health indicators associated with screen-based sedentary behavior among adolescent girls: a systematic review. *Journal of adolescent health,* 52**,** 382-392.

Coughlin, s. S., whitehead, m., sheats, j. Q., mastromonico, j., hardy, d. & smith, s. A. 2015. Smartphone applications for promoting healthy diet and nutrition: a literature review. *Journal of food nutrition,* 2**,** 021.

Cuadrado esther, gutiérrez-domingo, t., castillo-mayen, r., luque, b., arenas, a. & taberneroa, c. 2018. The self-efficacy scale for adherence to the mediterranean diet (sesamed): a scale construction and validation. *Appetite,* 120**,** 6-15.

Dagne, s., gelaw, y. A., abebe, z. & wassie, m. M. 2019. Factors associated with overweight and obesity among adults in northeast ethiopia: a cross-sectional study. *Diabetes, metabolic syndrome and obesity: targets and therapy,* 12**,** 391.

Darby alaina, strum matthew w., holmes erin & gatwood justin 2016. A review of nutritional tracking mobile applications for diabetes patient use. *Diabetes technology & therapeutics,* 18**,** 200-212.

Daugherty, b. L., schap, t. E., ettienne-gittens, r., zhu, f. M., bosch, m., delp, e. J., ebert, d. S., kerr, d. A. & boushey, c. J. 2012. Novel technologies for assessing dietary intake: evaluating the usability of a mobile telephone food record among adults and adolescents. *Journal of medical internet research,* 14**,** e58.

Deliens, t., clarys, p., de bourdeaudhuij, i. & deforche, b. 2014. Determinants of eating behaviour in university students: a qualitative study using focus group discussions. *Bmc public health,* 14**,** 1-12.

Demirci kadir, akgönül, m. & akpinar, a. 2015. Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. *Journal of behavioral addictions,* 4**,** 85-92.

Dent robert, mcpherson, r. & harper, m.-e. 2020. Factors affecting weight loss variability in obesity. *Metabolism - clinical and experimental,* 113.

Developer android team 2022. Reduce your app size. *Android developers*.

Developer.android.com 2021. Device compatibility overview. *Android developers*.

Dewantari, n. M., ambartana, i. W., suiraoka, i. P., kusumayanti, g. D., sukraniti, d. P. & putra, i. G. I. P. 2020. The effects of a low-fat diet and a low-carbohydrate diet with aerobic exercise on changing of lipid profile. *World nutrition journal,* 3**,** 53-58.

Diguna, m., rachmawati, m. & prawiradilaga, r. 2015. Association of quantity and type of fritters as morning snack with bmi among army yonzipur. Special

procedding, august, 2015 2015 bandung. Bandung: universitas islam bandung, 479-486.
Doku david, koivusilta, l., raisamo, s. & rimpelä, a. 2013. Socio-economic differences in adolescents' breakfast eating, fruit and vegetable consumption and physical activity in ghana. *Public health nutrition,* 16**,** 864-872.
Donnelly, j. E., blair, s. N., jakicic, j. M., manore, m. M., rankin, j. W. & smith, b. K. 2009. American college of sports medicine position stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Medicine and science in sports and exercise,* 41**,** 459-471.
Dunn caroline glagola, turner-mcgrievy, g. M., wilcox, s. & hutto, b. 2019. Dietary self-monitoring through calorie tracking but not through a digital photography app is associated with significant weight loss: the 2smart pilot study—a 6-month randomized trial. *Journal of the academy of nutrition and dietetics,* 119**,** 1525-1532.
Ebbeling cara b., feldman, h. A., chomitz, v. R., antonelli, t. A., gortmaker, s. L., osganian, s. K. & ludwig, d. S. 2012. A randomized trial of sugar-sweetened beverages and adolescent body weight. *New england journal of medicine,* 367**,** 1407-1416.
Ege, t., ando, y., tanno, r., shimoda, w. & yanai, k. Image-based estimation of real food size for accurate food calorie estimation. 2019 ieee conference on multimedia information processing and retrieval (mipr), 2019/03// 2019. San jose, ca, usa: institute of electrical and electronics engineers, 274-279.
Elfhag, k. & rössner, s. 2005. Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obesity reviews,* 6**,** 67-85.
Erikson, e. H. 1968. *Identity yuth and crisis,* new york, ww norton.
Ershov daniel 2018. The effect of consumer search costs on entry and quality in the mobile app market. *Unpublished manuscript*.
Fakih el khoury cosette. 2020. *An mhealth intervention for the dietary management of hemodialysis patients.* Doctoral thesis, ridderprint bv.
Fatsecret. 2022. *Fatsecret indonesia* [online]. Jakarta. Available: https://www.fatsecret.co.id/kalori-gizi/ [accessed].
Fitzgerald, s. T. 1991. Self-efficacy theory: implications for the occupational health nurse. *Aaohn journal,* 39**,** 552-557.
Flølo tone nygaard, tell, g. S., kolotkin, r. L., aasprang, a., norekvål, t. M., våge, v. & andersen, j. R. 2019. Eating self-efficacy as predictor of long-term weight loss and obesity-specific quality of life after sleeve gastrectomy: a prospective cohort study. *Surgery for obesity and related diseases,* 15**,** 161-167.
Flora harleen k, wang, x. & chande, s. V. 2014. An investigation on the characteristics of mobile applications: a survey study. *Ij information technology and computer science,* 11**,** 21-27.
Food and nutrition technical assistance, f. 2016. Module 2. Nutrition assessment and classification. *Nutrition assessment, counseling, and support (nacs).*
Franz, m. J., boucher, j. L., rutten-ramos, s. & vanwormer, j. J. 2015. Lifestyle weight-loss intervention outcomes in overweight and obese adults with

type 2 diabetes: a systematic review and meta-analysis of randomized clinical trials. *Journal of the academy of nutrition and dietetics,* 115**,** 1447-1463.

Freyne, j., yin, j., brindal, e., hendrie, g. A., berkovsky, s. & noakes, m. 2017. Push notifications in diet apps: influencing engagement times and tasks. *International journal of human–computer interaction,* 33**,** 833-845.

Fukuoka, y., gay, c. L., joiner, k. L. & vittinghoff, e. 2015. A novel diabetes prevention intervention using a mobile app: a randomized controlled trial with overweight adults at risk. *American journal of preventive medicine,* 49**,** 223-237.

Garcia-ortiz luis, recio-rodriguez, j. I., agudo-conde, c., patino-alonso, m. C., maderuelo-fernandez, j.-a., gento, i. R., puig, e. P., gonzalez-viejo, n., arietaleanizbeaskoa, m. S., schmolling-guinovart, y., gomez-marcos, m. A., rodriguez-sanchez, e. & group, e. I. 2018. Long-term effectiveness of a smartphone app for improving healthy lifestyles in general population in primary care: randomized controlled trial (evident ii study). *Jmir mhealth and uhealth,* 6**,** e9218.

Ghelani, d. P., moran, l. J., johnson, c., mousa, a. & naderpoor, n. 2020. Mobile apps for weight management: a review of the latest evidence to inform practice. *Frontiers in endocrinology,* 11**,** 412-412.

Ghelani drishti p., moran, l. J., johnson, c., mousa, a. & naderpoor, n. 2020. Mobile apps for weight management: a review of the latest evidence to inform practice. *Frontiers in endocrinology,* 11.

Google team. 2019. *Google analytics for firebase* [online]. Available: https://firebase.google.com/docs/analytics?hl=id [accessed november, 23 2020].

Gordon, m. M., bopp, m. J., easter, l., miller, g. D., lyles, m. F., houston, d. K., nicklas, b. J. & kritchevsky, s. B. 2008. Effects of dietary protein on the composition of weight loss in post-menopausal women. *The journal of nutrition, health & aging,* 12**,** 505-509.

Goyal, r. K., shah, v. N., saboo, b. D., phatak, s. R., shah, n. N., gohel, m. C., raval, p. B. & patel, s. S. 2010. Prevalence of overweight and obesity in indian adolescent school going children: its relationship with socioeconomic status and associated lifestyle factors. *The journal of the association of physicians of india,* 58**,** 151-158.

Griffiths carly, harnack lisa & pereira mark a. 2018. Assessment of the accuracy of nutrient calculations of five popular nutrition tracking applications. *Public health nutrition,* 21**,** 1495-1502.

Guo, s. S., roche, a. F., chumlea, w. C., gardner, j. D. & siervogel, r. M. 1994. The predictive value of childhood body mass index values for overweight at age 35 y. *The american journal of clinical nutrition,* 59**,** 810-819.

Haase christiane lundegaard, lopes, s., olsen, a. H., satylganova, a., schnecke, v. & mcewan, p. 2021. Weight loss and risk reduction of obesity-related outcomes in 0.5 million people: evidence from a uk primary care database. *International journal of obesity,* 45**,** 1249-1258.

Hall kevin d. & kahan, s. 2018. Maintenance of lost weight and long-term management of obesity. *The medical clinics of north america,* 102**,** 183-197.

Hanandita, w. & tampubolon, g. 2015. The double burden of malnutrition in indonesia: social determinants and geographical variations. *Ssm - population health,* 1**,** 16-25.

Hays, l. M., finch, e. A., saha, c., marrero, d. G. & ackermann, r. T. 2014. Effect of self-efficacy on weight loss: a psychosocial analysis of a community-based adaptation of the diabetes prevention program lifestyle intervention. *Diabetes spectrum,* 27**,** 270-275.

Heejin kim, kim, k., hong, j., heo, j. & kook, j. 2020. Edaroid: an efficient dynamic analysis tool for android applications. *Proceedings of the international conference on research in adaptive and convergent systems.* Gwangju, republic of korea: association for computing machinery.

Hock, k. B., tallman, d., kaur, d., daud, z. A. M., khosla, p. & karupaiah, t. 2018. Dietary assessment methods. *Journal of renal nutrition and metabolism,* 3**,** 8.

Hu, p., huang, w., bai, r., zhang, f., sharma, m., shi, z., xiao, x., abdullah, a. S. & zhao, y. 2016. Knowledge, attitude, and behaviors related to eating out among university students in china. *International journal of environmental research and public health,* 13**,** 696.

Huang chen, huang, j., tian, y., yang, x. & gu, d. 2014. Sugar sweetened beverages consumption and risk of coronary heart disease: a meta-analysis of prospective studies. *Atherosclerosis,* 234**,** 11-16.

Illner, a. K., freisling, h., boeing, h., huybrechts, i., crispim, s. P. & slimani, n. 2012. Review and evaluation of innovative technologies for measuring diet in nutritional epidemiology. *International journal of epidemiology,* 41**,** 1187-1203.

Indonesia ministry of health 2013. National health survey report (riskesdas) 2013. *Laporan riskesdas.* Jakarta: badan penelitian dan pengembangan kesehatan.

Indonesia ministry of health 2014. *Balanced nutrition guidelines,* jakarta, indonesia, ministry of health of the republic of indonesia.

Indonesia ministry of health. 2016. *Germas wujudkan indonesia sehat* [online]. Jakarta: kemenkes ri. Available: https://sehatnegeriku.kemkes.go.id/baca/rilis-media/20161115/1318864/germas-wujudkan-indonesia-sehat/ [accessed september, 1 2020].

Indonesia ministry of health. 2017. *Kebutuhan kalori basal (basal metabolic rate (bmr))* [online]. Available: http://www.p2ptm.kemkes.go.id/infographic-p2ptm/obesitas/tahukah-sobat-sehat-berapa-kebutuhan-kalori-anda-per-hari [accessed].

Indonesia ministry of health. 2018. *Survey konsumsi (consumtion survey)* [online]. Jakarta: bppsdmk. Available: http://bppsdmk.kemkes.go.id/pusdiksdmk/wp-content/uploads/2018/09/survey-konsumsi-pangan_sc.pdf [accessed 13/08/20 2020].

Indonesia ministry of health 2019. Regulations number 28 year 2019 about recommendation of nutritional adequacy rate. *28.* Jakarta: ministry of health.

Indonesia ministry of health. 2020. *Indonesian food composition data* [online]. Jakarta: indonesian ministry of health. Available: https://www.panganku.org/en-en/beranda [accessed 2021/05/11].

Indonesia ministry of health p2tm. 2018. *Suggestion of sugar, salt, and fat consumption* [online]. Jakarta: indonesia ministry of health available:

http://www.p2ptm.kemkes.go.id/infographic-p2ptm/hipertensi-penyakit-jantung-dan-pembuluh-darah/page/15/berapa-anjuran-konsumsi-gula-garam-dan-lemak-per-harinya [accessed 18 may 2021 2021].

Indonesian health research department 2019. East java province health report (riskesdas 2018). Jakarta: badan penelitian dan pengembangan kesehatan (lpb).

Indonesian ministry of health 2017. Guidance of "gerakan nusantara tekan angka obesitas (gentas)". Jakarta: indonesian ministry of health.

Indonesian ministry of health 2018. Health reported survey and guideline, riskesdas. Badan penelitian dan pengembangan kesehatan.

Indonesian ministry of health. 2019. *Cut of point for body mass index (bmi) for indonesian people* [online]. Kemenkes ri. Available: http://www.p2ptm.kemkes.go.id/infographic-p2ptm/obesitas/tabel-batas-ambang-indeks-massa-tubuh-imt [accessed].

Ioannidis john p. A. 2016. Biases in obesity research: identify, correct, endorse, or abandon effort? *Obesity*, 24**,** 767-768.

Jackson, l. W. 2013. The most important meal of the day: why children skip breakfast and what can be done about it. *Pediatric annals*, 42**,** 184-187.

Järvelä-reijonen elina, karhunen, l., sairanen, e., muotka, j., lindroos, s., laitinen, j., puttonen, s., peuhkuri, k., hallikainen, m., pihlajamäki, j., korpela, r., ermes, m., lappalainen, r. & kolehmainen, m. 2018. The effects of acceptance and commitment therapy on eating behavior and diet delivered through face-to-face contact and a mobile app: a randomized controlled trial. *International journal of behavioral nutrition and physical activity*, 15**,** 22.

Jiang, l., qiu, b., liu, x., huang, c. & lin, k. 2020. Deepfood: food image analysis and dietary assessment via deep model. *Ieee access*, 8**,** 47477-47489.

Jimoh florence, lund, e. K., harvey, l. J., frost, c., lay, w. J., roe, m. A., berry, r. & finglas, p. M. 2018. Comparing diet and exercise monitoring using smartphone app and paper diary: a two-phase intervention study. *Jmir mhealth and uhealth*, 6**,** e7702.

Johns david j., hartmann-boyce, j., jebb, s. A. & aveyard, p. 2016. Weight change among people randomized to minimal intervention control groups in weight loss trials. *Obesity (silver spring, md.)*, 24**,** 772-780.

Kang seok 2014. Factors influencing intention of mobile application use. *International journal of mobile communications*, 12**,** 360-379.

Karina sa'diah multi & amrihati, e. T. 2017. *Bahan ajar gizi: pengembangan kuliner*, ministry of health republic of indonesia.

Keramati abbas & ardabili, s. M. S. 2011. Churn analysis for an iranian mobile operator. *Telecommunications policy*, 35**,** 344-356.

Kessaram tara, mckenzie, j., girin, n., merilles, o. E. A., pullar, j., roth, a., white, p. & hoy, d. 2015. Overweight, obesity, physical activity and sugar-sweetened beverage consumption in adolescents of pacific islands: results from the global school-based student health survey and the youth risk behavior surveillance system. *Bmc obesity*, 2**,** 1-10.

Kim ju young 2021. Optimal diet strategies for weight loss and weight loss maintenance. *Journal of obesity & metabolic syndrome*, 30**,** 20-31.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Kitada munehiro, ogura, y., monno, i. & koya, d. 2019. The impact of dietary protein intake on longevity and metabolic health. *Ebiomedicine,* 43**,** 632-640.
Knez simon & šajn, l. 2020. Food object recognition using a mobile device: evaluation of currently implemented systems. *Trends in food science & technology,* 99**,** 460-471.
Knost, l. 2013. *Two thousand kisses a day: gentle parenting through the ages and stages*, little hearts books llc.
Kocakoyun senay & bicen, h. 2017. Development and evaluation of educational android application. *Cypriot journal of educational sciences,* 12**,** 58-68.
Koebnick, c., smith, n., black, m. H., porter, a. H., richie, b. A., hudson, s., gililland, d., jacobsen, s. J. & longstreth, g. F. 2012. Pediatric obesity and gallstone disease: results from a cross-sectional study of over 510,000 youth. *Journal of pediatric gastroenterology and nutrition,* 55**,** 328-333.
Kolawole afolabi kamaldeen, kevin, n. U., oluwole, i. & ademola, s. 2017. The association of socio-demographic factors with overweight/obesity among students (ages 18-35 years) in cavendish university, uganda. *Epidemiology (sunnyvale),* 7**,** 1-6.
Kreutzer, t. 2009. Generation mobile: online and digital media usage on mobile phones among low-income urban youth in south africa. *Retrieved on march,* 30**,** 903-920.
Kristi wempen. 2016. *Are you getting too much protein?* [online]. United states: mayo clinic. Available: https://www.mayoclinichealthsystem.org/hometown-health/speaking-of-health/are-you-getting-too-much-protein [accessed 2 april 2022 2016].
Kroeger cynthia m., trepanowski, j. F., klempel, m. C., barnosky, a., bhutani, s., gabel, k. & varady, k. A. 2018. Eating behavior traits of successful weight losers during 12 months of alternate-day fasting: an exploratory analysis of a randomized controlled trial. *Nutrition and health,* 24**,** 5-10.
Kroger, j. 2006. *Identity development: adolescence through adulthood*, sage publications.
Kumala febriandrini 2021. Developing empathy with steam learning in grade viii smp lazuardi al-falah depok. *Pedagonal: jurnal ilmiah pendidikan,* 5**,** 121-132.
Kunst alexander 2019. Usage of health apps to track nutrition among us adults by age 2017. *Statista*.
Laranjo, l., ding, d., heleno, b., kocaballi, b., quiroz, j. C., tong, h. L., chahwan, b., neves, a. L., gabarron, e., dao, k. P., rodrigues, d., neves, g. C., antunes, m. L., coiera, e. & bates, d. W. 2021. Do smartphone applications and activity trackers increase physical activity in adults? Systematic review, meta-analysis and metaregression. *British journal of sports medicine,* 55**,** 422-432.
Larson nicole i, miller jm, watts aw, story mt & neumark-sztainer dr 2016. Adolescent snacking behaviors are associated with dietary intake and weight status. *J nutr,* 146**,** 1348-55.
Lee hae jeong, kim, c. H., han, i. & kim, s. H. 2019. Emotional state according to breakfast consumption in 62276 south korean adolescents. *Iranian journal of pediatrics,* 29.

Lee, j.-e., song, s., ahn, j. S., kim, y. & lee, j. E. 2017. Use of a mobile application for self-monitoring dietary intake: feasibility test and an intervention study. *Nutrients,* 9**,** 748.

Letamo, g. 2011. The prevalence of, and factors associated with, overweight and obesity in botswana. *Journal of biosocial science,* 43**,** 75-84.

Li lian, zhang, s., huang, y. & chen, k. 2017. Sleep duration and obesity in children: a systematic review and meta-analysis of prospective cohort studies. *Journal of paediatrics and child health,* 53**,** 378-385.

Lieffers, j. R. L., arocha, j. F., grindrod, k. & hanning, r. M. 2018. Experiences and perceptions of adults accessing publicly available nutrition behavior-change mobile apps for weight management. *J acad nutr diet,* 118**,** 229-239.e3.

Likhitweerawong narueporn, boonchooduang, n., kittisakmontri, k., chonchaiya, w. & louthrenoo, o. 2020. Short-term outcomes of tablet/smartphone-based (obest) application among obese thai school-aged children and adolescents: a randomized controlled trial. *Obesity medicine,* 20**,** 100287.

Lim, b. Y., chng, x. & zhao, s. Trade-off between automation and accuracy in mobile photo recognition food logging. 2017/06/08/ 2017. New york, ny, usa: association for computing machinery, 53-59.

Lin wt., huang, h. L., huang, m. C., chan, t. F., ciou, s. Y., lee, c. Y., chiu, y. W., duh, t. H., lin, p. L., wang, t. N., liu, t. Y. & lee, c. H. 2013. Effects on uric acid, body mass index and blood pressure in adolescents of consuming beverages sweetened with high-fructose corn syrup. *International journal of obesity,* 37**,** 532-539.

Lipoeto nur indrawaty, geok lin, k. & angeles-agdeppa, i. 2013. Food consumption patterns and nutrition transition in south-east asia. *Public health nutrition,* 16**,** 1637-1643.

Llanaj, e., ádány, r., lachat, c. & d'haese, m. 2018. Examining food intake and eating out of home patterns among university students. *Plos one,* 13**,** e0197874.

Lombardo caterina, cerolini, s., alivernini, f., ballesio, a., violani, c., fernandes, m. & lucidi, f. 2021. Eating self-efficacy: validation of a new brief scale. *Eating and weight disorders - studies on anorexia, bulimia and obesity,* 26**,** 295-303.

Lu, l., risch, h., irwin, m. L., mayne, s. T., cartmel, b., schwartz, p., rutherford, t. & yu, h. 2011. Long-term overweight and weight gain in early adulthood in association with risk of endometrial cancer. *International journal of cancer,* 129**,** 1237-1243.

Lu ya, allegra dario, anthimopoulos marios, stanco filippo, farinella giovanni maria & mougiakakou stavroula. A multi-task learning approach for meal assessment. Proceedings of the joint workshop on multimedia for cooking and eating activities and multimedia assisted dietary management, 2018 2018. 46-52.

Lucan, s. C. & dinicolantonio, j. J. 2015. How calorie-focused thinking about obesity and related diseases may mislead and harm public health. An alternative. *Public health nutrition,* 18**,** 571-581.

Lucan sean c & dinicolantonio, j. J. 2015. How calorie-focused thinking about obesity and related diseases may mislead and harm public health. An alternative. *Public health nutrition,* 18**,** 571-581.

Lunde pernille, nilsson, b. B., bergland, a., kværner, k. J. & bye, a. 2018. The effectiveness of smartphone apps for lifestyle improvement in

noncommunicable diseases: systematic review and meta-analyses. *Journal of medical internet research,* 20**,** e9751.
Lwanga, s. K., lemeshow, s. & organization, w. H. 1991. *Sample size determination in health studies: a practical manual*, world health organization.
Lyzwinski, l. N., caffery, l., bambling, m. & edirippulige, s. 2019. The mindfulness app trial for weight, weight-related behaviors, and stress in university students: randomized controlled trial. *Jmir mhealth uhealth,* 7**,** e12210.
Ma juncheng, du, k., zheng, f., zhang, l., gong, z. & sun, z. 2018. A recognition method for cucumber diseases using leaf symptom images based on deep convolutional neural network. *Computers and electronics in agriculture,* 154**,** 18-24.
Maddah, m. & nikooyeh, b. 2010. Factors associated with overweight in children in rasht, iran: gender, maternal education, skipping breakfast and parental obesity. *Public health nutrition,* 13**,** 196-200.
Mahdum maulana, susanto, f. A. & sulistiyani, e. Rancang bangun instrumen teknologi perencanaan menu diet berbasis website. National conference for ummah (ncu) 2020, 2020 2020.
Malang office department 2019. Profil kesehatan kota malang malang: kementrian kesehatan ri.
Mane, d. T. & kulkarni, u. V. 2020. A survey on supervised convolutional neural network and its major applications. *Deep learning and neural networks: concepts, methodologies, tools, and applications.* Igi global.
Marangoni franca, martini, d., scaglioni, s., sculati, m., donini, l. M., leonardi, f., agostoni, c., castelnuovo, g., ferrara, n., ghiselli, a., giampietro, m., maffeis, c., porrini, m., barbi, b. & poli, a. 2019. Snacking in nutrition and health. *International journal of food sciences and nutrition,* 70**,** 909-923.
Maringer, m., wisse-voorwinden, n., veer, p. V. T. & geelen, a. 2019. Food identification by barcode scanning in the netherlands: a quality assessment of labelled food product databases underlying popular nutrition applications. *Public health nutrition,* 22**,** 1215-1222.
Maurer j., taren, d. L., teixeira, p. J., thomson, c. A., lohman, t. G., going, s. B. & houtkooper, l. B. 2006. The psychosocial and behavioral characteristics related to energy misreporting. *Nutr rev,* 64**,** 53-66.
Mayega, r. W., makumbi, f., rutebemberwa, e., peterson, s., östenson, c.-g., tomson, g. & guwatudde, d. 2012. Modifiable socio-behavioural factors associated with overweight and hypertension among persons aged 35 to 60 years in eastern uganda. *Plos one,* 7**,** e47632.
Mezgec, s. & koroušić seljak, b. 2017. Nutrinet: a deep learning food and drink image recognition system for dietary assessment. *Nutrients,* 9**,** 657.
Mhalagi, s. 2019. *The quest of higher accuracy for cnn models* [online]. Available: https://towardsdatascience.com/the-quest-of-higher-accuracy-for-cnn-models-42df5d731faf [accessed].
Min weiqing, jiang shuqiang, liu linhu, rui yong & jain ramesh 2019. A survey on food computing. *Acm computing surveys (csur),* 52**,** 1-36.
Ming zhao-yan, chen jingjing, cao yu, forde ciarán, ngo chong-wah & chua tat seng. Food photo recognition for dietary tracking: system and experiment.

International conference on multimedia modeling, 2018 2018. Springer, 129-141.

Ministry of health republic of indonesia 2014. Regulation no. 41 year 2014 about food pyramid. Indonesia: ministry of health republic of indonesia.

Mirmiran parvin, yuzbashian, e., asghari, g., hosseinpour-niazi, s. & azizi, f. 2015. Consumption of sugar sweetened beverage is associated with incidence of metabolic syndrome in tehranian children and adolescents. *Nutrition and metabolism,* 12**,** 1-9.

Nakatsuka yoshinari, handa, t., kokosi, m., tanizawa, k., puglisi, s., jacob, j., sokai, a., ikezoe, k., kanatani, k. T., kubo, t., tomioka, h., taguchi, y., nagai, s., chin, k., mishima, m., wells, a. U. & hirai, t. 2018. The clinical significance of body weight loss in idiopathic pulmonary fibrosis patients. *Respiration,* 96**,** 338-347.

Naska, a., lagiou, a. & lagiou, p. 2017. Dietary assessment methods in epidemiological research: current state of the art and future prospects. *F1000research,* 6.

National institute of diabetes and digestive and kidney diseases, n. 2020. *Overweight and obesity statistic* [online]. New york. Available: https://www.niddk.nih.gov/health-information/health-statistics/overweight-obesity [accessed].

Neglia, a. 2021. Nutrition, eating disorders, and behavior in athletes. *Psychiatric clinics,* 44**,** 431-441.

Nnanyelugo, d. & okeke 1987. Food habits and nutrient intakes of nigerian university students in traditional halls of residence. *Journal of the american college of nutrition,* 6**,** 369-374.

Noakes timothy david & windt, j. 2017. Evidence that supports the prescription of low-carbohydrate high-fat diets: a narrative review. *British journal of sports medicine,* 51**,** 133-139.

Nutrisurvey team 2010. Neue seite 2.

Nyman, j. 2017. Health and wellbeing needs of young adults age 18-25. *Joint strategic needs assessment (jsna) report.* The city of westminster: the royal borough of kensington and chelsea.

Oddo, v. M., maehara, m. & rah, j. H. 2019. Overweight in indonesia: an observational study of trends and risk factors among adults and children. *Bmj open,* 9**,** e031198.

Oduwole, a. A., ladapo, t. A., fajolu, i. B., ekure, e. N. & adeniyi, o. F. 2012. Obesity and elevated blood pressure among adolescents in lagos, nigeria: a cross-sectional study. *Bmc public health,* 12**,** 616.

Ojiambo, r. M., easton, c., casajús, j. A., konstabel, k., reilly, j. J. & pitsiladis, y. 2012. Effect of urbanization on objectively measured physical activity levels, sedentary time, and indices of adiposity in kenyan adolescents. *Journal of physical activity and health,* 9**,** 115-123.

Pais sarita, parry dave, petrova krassie & rowan jannet 2018. Acceptance of using an ecosystem of mobile apps for use in diabetes clinic for self-management of gestational diabetes mellitus. *Medinfo 2017: precision healthcare through informatics,* 245**,** 188-192.

Pandita, a., sharma, d., pandita, d., pawar, s., tariq, m. & kaul, a. 2016. Childhood obesity: prevention is better than cure. *Diabetes, metabolic syndrome obesity: targets therapy,* 9**,** 83.

Papathanasiou, g., zerva, e., zacharis, i., papandreou, m., papageorgiou, e., tzima, c., georgakopoulos, d. & evangelou, a. 2015. Association of high blood pressure with body mass index, smoking and physical activity in healthy young adults. *The open cardiovascular medicine journal,* 9**,** 5-17.

Par'i, h. M., wiyono, s. & harjatmo 2016. *Penilaian status gizi,* jakarta selatan, penerbit buku kedokteran: egc.

Paramastri rathi, pratama, s. A., ho, d. K. N., purnamasari, s. D., mohammed, a. Z., galvin, c. J., hsu, y.-h. E., tanweer, a., humayun, a., househ, m. & iqbal, u. 2020. Use of mobile applications to improve nutrition behaviour: a systematic review. *Computer methods and programs in biomedicine,* 192**,** 105459.

Park, d. J., kim, k. H., park, y. S., ahn, s.-h., park, d. J. & kim, h.-h. 2016. Risk factors for gallstone formation after surgery for gastric cancer. *Journal of gastric cancer,* 16**,** 98-104.

Park seon-joo, palvanov, a., lee, c.-h., jeong, n., cho, y.-i. & lee, h.-j. 2019. The development of food image detection and recognition model of korean food for mobile dietary management. *Nutrition research and practice,* 13**,** 521-528.

Park seong-hi, hwang, j. & choi, y.-k. 2019. Effect of mobile health on obese adults: a systematic review and meta-analysis. *Healthcare informatics research,* 25**,** 12-26.

Pathak ajeet ram, pandey, m. & rautaray, s. 2018. Application of deep learning for object detection. *Procedia computer science,* 132**,** 1706-1717.

Patrick, k., raab, f., adams, m., dillon, l., zabinski, m., rock, c., griswold, w. & norman, g. 2009. A text message-based intervention for weight loss: randomized controlled trial. *Journal of medical internet research,* 11**,** e1.

Payne jason e., turk, m. T., kalarchian, m. A. & pellegrini, c. A. 2021. Adherence to mobile-app-based dietary self-monitoring—impact on weight loss in adults. *Obesity science & practice*.

Pedersen, l. A., einarsson, s. S., rikheim, f. A. & sandnes, f. E. User interfaces in dark mode during daytime–improved productivity or just cool-looking? International conference on human-computer interaction, 2020 2020. Copenhagen, denmark: springer, 178-187.

Pellegrini, c. A., pfammatter, a. F., conroy, d. E. & spring, b. 2015. Smartphone applications to support weight loss: current perspectives. *Advanced health care technologies,* 1**,** 13-22.

Peltzer, k. & pengpid, s. 2011. Overweight and obesity and associated factors among school-aged adolescents in ghana and uganda. *International journal of environmental research and public health,* 8**,** 3859-3870.

Pengpid supa & peltzer, k. 2014. Prevalence of overweight/obesity and central obesity and its associated factors among a sample of university students in india. *Obesity research & clinical practice,* 8**,** e558-e570.

Poobalan amudha & aucott, l. 2016. Obesity among young adults in developing countries: a systematic overview. *Current obesity reports,* 5**,** 2-13.

Praditasari, j. A. & sumarmik, s. 2018. Fat intake, physical activity and obesity among adolescent girls in smp bina insani surabaya. *Media gizi indonesia,* 13**,** 117-122.

Prasad, d., kabir, z., suganthy, j., dash, a. & das, b. 2013. Appropriate anthropometric indices to identify cardiometabolic risk in south asians. *Who south-east asia journal of public health,* 2**,** 142-148.

Pulgaron, e. R. & delamater, a. M. 2014. Obesity and type 2 diabetes in children: epidemiology and treatment. *Current diabetes reports,* 14**,** 508.

Pusparisa yosepha. 2020. *Indonesia peringkat ke-3 global memanfaatkan aplikasi kesehatan (globally, indonesia achieved third rank for the highest country which used of health apps)* [online]. Databox. Available: https://databoks.katadata.co.id/datapublish/2020/10/13/indonesia-peringkat-ke-3-global-memanfaatkan-aplikasi-kesehatan [accessed 2022/02/08 2020].

Quintana-navarro gracia maria, alcala-diaz, j. F., lopez-moreno, j., perez-corral, i., leon-acuña, a., torres-peña, j. D., rangel-zuñiga, o. A., arenas de larriva, a. P., corina, a., camargo, a., yubero-serrano, e. M., rodriguez-cantalejo, f., garcia-rios, a., luque, r. M., ordovas, j. M., perez-martinez, p., lopez-miranda, j. & delgado-lista, j. 2020. Long-term dietary adherence and changes in dietary intake in coronary patients after intervention with a mediterranean diet or a low-fat diet: the cordioprev randomized trial. *European journal of nutrition,* 59**,** 2099-2110.

Radcliffe erin, lippincott, b., anderson, r. & jones, m. 2021. A pilot evaluation of mhealth app accessibility for three top-rated weight management apps by people with disabilities. *International journal of environmental research and public health,* 18**,** 3669.

Radmard, a. R., merat, s., kooraki, s., ashrafi, m., keshtkar, a., sharafkhah, m., jafari, e., malekzadeh, r. & poustchi, h. 2015. Gallstone disease and obesity: a population-based study on abdominal fat distribution and gender differences. *Annals of hepatology,* 14**,** 702-709.

Rahadi, d. R. 2014. Pengukuran usability sistem menggunakan use questionnaire pada aplikasi android. *Jsi: jurnal sistem informasi (e-journal),* 6.

Rajak manindra & shaw krishnendu 2019. Evaluation and selection of mobile health (mhealth) applications using ahp and fuzzy topsis. *Technology in society,* 59**,** 101186.

Rani rekha, dharaiya, c. N. & singh, b. 2021. Importance of not skipping breakfast: a review. *International journal of food science and technology,* 56**,** 28-38.

Roemling, c. & qaim, m. 2012. Obesity trends and determinants in indonesia. *Appetite,* 58**,** 1005-1013.

Rohmann jessica. 2017/09/05/t15:52:00+00:00 2017. Comparison groups should be similar. *Students 4 best evidence* [online]. Available from: https://s4be.cochrane.org/blog/2017/09/05/comparison-groups-should-be-similar/

Files/11033/comparison-groups-should-be-similar.html.

Ross, k. M. & wing, r. R. 2016. Impact of newer self-monitoring technology and brief phone-based intervention on weight loss: a randomized pilot study. *Obesity (silver spring),* 24**,** 1653-9.

Roza, a. M. & shizgal, h. M. 1984. The harris benedict equation reevaluated: resting energy requirements and the body cell mass. *The american journal of clinical nutrition,* 40**,** 168-182.
Ryan donna h. & yockey, s. R. 2017. Weight loss and improvement in comorbidity: differences at 5%, 10%, 15%, and over. *Current obesity reports,* 6**,** 187-194.
Sahoo, k., sahoo, b., choudhury, a. K., sofi, n. Y., kumar, r. & bhadoria, a. S. 2015. Childhood obesity: causes and consequences. *Journal of family medicine and primary care,* 4**,** 187.
Samoggia antonella & riedel bettina 2020. Assessment of nutrition-focused mobile apps' influence on consumers' healthy food behaviour and nutrition knowledge. *Food research international,* 128**,** 108766.
Sandborg, j., henriksson, p., larsen, e., lindqvist, a.-k., rutberg, s., söderström, e., maddison, r. & löf, m. 2021. Participants' engagement and satisfaction with a smartphone app intended to support healthy weight gain, diet, and physical activity during pregnancy: qualitative study within the healthymoms trial. *Jmir mhealth and uhealth,* 9**,** e26159.
Saunders, j., smith, t. & stroud, m. 2011. Malnutrition and undernutrition. *Journal medicine,* 39**,** 45-50.
Schembre susan m., liao yue, o'connor sydney g., hingle melanie d., shen shu-en, hamoy katarina g., huh jimi, dunton genevieve f., weiss rick, thomson cynthia a. & boushey carol j. 2018. Mobile ecological momentary diet assessment methods for behavioral research: systematic review. *Jmir mhealth and uhealth,* 6**,** e11170.
Schuetz philipp, fehr, r., baechli, v., geiser, m., deiss, m., gomes, f., kutz, a., tribolet, p., bregenzer, t., braun, n., hoess, c., pavlicek, v., schmid, s., bilz, s., sigrist, s., brändle, m., benz, c., henzen, c., mattmann, s., thomann, r., brand, c., rutishauser, j., aujesky, d., rodondi, n., donzé, j., stanga, z. & mueller, b. 2019. Individualised nutritional support in medical inpatients at nutritional risk: a randomised clinical trial. *The lancet,* 393**,** 2312-2321.
Schumer harleigh, amadi chioma & joshi ashish 2018. Evaluating the dietary and nutritional apps in the google play store. *Healthcare informatics research,* 24**,** 38-45.
Schweizer angélick, berchtold, a., barrense-dias, y., akre, c. & suris, j. C. 2017. Adolescents with a smartphone sleep less than their peers. *European journal of pediatrics,* 176**,** 131-136.
Septiana, p., nugroho, f. A. & wilujeng, c. S. 2018. Consumption of junk food and fiber among overnutrition female young adult who lived alone. *Jurnal kedokteran brawijaya,* 30**,** 61-67.
Severin richard, sabbahi, a., mahmoud, a. M., arena, r. & phillips, s. A. 2019. Precision medicine in weight loss and healthy living. *Progress in cardiovascular diseases,* 62**,** 15-20.
Shan, x. Y., xi, b., cheng, h., hou, d. Q., wang, y. & mi, j. 2010. Prevalence and behavioral risk factors of overweight and obesity among children aged 2–18 in beijing, china. *International journal of pediatric obesity,* 5**,** 383-389.
Sharma parul, berwal, y. P. S. & ghai, w. 2020. Performance analysis of deep learning cnn models for disease detection in plants using image segmentation. *Information processing in agriculture,* 7**,** 566-574.

CHULALONGKORN UNIVERSITY

Sheikh aijaz ahmad, ganai, p. T., malik, n. A. & dar, k. A. 2013. Smartphone: android vs ios. *The sij transactions on computer science engineering & its applications (csea),* 1**,** 141-148.

Shen, z., shehzad, a., chen, s., sun, h. & liu, j. 2020. Machine learning based approach on food recognition and nutrition estimation. *Procedia computer science,* 174**,** 448-453.

Shin, h., shin, j., liu, p.-y., dutton, g. R., abood, d. A. & ilich, j. Z. 2011. Self-efficacy improves weight loss in overweight/obese postmenopausal women during a 6-month weight loss intervention. *Nutrition research,* 31**,** 822-828.

Shinozaki, n. & murakami, k. 2020. Evaluation of the ability of diet-tracking mobile applications to estimate energy and nutrient intake in japan. *Nutrients,* 12**,** 3327.

Sila sara, ilić, a., mišigoj-duraković, m., sorić, m., radman, i. & šatalić, z. 2019. Obesity in adolescents who skip breakfast is not associated with physical activity. *Nutrients,* 11.

Simpson, r. 2009. The role of public service in young adult development: highlights from recent research. Mit public service center: citeseer.

Simpson, r. 2018. Stages of adolescent and young adult development (18-25). Mit young adult development project: mit.

Slining meghan m., mathias, k. C. & popkin, b. M. 2013. Trends in food and beverage sources among us children and adolescents: 1989-2010. *Journal of the academy of nutrition and dietetics*, 113**,** 1683-1694.

Soegoto herman 2019. Smartphone usage among college students. *Journal of research in engineering and technology,* 14**,** 1248-1259.

Souza, m. C. C. D., tibúrcio, j. D., bicalho, j. M. F., rennó, h. M. D. S., dutra, j. S., campos, l. G. & silva, e. S. 2014. Factors associated with obesity and overweight in school-aged children. *Texto & contexto-enfermagem,* 23**,** 712-719.

State adolescent health resource center, s. 2013. Understanding adolescence: late adolescence/young adulthood. Washington, dc.

Statistics indonesia 2020. *Konsumsi kalori dan protein penduduk indonesia dan provinsi, maret 2020,* bps-statistics indonesia.

Statistics of malang municipality. 2020. *Population growth in malang municipality by subdistrict, 2011-2020* [online]. Malang, indonesia: statistics indonesia. Available: https://malangkota.bps.go.id/dynamictable/2020/04/28/184/pertumbuhan-penduduk-di-kota-malang-menurut-kecamatan-2011-2020.html [accessed].

Suartama i. Kadek, setyosari punaji & ulfa saida 2019. Development of an instructional design model for mobile blended learning in higher education. *International journal of emerging technologies in learning,* 14.

Sucala, m., schnur, j. B., glazier, k., miller, s. J., green, j. P. & montgomery, g. H. 2013. Hypnosis—there's an app for that: a systematic review of hypnosis apps. *International journal of clinical experimental hypnosis,* 61**,** 463-474.

Sun jianing, radecka, k. & zilic, z. 2019. Foodtracker: a real-time food detection mobile application by deep convolutional neural networks. *Arxiv preprint arxiv:1909.05994*.

Supariasa, i., bakri, b. & fajar, i. 2016. *Penilaian status gizi edisi 2,* jakarta, penerbit buku kedokteran: egc.

Swift damon l, mcgee, j. E., earnest, c. P., carlisle, e., nygard, m. & johannsen, n. M. 2018. The effects of exercise and physical activity on weight loss and maintenance. *Progress in cardiovascular diseases,* 61**,** 206-213.

Tahir, g. A. & loo, c. K. 2021. A comprehensive survey of image-based food recognition and volume estimation methods for dietary assessment. *Healthcare,* 9**,** 1676.

Te velde, s. J., van nassau, f., uijtdewilligen, l., van stralen, m. M., cardon, g., de craemer, m., manios, y., brug, j., chinapaw, m. J. M. & toybox-study, g. 2012. Energy balance-related behaviours associated with overweight and obesity in preschool children: a systematic review of prospective studies. *Obesity reviews,* 13**,** 56-74.

Team, g. 2022. *Flutter on mobile* [online]. Google. Available: https://docs.flutter.dev/resources/faq [accessed 12/04/2022 2022].

Team., t. E. 2001. *Image processing has some clear advantages* [online]. Available: https://www.theengineer.co.uk/image-processing-has-some-clear-advantages/#:~:text=increased%20accuracy%2c%20higher%20speed%20and,keyence's%20cv700%20image%20processing%20system. [accessed].

Teipel, k. 2017. Understanding adolescence: seeing through a developmental lens. *Brief of amici curiae concerned psychiatrists, psychologists and neuropsychologists in support of petition for writ of certiorari.* United stated.

Teixeira, p. J., palmeira, a. L., branco, t. L., martins, s. S., minderico, c. S., barata, j. T., silva, a. M. & sardinha, l. B. 2004. Who will lose weight? A reexamination of predictors of weight loss in women. *International journal of behavioral nutrition and physical activity,* 1**,** 12.

Tensorboard team. 2018. *Tensorboard: tensorflow's visualization toolkit* [online]. Available: https://www.tensorflow.org/tensorboard [accessed].

Thivel, d., tremblay, m. S. & chaput, j. P. 2013. Modern sedentary behaviors favor energy consumption in children and adolescents. *Current obesity reports,* 2**,** 50-57.

Tobias deirdre k., chen, m., manson, j. E., ludwig, d. S., willett, w. & hu, f. B. 2015. Effect of low-fat vs. Other diet interventions on long-term weight change in adults: a systematic review and meta-analysis. *The lancet. Diabetes & endocrinology,* 3**,** 968-979.

Todd, a. S., street, s. J., ziviani, j., byrne, n. M. & hills, a. P. 2015. Overweight and obese adolescent girls: the importance of promoting sensible eating and activity behaviors from the start of the adolescent period. *International journal of environmental research and public health,* 12**,** 2306-2329.

Traficom.fi 2021. Factors affecting the speed and quality of internet connection. *Traficom*.

Traversy, g. & chaput, j.-p. 2015. Alcohol consumption and obesity: an update. *Current obesity reports,* 4**,** 122-130.

Tregarthen, j. P., lock, j. & darcy, a. M. 2015. Development of a smartphone application for eating disorder self-monitoring. *International journal of eating disorders,* 48**,** 972-982.

Trepanowski john f., kroeger, c. M., barnosky, a., klempel, m. C., bhutani, s., hoddy, k. K., gabel, k., freels, s., rigdon, j., rood, j., ravussin, e. & varady, k. A. 2017. Effect of alternate-day fasting onweight loss, weight maintenance, and cardioprotection among metabolically healthy obese adults. *Jama internal medicine,* 177**,** 930-938.

Turgut, s. T., içağasıoğlu, a., selimoğlu, e., şahin, p., yumuşakhuylu, y. & murat, s. 2014. Musculoskeletal pain and quality of life in obese patients. *Journal of musculoskeletal pain,* 22**,** 43-50.

Turner-mcgrievy, g. M., beets, m. W., moore, j. B., kaczynski, a. T., barr-anderson, d. J. & tate, d. F. 2013. Comparison of traditional versus mobile app self-monitoring of physical activity and dietary intake among overweight adults participating in an mhealth weight loss program. *Journal of the american medical informatics association,* 20**,** 513-518.

Turner-mcgrievy, g. M., wilcox, s., boutté, a., hutto, b. E., singletary, c., muth, e. R. & hoover, a. W. 2017. The dietary intervention to enhance tracking with mobile devices (diet mobile) study: a 6-month randomized weight loss trial. *Obesity (silver spring),* 25**,** 1336-1342.

Twenge jean m, martin, g. N. & campbell, w. K. 2018. Decreases in psychological well-being among american adolescents after 2012 and links to screen time during the rise of smartphone technology. *Emotion,* 18**,** 765.

Ukegbu, p., nwofia, b., ndudiri, u., uwakwe, n. & uwaegbute, a. 2019. Food insecurity and associated factors among university students. *Food and nutrition bulletin,* 40**,** 271-281.

Van asbroeck, s. & matthys, c. 2020. Use of different food image recognition platforms in dietary assessment: comparison study. *Jmir formative research,* 4**,** e15602.

Van heel, m., harauz, g., orlova, e. V., schmidt, r. & schatz, m. 1996. A new generation of the imagic image processing system. *Journal of structural biology,* 116**,** 17-24.

Vasiloglou maria f., christodoulidis stergios, reber emilie, stathopoulou thomai, lu ya, stanga zeno & mougiakakou stavroula 2021. Perspectives and preferences of adult smartphone users regarding nutrition and diet apps: web-based survey study. *Jmir mhealth and uhealth,* 9**,** e27885.

Vasiloglou, m. F., van der horst, k., stathopoulou, t., jaeggi, m. P., tedde, g. S., lu, y. & mougiakakou, s. 2021. The human factor in automated image-based nutrition apps: analysis of common mistakes using the gofood lite app. *Jmir mhealth uhealth,* 9**,** e24467.

Vica v., josephng, p. S., shibghatullah, a. S. & eaw, h. C. Jomimage snapfudo: control your food in a snap. 2019 ieee 6th international conference on engineering technologies and applied sciences (icetas), 2019/12// 2019. Kuala lumpur, malaysia: ieee, 1-5.

Villasana maría vanessa, pires ivan miguel, sá juliana, garcia nuno m., zdravevski eftim, chorbev ivan, lameski petre & flórez-revuelta francisco 2019. Mobile applications for the promotion and support of healthy nutrition and physical activity habits: a systematic review, extraction of features and taxonomy proposal. *The open bioinformatics journal,* 12.

Villinger karoline, wahl, d. R., boeing, h., schupp, h. T. & renner, b. 2019. The effectiveness of app-based mobile interventions on nutrition behaviours and nutrition-related health outcomes: a systematic review and meta-analysis. *Obesity reviews: an official journal of the international association for the study of obesity,* 20**,** 1465-1484.

Wallace lauren j., summerlee, a. J. S., dewey, c. E., hak, c., hall, a. & charles, c. V. 2014. Women's nutrient intakes and food-related knowledge in rural kandal province, cambodia. *Asia pacific journal of clinical nutrition,* 23**,** 263-271.

Warziski, m. T., sereika, s. M., styn, m. A., music, e. & burke, l. E. 2008. Changes in self-efficacy and dietary adherence: the impact on weight loss in the prefer study. *Journal of behavioral medicine,* 31**,** 81-92.

Wei chang-nian, harada, k., ueda, k., fukumoto, k., minamoto, k. & ueda, a. 2012. Assessment of health-promoting lifestyle profile in japanese university students. *Environmental health and preventive medicine,* 17**,** 222-227.

West joshua h., belvedere lindsay m., andreasen rebecca, frandsen christine, hall p. Cougar & crookston benjamin t. 2017. Controlling your “app”etite: how diet and nutrition-related mobile apps lead to behavior change. *Jmir mhealth and uhealth,* 5**,** e7410.

Wharton, c. M., johnston, c. S., cunningham, b. K. & sterner, d. 2014. Dietary self-monitoring, but not dietary quality, improves with use of smartphone app technology in an 8-week weight loss trial. *Journal of nutrition education and behavior,* 46**,** 440-444.

Whitaker, r. C., wright, j. A., pepe, m. S., seidel, k. D. & dietz, w. 1997. Predicting obesity in young adulthood from childhood and parental obesity. *New england journal of medicine,* 337**,** 869-873.

Whitelock, v., kersbergen, i., higgs, s., aveyard, p., halford, j. C. & robinson, e. 2019. A smartphone based attentive eating intervention for energy intake and weight loss: results from a randomised controlled trial. *Bmc public health,* 19**,** 611.

Widyanti ari, sunaryo, i. & kumalasari, a. D. 2014. The international society for southeast asian agricultural sciences. *Farmers sustainability index: the case of paddy farmers in state of kelantan, malaysia,* 20**,** 93-103.

Williams, j. R. 2008. The declaration of helsinki and public health. *Bulletin of the world health organization,* 86**,** 650-652.

Wilson, k. E., harden, s. M., almeida, f. A., you, w., hill, j. L., goessl, c. & estabrooks, p. A. 2016. Brief self-efficacy scales for use in weight-loss trials: preliminary evidence of validity. *Psychological assessment,* 28**,** 1255.

World health organization. 2017. *Prevalence of overweight among children and adolescents, bmi>+1 standard deviation above the median, crude - estimates by country, among children aged 5-19 years* [online]. Genewa: who. Available: https://apps.who.int/gho/data/view.main-searo.bmiplus1c05-19v?lang=en [accessed].

World health organization. 2018. *Adolescent health in the south-east asia region* [online]. Genewa: who. Available: https://www.who.int/southeastasia/health-topics/adolescent-health [accessed 17 october 2020].

World health organization. 2019. *Body mass index - bmi categorized* [online]. Genewa: who. Available: https://www.euro.who.int/en/health-topics/disease-

prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmifiles/10056/body-mass-index-bmi.html [accessed].
World health organization. 2020a. *Ehealth* [online]. Available: https://www.who.int/ehealth/en/ [accessed].
World health organization. 2020b. *Healthy diet* [online]. Genewa: who. Available: https://www.who.int/news-room/fact-sheets/detail/healthy-diet [accessed 5/2/2022 2022].
World health organization. 2020c. *Obesity and overweight* [online]. Geneva: who. Available: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight [accessed].
World health organization 2020d. Who | what is overweight and obesity? *Who*.
Wright n., wilson, l., smith, m., duncan, b. & mchugh, p. 2017. The broad study: a randomised controlled trial using a whole food plant-based diet in the community for obesity, ischaemic heart disease or diabetes. *Nutrition & diabetes*, 7**,** e256-e256.
Xu zidu, geng, j., zhang, s., zhang, k., yang, l., li, j. & li, j. 2020. A mobile-based intervention for dietary behavior and physical activity change in individuals at high risk for type 2 diabetes mellitus: randomized controlled trial. *Jmir mhealth and uhealth*, 8**,** e19869.
Yadav, r. L., yadav, p. K., yadav, l. K., agrawal, k., sah, s. K. & islam, m. N. 2017. Association between obesity and heart rate variability indices: an intuition toward cardiac autonomic alteration – a risk of cvd. *Diabetes, metabolic syndrome and obesity: targets and therapy*, 10**,** 57-64.
Yahia najat, wang, d., rapley, m. & dey, r. 2015. Assessment of weight status, dietary habits and beliefs, physical activity, and nutritional knowledge among university students. *Perspectives in public health*, 136**,** 231-244.
Zečević, m., mijatović, d., koklič, m. K., žabkar, v. & gidaković, p. 2021. User perspectives of diet-tracking apps: reviews content analysis and topic modeling. *Journal of medical internet research*, 23**,** e25160.
Zhou lei, zhang chu, liu, f., qiu, z. & he, y. 2019. Application of deep learning in food: a review. *Comprehensive reviews in food science and food safety*, 18**,** 1793-1811.
Zimmerman, m. & snow, b. 2013. *Essentials of nutrition: a functional approach,* united stated, flat world knowledge.

Appendix

1. Questionnaire for Phase I: Requirement Step

Part 1: Sociodemographic

1. Birthday (DD/MM/YY): ………………
2. District address: ………………
3. Length of stay in Malang City: ………………
4. Degree : ☐ Bachelor ☐ Master
5. Major of study: ………………
6. Living Allowance: ☐ < Rp. 1.500.000 ☐ Rp. 1.500.000- 3.000.00 ☐ > Rp. 3.000.000

Part 2 Health Profile:

7. Weight: ……..kg
8. Height: ……...cm
9. Food Allergic: ………….
10. Chronic disease: ………..

Part 3 The Mobile Application Usage:

Put the short answer on the blank place or check sign (√) in these questions!

11. What kind of brand smartphone you use? ………………………
12. How much phone memory inside your smartphone? (internal and external) …….. MB

13. What kind of mobile networking you use?	☐ 3G ☐ LTE ☐ 4G ☐ 5G
14. How much money you pay for your monthly internet package?	☐ < Rp. 50.000 (<100 THB) ☐ Rp. 50.000 – Rp. 99.999 (100-200 THB) ☐ Rp. 100.000 – Rp. 150.000 (201-300 THB) ☐ > Rp. 150.000 (> 300 THB)
15. Time consuming for your smartphone	………… hour(s)/day
16. What kind of features in your	☐ Message application (e.g. Whatssapp, line, telegram, etc) ☐ Photo & video edited application (e.g. KineMaster,

phone? (put check (√) if you have this feature in your phone)

FilmoraGo, etc)
- ☐ Music application (e.g. joox, sportify, etc)
- ☐ Games application (e.g. candy crush saga, angry bird, etc)
- ☐ Ecommerce application (e.g. Lazada, Shopee, JD, etc)
- ☐ Finance application (e.g. ebanking , etc)
- ☐ Travel application (e.g. Traveloka, Airbnb, google maps, etc)
- ☐ Social media application (e.g. facebook, Instagram, tiktok, etc)
- ☐ Education application (e.g. thesaurus, google translate, chrome, ms.team, zoom, etc)
- ☐ Health support application (e.g. diet apps, exercise apps, etc)
- ☐ Mailing application (e.g. gmail, outlook, etc)
- ☐ Entertainment application (e.g. youtube, neflix, beautyplus, etc)

17. How often your mobile activity?

Activity	Several times daily	Once per day	6-5 times a week	4-3 times a week	2-1 times a week	Less often	Never	Don't Know
Calling from messenger application								
Editing video or photos								
Text messaging								
Listening music								
Playing game								
Shopping activity (browsing or wishlist or purcasing)								
Traveling activity (browsing promotion, booking ticket or accomodation)								
Using Social media (browsing or posting news)								
Watch movie or video								
Financing transaction								
Education meeting								
Browsing information for school								
Browsing for entertainment news								
Mailing activity								

18. How often you charge your mobile phone either electricity charge or powerbank?
- ☐ 1 times a day
- ☐ 2 times a day
- ☐ Others: ………..

19. How often you taking rest from using your mobile phone per day?
- ☐ Never (I never leave my phone even for 20 minutes)
- ☐ <1 hour per day
- ☐ 1-3 hours per day
- ☐ > 3 hours when sleep

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Part 4. Food and Dietary Habit

20. How many meals you have per day?	□ 3 times (breakfast, lunch, dinner) □ 2 times (breakfast and lunch) □ 2 times (lunch and dinner) □ 2 times (breakfast and dinner) □ 1 times only
21. What your favorite breakfast menu? (3 menus)	□ ……………… □ ……………… □ ………………
22. What your favorite lunch menu? (3 menus)	□ ……………… □ ……………… □ ………………
23. What your favorite dinner menu? (3 menus)	□ ……………… □ ……………… □ ………………
24. How often you consume snack?	□ > 3 times per day □ 1-2 times per day □ 3-6 times per week □ 1-2 times per week □ 2 times per month □ never
25. What your favorite snack menu? (3 menus, you can mention the brand also)	□ ……………… □ ……………… □ ………………
26. Do you like sweet drink?	Yes/ No
27. If yes, what your favorite sweet drink? (3 menus)	□ ……………… □ ……………… □ ………………

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

2. Questionnaire for Phase I: Validation Expert in Designing Wireframes step

No	Item Evaluation	Evaluation Score (Most Negative to Most Positive Response)				
		1	2	3	4	5
	System aspect					
1	Is the apps visually easy to recognize?					
2	Is the apps easy to operate?					
3	Is the outlook of apps attractive?					
	User aspect					
4	Is the menu type easy to recognize?					
5	Is the main menu visually simple and clear?					
6	Is the main menu composed of related submenus?					
7	Is the menu use familiar term?					
8	Is the symbol used easy to understand?					
	Interaction aspect					
9	Do all features in apps conform to user needs?					
10	Can users change the input on profile easily?					
11	Is exercise record easy to use?					
12	Does pop-up diet information notice failure or cancel of sending process?					
13	Does Estimated Energy Requirement (EER) has correct formulation?					
14	Is it easy to access the calories information from the meal diary features?					
15	Does pop-up reminder has delayed notification?					
16	Does meal graphs feature informative and easy to understand?					

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

3. Questionnaire for Phase I: Testing and Maintenance Step

Part 1: Evaluation of accuracy

Using Yolo lite3 tools to show the accuracy of tools

Part 2: Usability of diamond interface

It will measure using Firebase analytic. Thus, the user activity data average (in percentage) will put on this form:

Telemetry resume:

Activity (per day)	After 8 weeks
1. Open the apps	
2. Using meal diary	
3. Read Diet Information (at least 2 minutes)	
4. Answer the quiz	
5. Using exercise features	
6. Uninstall apps	

Feedback Questionnaire:

NO	The Feasibility Item	Agree	Slightly agree	Slightly disagree	Disagree
1	This application was an easy way to control my dietary consumption.				
2	I learned about control dietary consumption during the period I used Diamond apps				
3	The function of meal diary helped me to remember the foods I consumed.				
4	The photograph feature in food assist me to decide what I want to ate.				
5	The barcode scan in food helped me to decide what I want to ate.				
6	The application made me aware to manage my meals				
7	This application actually affected my food consume habits				
8	This application was useful for controlling the dietary intake				
9	The application was an easy to use				
10	I was able to get enough information about controlling dietary intake				
11	It was helpful to control my dietary				

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

NO	The Feasibility Item	Agree	Slightly agree	Slightly disagree	Disagree
	consumed using the diet reminder				
12	I quickly received the food calories information when I take the photos.				
13	The diet information provided on the application was easy to understand				
14	The meal graph provided on the application was helpful				
15	I like using this application				
16	I satisfied with using this application to control my food intake				
17	I improve my knowledge about maintain the dietary consumption.				
18	Sometimes, I had problem remembering to record my dietary intake using meal diary features				
19	Diamond application intervene with my daily life				
20	It took a long time to apply Diamond application				
21	It was troublesome to apply Diamond application				

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

4. Questionnaire for Phase II: Baseline Measurement

Part 1: Sociodemographic

ID participant: ……………………

1. Birthday (DD/MM/YY): ………………
2. Home town address: ……………… (Rural/Urban)
3. Religion: 1) Christian, 2) Muslim, 3) Hinduism, 4) Catholic, 5) Confucianism, and 6) Buddhism
4. Education level : ☐ Bachelor ☐ Master
5. An academic year of Study: ☐ Fi☐ S☐ond ☐ Third ☐ Fourth > Forth
6. Major of study: ………………
7. Relationship status: Single/in relationship/Engage/Married/Divorce/widow
8. Living Allowance: ☐ ≤ Rp. 1.500.000 (<$10☐4) Rp. 1.500.001-3.000.0☐($104.65-$209) > Rp. 3.000.000 (>$209)

Part 2 Genetic factor

1. Are your parents in overweight or obesity conditions?
   - ☐ Yes, my mother
   - ☐ Yes, my father
   - ☐ Yes, both of them
   - ☐ No, They are not

Part 3 Eating Self- Efficacy:

Give the score from 0-9 to indicate your confident about the statement item as below. For instance, 0 refers to "not confident at all" while 9 related with "very confident"

No	Question	Score
1	I able to resist eating when I am nervous or anxious	
2	I able to manage my eating on the weekend	
3	I able to resist eating even when I have to say "no" to others	
4	I able to resist eating when I am feeling physically down	
5	I able to resist eating while I watch TV	
6	I able to resist eating when I feel down or frustrate	
7	I able to resist eating while there are many variants food available	
8	I able to resist eating even when I feel its impolite to refuse a second helping	
9	I able to resist eating when I have a broken heart	
10	I able to resist eating while I am reading	
11	I able to resist eating when I am irritable or angry	
12	I able to resist eating even when I come to party	
13	~~I able to resist eating even when others pursuing me~~ to eat	
14	I able to resist eating when I am in pain	
15	I able to resist eating less than 1 hours before going to bed	
16	I able to resist eating when I have experienced failure	
17	I able to control my eating even when high calorie foods are available	
18	I able to resist eating when I think other people will be upset if I don't eat	
19	I able to resist eating even when I am feeling uncomfortable	
20	I can resist eating though I feel happy	

จุฬาลงกรณ์มหาวิทยาลัย

Part 4. Behavior factors:

Put the short answer on the blank place or check sign (√) in these questions!

a. Regular Exercise

1. Do you practice exercise during these 6 months? Yes/ No

2. If yes, what kind of exercise you did?
3. How many times a week you did that
   - ☐ 1-2 times
   - ☐ 3-4 times
   - ☐ 5-6 times
   - ☐ everyday
4. How long you do exercise?
   - ☐ >30 minutes each time
   - ☐ 30-60 minutes each time
   - ☐ >60 minutes each time

b. Sleep duration

5. How many hours you sleep within 1 weeks?
   - ☐ < 6 hours in average
   - ☐ 6-8 hours in average
   - ☐ > 8 hours in average

c. Smoking

6. Do you smoke?
   - ☐ Yes, active smoker
   - ☐ Yes, occasional smoker
   - ☐ No, I stop smoke for …. month/year
   - ☐ No, I never smoke

7. If you are an active smoker, how many cigarettes you smoke for 1 days? ……

d. Alcohol drinking

8. Do you drink alcohol?
   - ☐ Yes, regularly drinking (per week)
   - ☐ Yes, occasional drinker
   - ☐ No, I stop smoke for …. month/year
   - ☐ No, I never drink alcohol

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

e. Food Frequency Questionnaire

Group	**No**	**Food Item**	**days**		**Week**			**1-3x per month**	**Never**
			>1x	**1x**	**4-6x**	**2-3x**	**1x**		
Carbohydrate	1								
	2								
	3								
Fat	1								
	2								

5. Questionnaire for Phase II: Outcome Measurement

Part 1. Dietary practice (24 hours recall form)

1. Name of Interviewer :	Date of Recall:
2. ID number of Participant :	takes nutritional supplement : Y/N
	if Y, list type:
Mealtime	**Serving abbreviations**
1. Morning (4 to 9 a.m) 4. Afternoon (2 to 5 p.m)	tbsp= tablespoon c=cup
2. Midmorning (9 to 11.30 a 5. Evening (5 to 8 p.m)	tsp=teaspoon lb=pound
3. Noon (11.30 to 2 p.m) 6. Late Evening (8 p.m to 4 a.m)	Oz=ounce sl=Slice

Meal Time		List Menu and Description (List Food and Additional Ingredient)	Amount		Gram/ml conversion	Nutrient (kal/Kkal)		
Type	Time		Amount	Serving Abb		Carbohydrate Kal	Fat Kal	Total Calories
Breakfast	04.00 - 09.00 a.m							
Snack	09.00 - 11.30 a.m							
lunch	11.30 a.m - 2.00 p.m							
snack	2.00 - 5.00 p.m							
	5.00 - 8.00 p.m							
dinner	8.00 p.m - 04.00 a.m							
Total								

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Part 2. BMI

Data Collector: ……

Date of Collect: ……………. Time ………

Measure 1 times	Measure 2 times
Weight: ………… kg	Weight: ………… kg
Height: ………….cm	Height: ………….cm

6. Ethic Approval Documents

Indonesian ethic approval

Bhakti Wiyata

CERTIFICATE OF RESEARCH ETHICS CLEARANCE
No: 100/PP2M-KE/II/2021

Research Ethics Committee of Institut Ilmu Kesehatan Bhakti Wiyata Kediri has recently reviewed your responses to the condition placed upon the ethical approval for the the project outlined below:

Researcher's Name	:	Nurnaningsih Herya Ulfah
Department	:	Public Health
Project Title	:	Effect of Diamond Application on Dietary Intake, and BMI Among Overnutrition Female College Student In Malang City, Indonesia: A Quasi-Experiment Study
Approval Date	:	February 8, 2021
Consideration	:	This project meets the requirements of the Ethical Guidelines issued by CIOMS (2016), including 1)Social Value, 2)Scientific value, 3)Distribution of Benefits and Burdens, 4)Risk, 5)Referral/Exploitation, 6)Confidentiality and Privacy, and 7)Informed consent.

The researcher may therefore commence with the research as from the date of this certificate. Please note that failure to conduct the research in the manner described may lead to automatic failure.

KOMITE ETIK PP2M IIK BHAKTI WIYATA

Ind... ...abban, S.Pd., M.Sc
Ethics Coordinator

CHULALONGKORN UNIVERSITY

Chulalongkorn Ethic Approval

บันทึกข้อความ

ส่วนงาน คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 โทร.0-2218-3202
ที่ จว 136/2564 **(ผ)** **วันที่** 29 มิถุนายน 2564
เรื่อง แจ้งผลผ่านการพิจารณาจริยธรรมการวิจัย

เรียน คณบดีวิทยาลัยวิทยาศาสตร์สาธารณสุข

สิ่งที่ส่งมาด้วย เอกสารแจ้งผ่านการรับรองผลการพิจารณา

ตามที่นิสิต/บุคลากรในสังกัดของท่านได้เสนอโครงการวิจัยเพื่อขอรับการพิจารณาจริยธรรมการวิจัย จากคณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย นั้น ในการนี้ กรรมการผู้ทบทวนหลักได้เห็นสมควรให้ผ่านการพิจารณาจริยธรรมการวิจัยได้ ดังนี้

โครงการวิจัยที่ 029.1/64 เรื่อง **ผลของแอพพลิเคชั่นไดมอนด์ ต่อการบริโภคอาหารและดัชนีมวลกายของนักศึกษาหญิงที่มีโภชนาการเกินในเมืองมาลังประเทศอินโดนีเซีย : การวิจัยกึ่งทดลอง** (EFFECT OF DIAMOND APPLICATION ON DIETARY INTAKE AND BMI AMONG OVERNUTRITION FEMALE COLLEGE STUDENT IN MALANG CITY, INDONESIA : A QUASI-EXPERIMENT STUDY) ของ Nurnaningsih Herya Ulfah นิสิตระดับดุษฎีบัณฑิต วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย (รับรองระยะที่ 2 ของโครงการวิจัย)

จึงเรียนมาเพื่อโปรดทราบ

ระวีนันท์ มิ่งภัคนีย์

(ผู้ช่วยศาสตราจารย์ ดร.ระวีนันท์ มิ่งภัคนีย์)
กรรมการและเลขานุการ
คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน
กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย

7. Food Database Application

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

No	Menu (Ind-Eng)
1	Acar mentimun / cucumber salad
2	Air jeruk nipis /lemon / lime or lemon water
3	Air madu / honey water
4	Air mineral / mineral water
5	Air putih / water
6	Almond / Almond
7	Alpukat / Avocado
8	Ampela ati goreng / fried chicken liver and gizzard
9	Anggur / grapes
10	Angsle / hot coconut soup of sago pearls
11	Apel / apple
12	Arem-arem / stuffed rice rolls
13	Ayam asam manis / chicken with sour and sweet sauce
14	Ayam asam pedas / chicken with sour and spicy sauce
15	Ayam bakar / grilled chicken
16	Ayam balado / dried chicken with chillies
17	Ayam baleluwe / baleluwe chicken
18	Ayam bistik / stews chicken
19	Ayam goreng / fried chicken
20	Ayam goreng dan sambal / fried chicken with chilli sambal
21	Ayam kecap / chicken with sweet soy sauce
22	Ayam Taiwan street food (Aiciro) / Taiwan street food chicken (Aiciro)
23	Ayam kremes / Fried chicken with crunchy flakes
24	Ayam krispi / Crispy chicken
25	Ayam lada hitam / chicken with black pepper sauce
26	Ayam laos / galangal fried chicken
27	Ayam lodho / lodho chicken
28	Ayam panggang / roasted chicken
29	Ayam penyet / smashed fried chicken
30	Ayam rebus dada /boiled chicken breast part
31	Ayam rebus paha / boiled chicken thigh part
32	Ayam rica-rica / chicken with red spices sauce
33	Ayam saos korea / chicken with Korean sauce
34	Ayam serundeng / chicken with relish of grated coconut and spices
35	Ayam suwir / shredded chicken
36	Ayam woku / Manadonese spicy stewed chicken
37	Babat goreng /fried beef tripe
38	Bakpao ayam / chicken dumplings
39	Bakmie / China noodles
40	Bakpao cokelat / chocolate dumplings
41	Bakpao kacang hijau / mung beans dumplings
42	Bakpao strawberry / strawberry dumplings
43	Bakpia / Javanese pastry (bakpia)
44	Bakso /meatball soup
45	Bakso aci / tapioca meatball
46	Bakso bakar / roasted meatball
47	Bakwan jagung /corn fritter
48	Bali telur / Balinese spiced egg dish
49	Bandeng goreng /fried milkfish
50	Basreng / fried fish meatballs
51	Batagor / fried tofu meatballs
52	Bear brand milk
53	Bear brand gold malt putih
54	Bear brand white tea
55	Bebek goreng / fried duck
56	Beef salad wrap
57	Belimbing / star fruit
58	Belut goreng / fried eel
59	Better biscuits
60	Bihun goreng / fried vermicelli
61	Biskuit cokelat / chocolate biscuits
62	Blendrang terong / eggplant in coconut milk soup
63	Es boba brown sugar / iced brown sugar with pearl bubble
64	Es boba brown sugar milk / iced brown

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

	sugar milk with pearl bubble
65	Es boba choco milk / iced choco milk with pearl bubble
66	Es boba coklat strawberry / iced choco strawberry with pearl bubble
67	Es boba fresh milk / iced fresh milk with pearl bubble
68	Es boba green tea / iced green tea with pearl bubble
69	Es boba milik tea / iced milk tea with pearl bubble
70	Es boba original / iced pearl bubble
71	Es boba sugar milk / iced sugar milk with pearl bubble
72	Iced boba taro milk tea with cream cheese
73	Bolen pisang / banana bollen
74	Bolu apollo / apollo sponge cake
75	Bolu kukus / steamed sponge cake
76	Bolu panggang / roasted sponge cake
77	Botok / dish made from coconut and meat, fish, etc
78	Iced brown sugar
79	Brownies / brownie
80	Buah naga / dragon fruit
81	Buah Nangka / jackfruit
82	Buah pisang / banana
83	Bubur ayam / chicken porridge
84	Bubur kacang hijau / mung bean porridge
85	Bubur ketan hitam / black glutinous rice porridge
86	Bubur Manado / Manado porridge
87	Bubur sumsum / sweet glutinous porridge
88	Bulgogi / Korean beef bulgogi
89	Burger daging / beef burger
90	Cah jamur / stir-fry mushrooms
91	Cah kangkung / sauteed kalee
92	Cah sawi / stir-fry of green mustard
93	Cah sawi putih kecambah / stir-fry white mustard sprouts
94	Cah wortel / saute carrots
95	Cake / chocolate cheese
96	Cake pisang / banana cake
97	Cakue / fried cake
98	Permen / candy
99	Capcay / mixed vegetable dishes
100	Capcin / iced cappuccino with grass jelly
101	Hot Cappuccino
102	Iced caramel latte
103	Ceker asam manis / sour and sweet chicken feet
104	Ceker pedas / spicy chicken feet
105	Cenil / dessert made from cassava
106	Chicken katsu / rice with chicken katsu
107	Chicken salad wrap
108	Chicken toast
109	chicken popcorn (chickmi) / chicken popcorn (chickmi)
110	Chitato
111	Iced choco cheese
112	Hot chocolate milk
113	Hot chocolate oreo
114	Iced choco-avocado milk
115	Chocolate bar
116	Iced chocolate
117	Chocolate snack stick
118	Chocolatos matcha drink
119	Churros cokelat / chocolate churros
120	Cilok / tapioka meatball
121	Cilor / Fried tapioka meatball with egg
122	Cimol/ fried tapioka meatball
123	Cimory
124	Cireng/ fried tapioka meatball
125	Cocktail
126	Cokelat klasik
127	Cookies
128	Cookies and cream
129	Creamy coffee
130	Crepes
131	Croffle
132	Croissant chocolate
133	Cucur/ fried cake made of rice flour and sugar
134	Cui mie/ noodle soup without topping

135	Cumi tepung/ fried squid	171	Es teh tawar/ plain iced tea
136	Cumi tumis/ stir-fry squid	172	Es teler/ Indonesian fruit cocktail ice
137	Dadar gulung/ rolled pancake with sweet coconut sugar	173	Eseng-eseng tladak selada air/ stir-fry watercress
138	Daging goreng/ fried beef	174	Fitbar
139	Daging oseng-oseng/ beef stir-fried	175	Fried chicken KFC/ Kentucky Fried Chicken (KFC)
140	Dalgona/ whipped coffee	176	Fried chicken MCD
141	Dalgona matcha/ matcha whipped coffee	177	Fuyunghai/ egg foo young cuisine
142	Dawet/ cold drink made from rice or arrowroot flour, coconut milk, and palm sugar	178	Gabin/ biscuit gabin
143	Dessert box cheesecake	179	Gado-gado/ mixed vegetables and egg with peanut sauce
144	Dessert box chese regal	180	Garang asam/ spicy and sour chicken steam
145	Dessert box choco oreo	181	Getas/ brittle
146	Dessert box chocolate	182	Goodtime/ biscuit goodtime
147	Dessert box regal coklat keju/ dessert box regal choco cheese	183	Gorengan/ fritters
148	Dimsum/ dumpling	184	Granola
149	Donat/ donuts	185	Gulai/ beef curry
150	Durian	186	Gurami asam manis/ fried gourami with sour and sweet sauce
151	Edamame/ Japan soya bean	187	Hati ayam bumbu kecap/ chicken liver with sweet soy sauce
152	Emping mlinjo/ melinjo nuts chips	188	Hilo avocado/ iced chocolate avocado (Hilo)
153	Energen	189	Ice amerikano/ iced americano
154	Es buah/ Indonesian iced fruit cocktail dessert	190	Ice cappuccino
155	Es degan/ iced coconut water	191	Ice coffee jelly/ coffee jelly ice
156	Es jeruk/ iced orange	192	Ice cokelat oreo/ iced chocolate oreo
157	Es jeruk nipis/ lime iced	193	Ice cream cone/ cone ice cream
158	Es ketan ireng/ iced black sticky rice	194	Ice cream mochi cokelat aice
159	Es kopi/ iced coffee	195	Ice cream mochi durian aice/ mochi durian iced cream (Aice)
160	Es kopi susu/ iced coffee milk	196	Ice cream mochi matcha choco walls/ mochi matcha choco iced cream (Wall's)
161	Es lemon tea/ lemon tea ice	197	Ice cream mochi milky coffe walls/ mochi mily coffee iced cream (Wall's)
162	Es oyen/ fruit iced with milk and coconut	198	Ice cream mochi strawberry aice/ mochi strawberry iced cream (Aice)
163	Es puter/ coconut iced cream	199	Ice cream mochi vanilla/ mochi vanilla iced cream (Aice)
164	Es santan/ coconut iced with syrup	200	Ice green tea/ iced green tea
165	Es sirup/ syrup iced	201	Ice green tea latte/ iced green tea latte
166	Es susu/ iced milk		
167	Es susu milo/ iced milo milk		
168	Es tebu/ iced cane		
169	Es teh blueberry/blueberry iced tea		
170	Es teh manis/ sweet iced tea		

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

202	Ice hazelnut choco milk/ iced hazelnut choco milk
203	Ice hazelnut coffee latte/ iced hazelnut coffee latte
204	Ice hazelnut milk tea/ iced hazelnut milk tea
205	Ice jahe/ iced ginger
206	Ice jelly grass/ jelly grass iced
207	Ice lychee float/iced lychee float
208	Ice lychee tea/ iced lychee tea
209	Ice milk tea/ iced milk tea
210	Ice mint tea/ iced mint tea
211	Iga gulai/ curry ribs
212	Ikan asin/ salted fish
213	Ikan bakar/ grilled fish
214	Ikan bumbu kuning/ yellow spiced fish
215	Ikan goreng/ fried fish
216	Ikan gulai/ curry fish
217	Ikan panggang/ roasted fish
218	Ikan patin/ catfish
219	Ikan pindang bumbu kuning/ yellow spiced pindang fish
220	Infuse water (lemon dan tomat)/ infuse water (lemon and tomato)
221	Jagung bakar/ roasted corn
222	Jagung rebus/ boiled corn
223	Jahe hangat/ warm ginger
224	Jambu air/ rose apple
225	Jambu biji/ guava
226	Jamu/ herb
227	Jamur krispi/ crispy mushroom
228	Jamur tumis/ stir-fry mushroom
229	Jasuke/ cheese milk corn
230	Jelly
231	Jemblem/ confection of fried cassava
232	Jenang/ sweet porridge
233	Jeruk/ orange
234	Jus alpukat/ avocado juice
235	Jus buah naga/ dragon fruit juice
236	Jus jambu/ guava juice
237	Jus jeruk/ orange juice
238	Jus mangga/ mango juice
239	Jus mangga nanas/ mango and pineapple juice
240	Jus melon/ melon juice
241	Jus sawi nanas/ pineapple mustard juice
242	Jus semangka/ watermelon juice
243	Jus sirsak/ soursop juice
244	Jus tomat/ tomato juice
245	Jus wortel/ carrot juice
246	Jus wortel tomat/ carrot and tomato juice
247	Kacang atom/ atomic bean
248	Kacang telur/ egg nuts
249	Kaki ayam/ chicken feet
250	Kangkung/ kale steam
251	Kare ayam/ chicken curry
252	Kare pedas/ spicy curry
253	Kebab
254	Kedelai/ soya bean
255	Keju mozzarella/ mozzarella cheese
256	Kelengkeng/ longan
257	Kentang goreng/ French fries
258	Kentang mustofa/ Indonesian spiced crispy potatoes
259	Kentang rebus/ boiled potato
260	Kepala ayam bumbu kecap/ chocken head with sweet soy sauce
261	Kepala ayam goreng/ fried chicken head
262	Kepiting saus telur asin/ crab with salted egg sauce
263	Kerang kecap/ shellfish with sweet soy sauce
264	Kering kentang tempe/ dry tempe and potatoes
265	Keripik ceker ayam/ chicken claw chips
266	Keripik jagung/ corn chips
267	Keripik ketela/ cassava chips
268	Keripik pisang/ banana chips
269	Keripik singkong/ cassava chips
270	Keripik tempe/ fermented soya bean (tempe) chips
271	Kerupuk udang/ shrimp crisp
272	Ketan durian/ durian sticky rice
273	Ketela goreng/ fried cassava

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

274	Ketoprak/ Betawi vegetable salad served with peanut sauce
275	Kikil/ foot of an animal
276	Klepon/ steamed rice cake filled with java palm sugar
277	Kol goreng/ fried cabbage
278	Kolak pisang/ banana compote
279	Kolak pisang ubi/ sweet potato and banana compote
280	Koloke/ chicken with sweet and sour sauce
281	Kopi susu panas/ hot coffee milk
282	Krengsengan/ lamb stir-fry
283	Krim sup jagung/ corn cream soup
284	Kroket kentang/ potato crocuqettes
285	Kuaci/ sunflower seed
286	Kubis/ cabbage
287	Kue apem/ rice flour cake
288	Kue kering nastar/ pineapple nastar roll
289	Kue pancong/ rice flour cake with coconut-base batter
290	Kue perut ayam/ tapioka sweet cake
291	Kue sus coklat/ chocolate eclairs
292	Kue thok/ mung bean cake
293	Kulit ayam goreng/ fried chicken skin
294	Kunyit asam sidomuncul/ sour turmeric (Sido Muncul)
295	Kurma/ date
296	Kwetiau goreng/ stir fried flat rice noodle dish
297	Lalapan ayam bakar/ rice and grilled chicken with fresh vegetables
298	Lalapan ayam goreng/rice and fried chicken with fresh vegetables
299	Lalapan bebek goreng/ rice and fried duck with fresh vegetables
300	Lalapan belut/ fried eel with fresh vegetables
301	Lalapan bumbu kacang/ peanut sauce with fresh vegetables
302	Lalapan ikan lele/ fried catfish with fresh vegetables
303	Lalapan jamur/ fried mushroom with fresh vegetables
304	Lalapan tahu, tempe, telur/ fried tofu, fermented soya bean, egg with fresh vegetables
305	Lalapan tahu/tempe bacem/ tofu and fermented soya bean of brown sugar water with fresh vegetables
306	Lasagna daging/ beef lasagna
307	Lekker/ crepes
308	Lemet/ cake of grated coconut steamed in banana leaves or corn husks
309	Lemon squash
310	Lemon tea/ iced lemon tea
311	Lemper/ sweet stiffed sticky rice roll
312	Lodeh/ vegetable dish cooked woth coconut cream soup
313	Lontong/ rice rolls
314	Lontong balap/ rice rolls with bean sprouts, fried tofu, sweet soy sauce and shrimp paste
315	Lontong kupang/ rice rolls with small white clams
316	Lontong sayur/ vegetable rice rolls
317	Lontong tahu kecap/ rice rolls with tofu in sweet soy sauce
318	Lontong tahu telur rice rolls with tofu and egg in sweet soy sauce
319	Lumpia/ spring rolls
320	Lumpur/ sweet potato cake
321	Lupis/ triangle green glutinous rice with coconut and sugar
322	Madumongso/ Javanese snack made from black sticky rice
323	Makaroni asin/ salted macaroni
324	Makaroni bon cabe level 10/ macaroni with bon cabe level 10
325	Makaroni ngehe (original)/ macaroni ngehe (original)
326	Makaroni pedas/ spicy macaroni
327	Makaroni schotel/ macaroni schotel
328	Makaroni telur/ egg macaroni
329	Malkist cokelat/ malkist chocolate cracker
330	Malkist crackers
331	Mangga/ mango

332	Manggis/ mangosteen	365	Milk shake
333	Mango float	366	Misoa
334	Mangut lele kemangi/ basil catfish in mangut spices	367	Mocacinno
		368	Mojito
335	Manisan/ compote	369	Moktail/ mocktails
336	Marshmallow	370	Molen/ banana fried pastry
337	Martabak ayam/ deep fried chicken and vegetables wrap	371	Momogi/ momogi snacks
338	Martabak daging/ deep fried beef and vegetables wrap	372	Nagasari/ rice flour cake stuffed with banana bits and steames in banana leaves
339	Martabak mie/ deep fried noodle and vegetables wrap	373	Nanas/ pineapple
		374	Nasi ayam/ rice with steam chicken
340	Martabak telur/ deep fried egg and vegetables wrap	375	Nasi bakar ayam/ roasted rice chicken
341	Mie gacoan/ noodles brand gacoan	376	Nasi ayam bakar/ rice with grilled chicken
342	Melon	377	Nasi ayam geprek/ rice with smashed chicken
343	Mendol/ tempeh fritters		
344	Menjes goreng/ deep fried soya bean	378	Nasi ayam goreng dan sayur/ rice with fried chicken and vegetable
345	Mentimun/ cucumber		
346	Mie/ noodle	379	Nasi ayam laos/ rice with galangal fried chicken
347	Mie ayam/ chicken noodles	380	Nasi ayam pedas/ rice with spicy chicken
348	Mie ayam bakso/ chicken noodles with meatball	381	Nasi ayam penyet/ rice with smashed chicken
349	Mie ayam ceker/ noodles with chicken feet	382	Nasi ayam semur/ rice with chicken stew in sweet soy sauce
350	Mie bakar/ grilled noodles	383	Nasi bebek/ rice with fried duck
351	Mie bihun goreng/ fried vermicelli	384	Nasi cah kangkung dan tempe goreng/ rice with sauted kale and fried tempeh
352	Mie boncabe/ BonCabe noodle		
353	Mie goreng/ fried noodles	385	Nasi campur/ rice with an assortment of side dishes
354	Mie goreng Aceh/ Acehnese fried noodles	386	Nasi capcay/ rice with mixed vegetables
355	Mie goreng jawa/ Javanese fried noodles	387	Nasi ceker/ rice with fried chicken feet
356	Mie iblis level 0/ devil noodles level 0	388	Nasi Chicken Teriyaki/ rice with chicken soya sauce
357	Mie Indomie goreng/ indomie fried noodle	389	Nasi dan Ikan krispi/ rice with crispy fish
358	Mie instan goreng dan telur/ instant noodles with egg	390	Nasi dan tahu telur/ rice with tofu omelette
359	Mie instan kuah/ instant noodle soup	391	Nasi dan telur/ rice and fried egg
360	Mie kuah/ noodle soup	392	Nasi dengan lauk gorengan/ rice with fried food
361	Mie lidi/ stick noodles		
362	Mie nasi/ noodle with rice	393	Nasi empog/ corn rice
363	Mie pangsit/ dumpling noodles	394	Nasi garam/ rice with salt
364	Mie pedas/ spicy noodles	395	Nasi gila/ rice with spicy stir-fry egg and chicken

396	Nasi goreng/ fried rice	423	Nasi rames/ mixed rice
397	Nasi goreng jawa/ Javanese fried rice	424	Nasi rawon/ rice with diced beef in black sauce soup
398	Nasi gudeg/ rice with traditional Javanese cuisine made from unripe jackfruit	425	Nasi rolade/ rice with meat loaf
399	Nasi ikan cakalang/ rice with fried skipjack	426	Nasi sayur asam/ rice with vegetables tamarind soup
400	Nasi ikan goreng/ rice with fried rice	427	Nasi sayur bayam/ rice with spinach soup
401	Nasi ikan pindang/ rice with preserve large fish with salt without drying	428	Nasi sayur labu siam/ rice with chayote soup
402	Nasi ikan tongkol/ rice with mackerel tuna rice	429	Nasi sayur lodeh/ rice with vegetable dish cooked with coconut cream soup
403	Nasi jamur/ rice with stor-fry mushrooms	430	Nasi sayur sup/ rice with vegetables soup
404	Nasi jamur krispi/ rice wth crispy mushrooms	431	Nasi sayur sup ayam/ rice with chicken soup
405	Nasi kare tahu/ rice with tofu curry soup	432	Nasi sayur sup tahu/ rice with tofu soup
406	Nasi kebuli/ Indonesian variation of pillaf rice	433	Nasi soto/ clear soup rice
407	Nasi kentang balado/ rice with dried potato with chillies	434	Nasi sup daging/ rice with beef soup
408	Nasi kuning/ turmeric rice	435	Nasi sup telur puyuh/ rice with quail egg soup
409	Nasi lalapan ati/ rice with fried chicken liver and fresh vegetables	436	Nasi sup, telur, dan ayam goreng/ rice with egg and fried chicken
410	Nasi lalapan lele/ rice with fried catfish and fresh vegetables	437	Nasi tahu bumbu/ rice with spiced tofu
411	Nasi lemak/ rice cooked with coconut milk and padan leaf	438	Nasi tahu goreng/ rice with fried tofu
412	Nasi liwet/ rice cooked with coconut water	439	Nasi tahu telur/ rice with fried tofu and egg in peanut sauce
413	Nasi mentai/ mentai rice	440	Nasi tahu tempe/ rice with fried tofu and fermented soya bean
414	Nasi merah/ brown rice	441	Nasi tahu tempe telur/ rice with fried tofu, fermented soya bean and egg
415	Nasi mie/ rice with noodle	442	Nasi telur dadar/ rice with scrambled egg
416	Nasi padang ayam goreng/ Padang steamed rice with fried chicken	443	Nasi telur kecap/ rice with egg in sweet soya sauce
417	Nasi padang ayam pop/ Padang steamed rice with pop chicken	444	Nasi telur orak-arik/ rice with egg and cabbage scramble
418	Nasi padang rendang/ Padang steamed rice with meat simmered in spices and coconut milk	445	Nasi tempe/ rice with fried fermented soya bean
419	Nasi padang telur dadar/ Padang steamed rice with omelette	446	Nasi tiwul ikan laut/ rice with cassava in coconut milk soup and fresh fish
420	Nasi pecel/ rice with vegetables and peanut sauce	447	Nasi tumis tempe/ rice with stir-fry fermented soya bean
421	Nasi perkedel dan telur/ rice with potato fritters and omelette	448	Nasi tumpeng/ Indonesian cone-shaped rice dish with side dishes of vegetables and meat
422	Nasi putih/ rice	449	Nasi udang balado/ rice with dried shrimp with chillies

450	Nasi udang krispi/ rice with crispy shrimp	480	Pasta
451	Nasi uduk/ rice cooked in coconut milk	481	Pastel/ patty
452	Nasi urap-urap dan telur/ riced cooked vegetables with grated coconut and egg	482	Pastel kering isi abon/ dried patty filled floss
453	Nextar choco delight	483	Peach green tea
454	Nextar coconut delight	484	Pecel sayur/ salad made of blanched vegetables served with peanut sauce
455	Nextar pineapple jam	485	Pelasan ikan/ fish wrapped in banana leaf and roasted
456	Nextar strawberry	486	Pempek goreng/ fried savoury fishcake
457	Nugget	487	Pempek rebus/ boiled savoury fishcake
458	Nutriboost	488	Pentol/ tapioka meatball
459	Nutriboost cokelat/ nutriboost chocolate	489	Pentol bakar/ roasted tapioka meatball
460	Nutriboost jeruk/ nutriboost orange	490	Penyetan ayam/ smashed chicken
461	Nutriboost kopi susu/ nutriboost coffee milk	491	Penyetan lele/ smashed catfish
462	Nutriboost manga/ nutriboost mango	492	Pepaya/ papaya
463	Nutriboost strawberry/ nutriboost strawberry	493	Pepes ayam/ chicken wrapped in banana leaf and roasted
464	Oat snack	494	Perkedel jagung/ croquette of spice grund meat and boiled potatoes
465	Oatmeal	495	Permen karet/ chewing gum
466	Omelet/ omelette	496	Kopi susu sachet/ coffee milk sachet
467	Onde-onde/ round cake made of rice flour fille with sweetened ground mung beans	497	Peyek/ peanut crips
		498	Pie apel/ apple pie
468	Onigiri/ Japanese rice ball (onigiri)	499	Pie cokelat/ chocolate pie
469	Onion rings	500	Pie susu/ milk egg tart
470	Opor ayam/ braised chicken in coconut milk	501	Pindang pedas/ spice preserve large fish with salt without drying
471	Oreo/ oreo snack	502	Pir/ pear
472	Oseng sayur/ stir-fried vegetables with chilli peppers	503	Pisang/ banana
		504	Pisang bakar/ roasted banana
473	Oseng tahu/ stir-fried tofu with chilli peppers	505	Pisang cokelat/ chocolate banana
474	Oseng tahu tempe hati ayam dan udang/ stir-fried tofu, fermented soya bean, chicken liver, and shrimp with chilli peppers	506	Pisang goreng/ fried banana
		507	Pisang keju/ cheese banana
		508	Pisang nuget/ banana nugget
		509	Pizza
475	Oseng tempe/ stir-fried fermented soya bean with chilli peppers	510	Pocky choco banana
		511	Pocky chocolate
476	Oseng tongkol/ stir-fried mackerel tuna with chilli peppers	512	Pocky cookie and cream
		513	Pocky double choco
477	Otak-otak sapi/ fried stuffed beef	514	Pocky matcha
478	Ote-ote/ fritter filled vegetables	515	Pocky strawberry
479	Ovaltine/ milk brand ovaltine		

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

516	Pop corn	547	Salad buah/ fruit salad
517	Pop mie	548	Salad sayur/ vegetables salad
518	Puding/ pudding	549	Salak/ snakefruit
519	Pukis/ butter cake	550	Salted potato
520	Putu ayu/ Indonesian cake made of rice flour ad coloured green with pandan leaves, filled with palm sugar	551	Sambal/ chili sauce
		552	Sambal balado/ dried chilli sauce
		553	Sambal cumi/ spicy squid saute
521	Rambutan	554	Sambal goreng kentang dan hati/ spicy potato and chicken liver saute
522	Ramen/ ramen Japanese noodles		
523	Rawon/ dice beef in black sauce soup	555	Sambal goreng tahu/ spicy and seet tofu saute
524	Red velvet cake		
525	Red velvet ice	556	Sambal goreng tempe/ spicy tempe saute
526	Rempelo ati goreng	557	Sambal goreng teri/ spicy sweet anchovy saute
527	Rendang/ meat simmered in spices and coconut milk		
528	Rengginang asin/ salted cracker made of glutinous rice	558	Sambal goreng tuna/ spicy sweet tuna saute
		559	Sambal kacang/ peanut chilli sauce
529	Rengginang manis/ sweet crisp cracker made of glutinous rice	560	Sambal petai/ spicy stink bean chilli saute
530	Risol mayo/ mayonnaise rissole	561	Sambal pokak/ spicy poka saute
531	Risoles/ rissole	562	Sambal tempe/ tempeh chilli sauce
532	Roma sari gandum/ wheat cider biscuits	563	Sambal teri/ anchovy chilli sauce
533	Roma sari gandum sandwich/ wheat cidder sandwich biscuits	564	Sambal terongeggplant chilli sauce
		565	Samgak kimbap/ triangle rice roll
534	Roti atau burger/ bread or burger	566	Sandwich keju/ cheese sandwich
535	Roti bakar/ toast	567	Sarden/ sardines
536	Roti canai/Maryam/ Maryam (flat Malaysian bread made from wheat)	568	Sari jahe/ ginger extract
		569	Sari kedelai/ soya bean juice
537	Roti goreng/ fried cake	570	Sari roti/ tear and share bread brand sariroti
538	Roti isi cokelat/ bread filled chocolate		
539	Roti maryam dengan skm/ Maryam bread (Malaysian bread made from wheat with sweetened condensed milk	571	Satai ayam/ chicken satay
		572	Satai daging/ beef satay
		573	Satai kambing/ goat satay
540	Roti sisir mentega/ butter bread	574	Satai padang/ Padang steamed satay
541	Roti tawar/ bread	575	Satai pusut/ pusut beef satay
542	Rotiboy/ Mexican bun	576	Satai tahu/ tofu satay
543	Rujak manis/buah / fruit salad with sweet brown coconut sugar	577	Sawo/ sapodilla
		578	Sawo duren/kenitu / durian sapodilla
544	Rujak cingur/ vegetables with slices of beef snout in shrimp paste sauce (cingur)	579	Sayap ayam bumbu pedas manis/ chicken wings with sweet and spicy sauce
545	Rujak serut/ shaved fruit salad with slices of beef snout	580	Sayap ayam goreng/ fried chicken wings
546	Rujak uleg/sayur / vegetables salad with shrimp paste sauce (Rujak)	581	Sayur asam/ tamarind vegetable soup

582	Sayur bayam/ spinach soup
583	Sayur bening/ spinach soup
584	Sayur daun papaya/ papaya leaf soup
585	Sayur daun singkong/ cassava leaf soup
586	Sayur kelor/ moringa vegetable soup
587	Sayur klothok pindang/ fish with coconut cream soup
588	Sayur lodeh/ vegetable dish cooked with coconut cream soup
589	Sayur Nangka/ young jackfruit cooked with coconut cream soup
590	Sayur pakis tahu tempe petai/ fern, tofu, fermented soya bean and stink bean cooked with coconut cream soup
591	Sayur santan/ coconut cream soup
592	Sayur sup/ soup
593	Sayur tauge/ bean sprouts soup
594	Sayur urap urap/ cooked vegetables with grated coconut
595	Sayuran bayam rebus/ boiled spinach
596	Seblak/ spicy savory wet chips
597	Sego banting/ rice with fried noodles, shredded chicken, and sweet tofu in soy sauce
598	Selada/ lettuce
599	Semangka/ watermelon
600	Sempol/ skewered chicken rolls
601	Semur daging/ beef stew
602	Semur jengkol/ dogfruit stew
603	Semur tahu kentang/ tofu and potato stew
604	Semur telur/ egg stew
605	Sereal/ cereal
606	Serundeng daging sapi/ beef with grated coconut and spices
607	Serundeng kelapa/ grated coconut and spices
608	Singkong goreng/ fried cassava
609	Singkong rebus/ boiled cassava
610	Siomay / dumplings
611	Siomay sawi putih/ Chinese cabbage dumplings
612	Smoothie buah/ fruit smoothie
613	Soda
614	Soda gembira/ soda with condensed milk, syrup, and ice
615	Sosis ayam/ chicken sausage
616	Sosis bakar/ grill sausage
617	Sosis sapi/ beef sausage
618	Sosis solo/ fried egg crepe with sweet and minced beef filling
619	Soto ayam/ chicken sou
620	Soto ayam dan telur/ egg and chicken soup
621	Soto Betawi/ beef soto
622	Soto daging/ beef soup
623	Souffle
624	Spaghetti
625	Steak
626	Steak ayam/ chicken steak
627	Stick balado/ dried stick with chillies
628	Stick tahu/ tofu stick
629	Stik rasa bawang/ onion stick
630	STMJ
631	Strawberry
632	Strawberry tea
633	Sukiyaki/ sukiyaki Japanese hot pot
634	Sumpia udang/ shrimp chopticks
635	Sup/ veggie soup
636	Sup asparagus/ asparagus soup
637	Sup ayam/ chicken soup
638	Sup ayam macaroni/ macaroni chicken soup
639	Sup buntut/ oxtail soup
640	Sup jamur. Mushroom soup
641	Sup lontong daging bumbu kacang/ rice rolls and beef soup with peanut sauce
642	Sup merah/ tomato soup
643	Sup telur/ egg soup
644	Surabi/ pancake made from rice flour wwith coconut milk or shredded coconut
645	Sushi
646	Susu cokelat/ chocolate milk
647	Susu kedelai/ soya bean milk
648	Susu pisang (cimory)/ banana milk (cimory)

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

649	Susu pisang (frisian flag junio)/ banana milk (frisian flag junio)
650	Susu pisang (indomilk banana)/ banana milk (indomilk)
651	Susu sereal/ cereal milk
652	Tahu bacem/ tofu steeped prior to cooking
653	Tahu bakar/ grilled tofu
654	Tahu bakso/ tofu meatball
655	Tahu bulat/ round tofu
656	Tahu fantasi bihun/ vermicelli tofu
657	Tahu goreng/ fried tofu
658	Tahu goreng tepung/ deep-fried tofu
659	Tahu isi/ deep-fried vegetable tofu
660	Tahu kecap/ fried tofu in soy sauce
661	Tahu krispi/ crispy tofu
662	Tahu lontong / rice rolls with tofu peanut sauce
663	Tahu mercon/ hot and spicy tofu
664	Tahu panggang/ roasted tofu
665	Tahu rebus/ boiled tofu
666	Tahu sutera/ silken tofu
667	Tahu telur/ deep-fried egg with tofu
668	Tahu tempe/ fried tofu and fermented soya bean
669	Tahu thek/ tofu with rice rolls in peanut sauce
670	Tahu walik/fried tapioka starch tofu
671	Tahu/tempe penyet / smashed tofu/tempewith chilli sauce
672	Takoyaki
673	Tape goreng/ fried fermented cassava
674	Tape singkong/ fermented cassava
675	Taro/ snack brand Taro
676	Teh Tarik/ Tarik tea
677	Tela-tela/ cassava snack brand Tela-tela
678	Telur asin/ salted egg
679	Telur ayam rebus/ boiled egg
680	Telur balado/ egg with chillies saute
681	Telur bumbu/ spiced eggs
682	Telur ceplok goreng/ fried egg
683	Telur gulung/ egg roll
684	Telur puyuh kecap/ quail egg in sweet soy sauce
685	Telur rebus/ boiled egg
686	Tempe bacem/ fermented soya bean steeped prior to cooking
687	Tempe bakar/ roated fermented soya bean
688	Tempe balado/ dried fermented soya bean with chillies
689	Tempe goreng/ fried fermented soya bean
690	Tempe goreng tepung/ deep-fried fermented soya bean
691	Tempe kacang goreng/ fried fermented peanut soya bean
692	Tempe orak-arik/ stir-fry fermented soya bean
693	Tempe rebus/ boiled fermented soya bean
694	Terang bulan special/ sweet pancake
695	Terong goreng/ fried eggplant
696	Terong rebus/ boiled eggplant
697	Tetelan salmon/ salmon bones a bit of adhering meat
698	Thai tea
699	Tictac/ snack brand tic tac
700	Tiramisu
701	Toast ham and cheese
702	Tomat/ tomato
703	Tongkol pedas/ spicy tuna
704	Tongsengan kambing/ cabbage and goat beef saute
705	Topppoki/ Korean spicy rice cake
706	Tumis ayam/ stir-fry chicken
707	Tumis brokoli/ stir-fry broccoli
708	Tumis bunga papaya/ stir-fry papaya flower
709	Tumis kacang Panjang/ sauted long beans
710	Tumis kangkung/ stir-fry kale
711	Tumis kentang/ stir-fry potatoes
712	Tumis pare/ stir-fry bitter gourd
713	Tumis pepaya muda/ stir-fry papaya
714	Tumis tahu buncis/ stir-fry tofu and green beans
715	Tumis tahu jamur/ stir-fry tofu and

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

	mushrooms
716	Tumis tauge/ stir-fry bean sprouts
717	Tumis tauge tahu/ stir-fry bean sprouts and tofu
718	Tumis wortel/ sauteed carrots
719	Tuna pedas/ spicy tuna
720	Ubi cilembu bakar/ roasted cilembu sweet potato
721	Ubi cilembu rebus/ boiled cilembu sweet potato
722	Ubi goreng/ fried sweet potato
723	Ubi ungu rebus/ boiled sweet potato
724	UC 1000
725	Udang asam manis/ shrimp with sweet and sour sauce
726	Udang bumbu merah/ hot and spicy shrimp
727	Udang keju/ cheese shrimp
728	Udang krispi/ crispy shrimp
729	Udang mentega/ shrimp roated butter
730	Udang rambutan/ shrimp dumplings
731	Usus ayam goreng/ fried chicken intestine
732	Usus pedas/ hot and spicy chicken intenstine
733	Vanilla frappe
734	Vanilla Latte/ iced vanilla latte
735	Wafer cokelat/ chocolate wafer
736	Waffle cokelat/ chocolate waffle
737	Waffle keju/ cheese waffle
738	Wedang jahe/ hot ginger drink
739	Widaran manis/ sweet glutinous rice flour
740	Yogurt
741	Yupi/ yupi candy

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

8. Diet Information Materials

All of the material will use Indonesian obesity guidebook program.

Session 1: How to start to manage the diet

Dietary pattern which caused obesity
1. Too much consumption of fried, fatty and sweet foods
2. Eating too quickly
3. Less vegetables and fruits consumption
4. Avoid breakfast
5. Eating in big portion
6. Eating in inconsistent schedule
7. Often for eating high calories snack

.

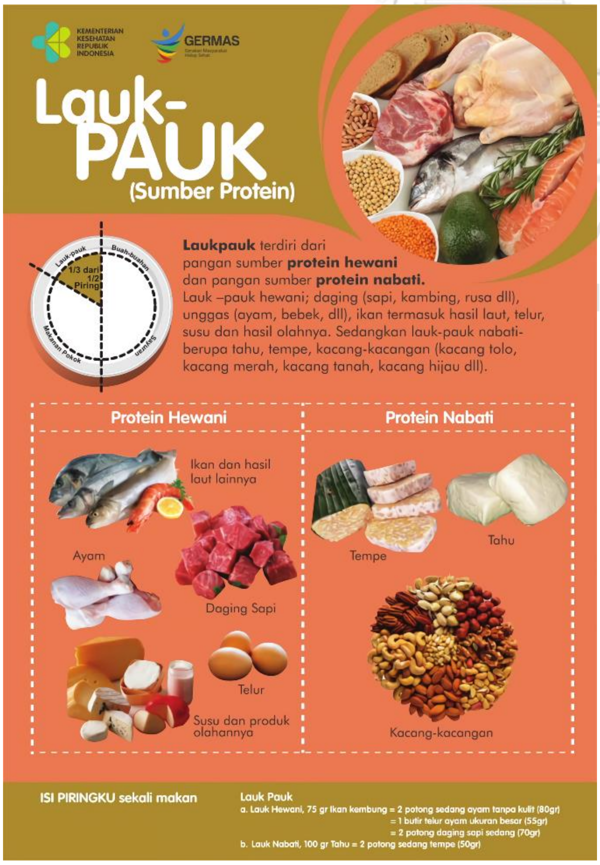
Is it safe to lose weight too fast?
The suggestion of losing weight is 0.5-1 kg per week with reducing approximately 500 kcal from estimated energy requirements.

Losing weight too fast can cause dehydration, tired and unbalancing electrolyte.

What should we do if we had overweight or obese?

1. Do exercise for reducing weight (normal BMI <25 and waist circumference max for women are 80 cm and men are 90 cm)
2. Reduce sugar, salt and fat intake
3. Consume more fruits and vegetables

Session 2: Healthy diet



Protein sources:

In plate portion, the portion of protein should be 1/3 from half of plate

It consisted of animal and plant based

1. Animals: fish, chicken, meat, egg and other milk daily products
2. Plant: tempe, tofu and beans

Vegetables portions per day.

Vegetables should eat 2 portions per day

1 portion of vegetables seems like 1 bowl of fresh vegetable or cooked vegetables

it is better for consuming fresh vegetable or steam because boiling vegetables will disolve the vitamin and mineral.

Fruit portion per day: Fruits can consume 2-3 times per day.

For instance, you can eat ½ bowl of fruits or 1 glass of juice or 1 piece of orange, apple, guava or banana.

It consists of many nutrients and good for health

Session 3: “food portion” and “challenge I: less carbohydrate for 1 week”

Plate portion in one meal:
Example: lunch – 700 cal
1. carbohydrate – 3 rice spoons or 3 medium piece potatos
2. protein – 2 pieces of chicken without skin or 1 piece of big egg (55 gr) or 100 gr of Tofu or 2 medium piece of tempe (50 gr)
3. vegetables -- 1 medium bowl = 150 gr
4. fruits – 150 gr papaya – 2 medium piece or 2 medium of orange

How to prevent obesity?
Consuming food should have 5 components (carbohydrate, protein, vegetables, fruits and water).

Consuming food used plate portion:
2/3 from half plate is carbohydrate
1/3 from half plate is protein
2/3 from half plate is vegetables
1/3 from half plate is fruits

Preventing obesity by manage the dietary intake:
The suggestion portion:
50% from plate should be vegetables and fruits
25% protein
25% carbohydrate
+ consuming complex carbohydrate
+consume protein from animal and plants
+consuming vegetables minimum 5 portion and fruits 2-3 portions per day
+regular meals schedule
+ portion for dinner is less than lunch and breakfast

Challenge for users:
In 2 weeks, reduce the rice portion to be 1/2

Session 4: meal plan

Food schedule:
07.00-08.00
Breakfast
09.00–10.00 snack
12.00-13.00 lunch
15.00-16.00 snack
18.00-19.00 dinner

Suggestion about consuming sugar, salt and fat per day
1. 4 table spoons of sugar per day (50 gram)
2. 1 tea spoon of salt (5 gram)
3. 5 table spoons of fat (67 gram)

Dietary pattern which caused obesity

1. Avoid breakfast
2. Too much consumption of fried, fatty and sweet foods
3. Eating in big portion
4. Eating too quickly
5. Eating in inconsistent schedule
6. Often for eating high calories snack
7. Less vegetables and fruits consumption

How much water you should drink every day?
There is table with weight and water in liter

Session 5: about “subtitution food” and “challenge 2: less fried food”

Tips for healthy consuming in sugar, salt and fat

- Choose fresh food than packaged food
- Read carefully the label of food nutrient
- Avoid food or drink with sweeteners
- Avoid the food with high natrium
- Avoid high cholesterol food
- Reducing coconut milk and oil when cooked.

GERMAS Gerakan Masyarakat Hidup Sehat

KEMENKES RI

Penukar 1: Sumber Karbohidrat

1 satuan penukar mengandung 175 kkal, 4 gram protein, 40 gram karbohidrat

Bahan Makanan	Ukuran	Berat (gram)
Bihun	½ gelas	50
Bubur Beras	2 gelas	400
Biskuit	4 buah besar	40
Gandum	5 ½ sdm	45
Kentang	2 biji sedang	210
Makaroni	½ gelas	50
Mi kering	1 gelas	50
Mi basah	2 gelas	200
Nasi	¾ gelas	100
Nasi Tim	1 gelas	200
Roti Putih	3 potong sedang	70
Singkong	1 potong	120
Talas	1 potong	125
Tepung Sagu	8 sdm	50
Tepung Hunkwe	10 sdm	50
Tepung Terigu	5 sdm	50
Tepung Maizena	10 sdm	50
Tepung Beras	8 sdm	50
Ubi	1 biji sedang	135

www.pptm.depkes.go.id @p2ptmkemenkesRI @p2ptmkemenkesRI @p2ptmkemenkesRI

it showed carbohydrate substitution

Bahan Makanan	Ukuran	Berat (gram)
Ayam tanpa kulit	1 potong sedang	40
Babat	1 potong sedang	40
Daging kerbau	1 potong sedang	35
Ikan	1 potong sedang	40
Ikan Asin	1 potong sedang	15
Teri Kering	1 sdm	15
Udang Segar	5 ekor sedang	35

Bahan Makanan	Ukuran	Berat (gram)
Bakso	1 biji sedang	170
Daging Kambing	1 potong sedang	40
Daging Sapi	1 potong sedang	35
Hati Ayam	1 potong sedang	30
Hati Sapi	1 potong sedang	35
Otak	1 potong besar	60
Telur Ayam	1 butir	55
Telur Bebek	1 butir	55
Usus Sapi	1 potong besar	50

Bahan Makanan	Ukuran	Berat (gram)
Ayam dengan kulit	1 potong sedang	55
Bebek	1 potong sedang	45
Corned Beef	2sdm	45
Daging Babi	1 potong sedang	50
Kuning Telur Ayam	4 butir	45
Sosis	1 potong sedang	50

It showed protein substitution

it challenges for users "In 2 weeks, reduce carbohydrate ½ portion and don't consume fried food"

Session 6: Indonesian nutrient guideline (food balancing composition)

Food balancing composition:
Eating with balancing composition in carbohydrate, protein and fibre, active in exercise and manage the weight.

Food balancing general message:
1. consuming variety of food items
2. eating more vegetables and fruits
3. eating high protein
4. consume others carbohydrate source
5. control the consumption of sugar, salt and fat

10 food balancing messages:
1. consuming variety of food items
2. eating more vegetables and fruits
3. eating high protein
4. consume others carbohydrate source
5. control the consumption of sugar, salt and fat
6. don't avoid breakfast
7. drink enough water
8. read carefully nutrition facts
9. wash hand with soap and water
10. do regular exercise and manage the weight

Session 7: Indonesian nutrient guideline (beverage and snack) and "challenge 3: less sweet drink

Thirsty? Choose mineral water and not sugary drink

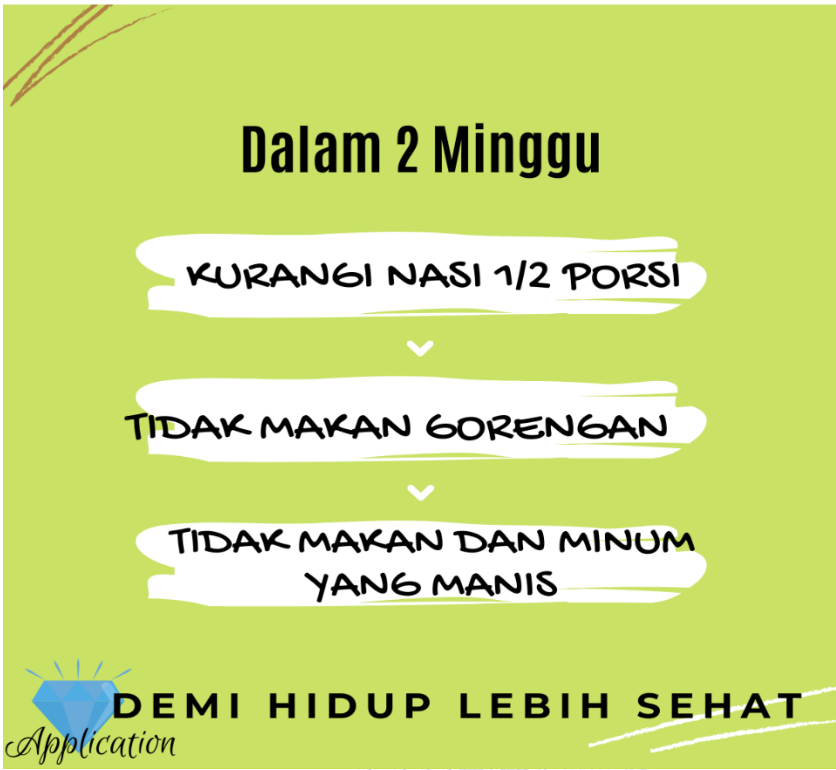
sugar portion in snack:

1. chocolate bar – 7 tea spoons
2. es cream – 4 tea spoons
3. soda can – 9 tea spoons
4. 1 piece of bread – ½ tea spoon

Sugar portion in beverages:

- no sugar tea – 0 gram
- soda – 33 grams
- tea/coffee with condensed milk – 21 grams

limitation of sugar consumption per day is 50 grams = 4 table spoons of sugar



Challenge for users:
In 2 weeks,
Reduce ½ portion of rice
Don’t consume fried food
Don’t consume sweet dessert and beverages

Session 8: about diet advice

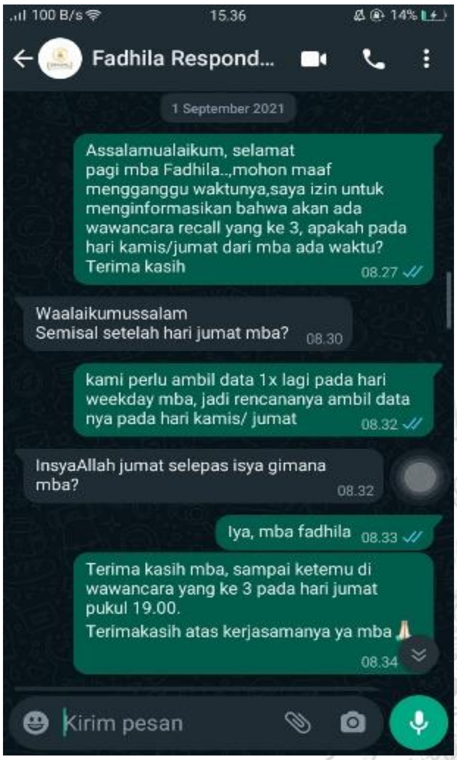
6 tips to assist your diet program:
1. using small plate for meals
2. drink water before eat
3. eat slowly
4. eating before shopping
5. avoid unhealthy food
6. eat more vegetables

Tips for shopping in market or supermarket:
1. read carefully the nutrient facts
2. read the sodium/natrium percentages
3. choose food which had lower sodium/ natrium percentages
4. don't forget to check the expired date

Tips to reduce the fat and cholesterol when you cooked:
5. when you fried the food, dry it first before eat
6. reduce oil usage for stir fry, try steam food for meat and vegetables
7. remove fat in soup.

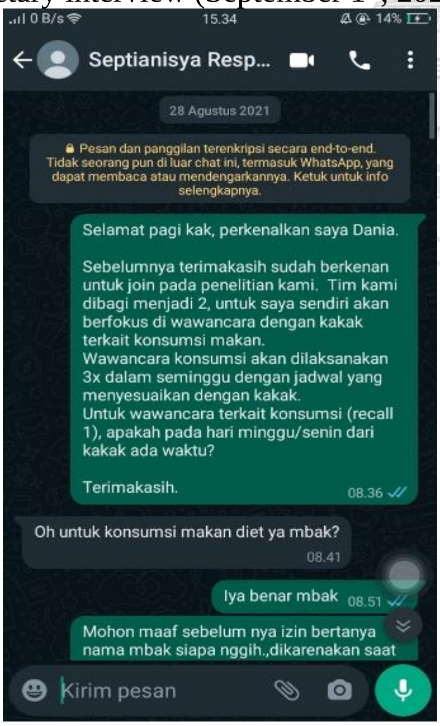
9. Documentation of dietary intake appointments

Week 0 | **Week 9**

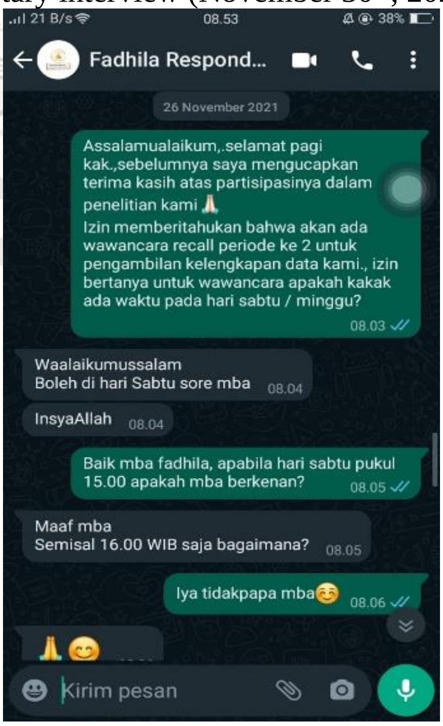


Appointment chat with respondent for dietary interview (September 1st, 2021)

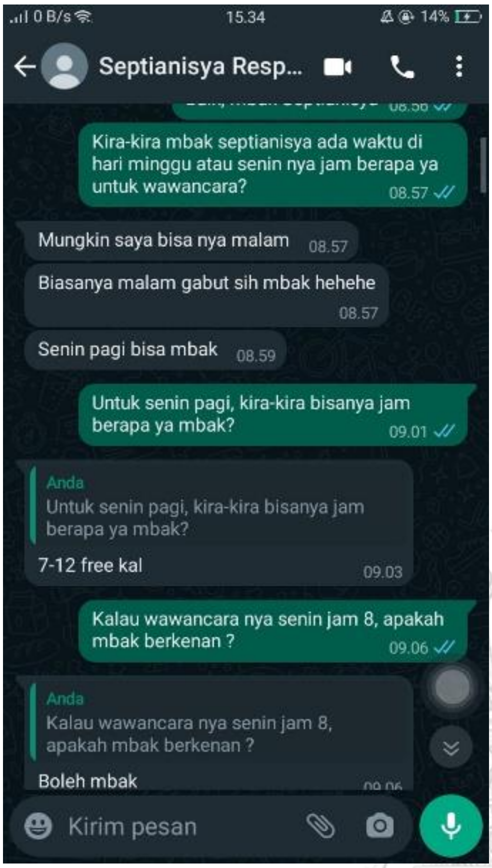
Appointment chat with respondent for dietary interview (November 30th, 2021)



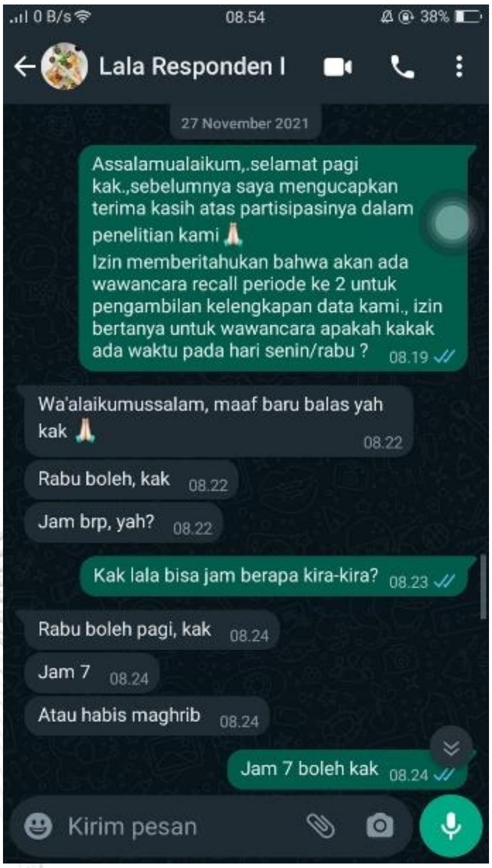
Appointment chat with respondent for dietary interview (August 28th, 2021)



Appointment chat with respondent for dietary interview (November 26th, 2021)



Appointment chat with respondent for dietary interview (September 1st, 2021)



Appointment chat with respondent for dietary interview (November 27st, 2021)

10. Dietary portion meter

จุฬาลงกรณ์มหาวิทยาลัย

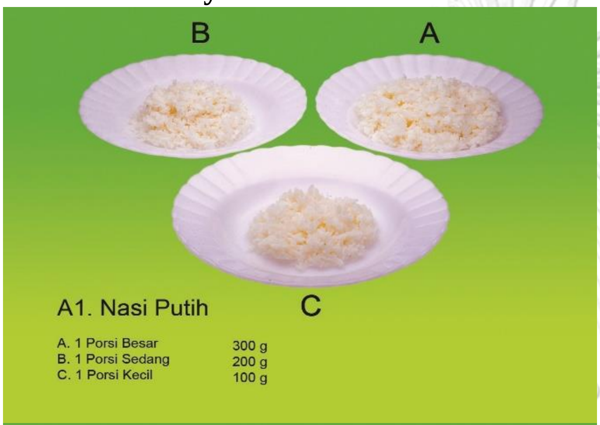
Food Utensil

Cup

Glass

Food

a. **Carbohydrate**



A1. Rice

A. 1 large portion = 300 g
B. 1 medium portion = 200 g
C. 1 small portion = 100g

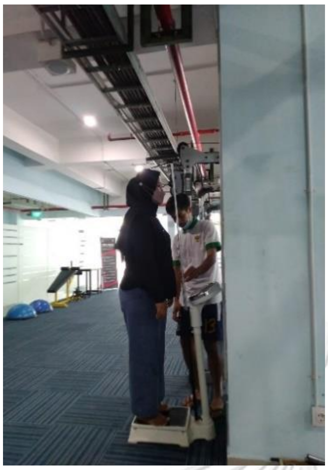
A2. Rice

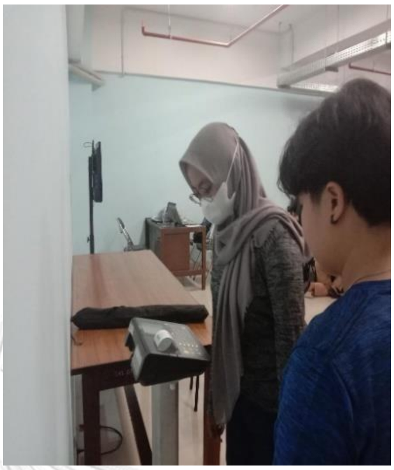
A. 1 scoop rice cooker = 50 g
B. 1 scoop of plastic = 60 g
C. 1 wooden scoop = 70 g
D. 1 tablespoon = 15 g

Full access of portion meter is https://sipolan.sikap.pemkomedan.go.id/porsimetri.pdf

11. BMI Measurement

Week 0





CHULALONGKORN UNIVERSITY

Week 9



Shafa
TANITA
BODY COMPOSITION
ANALYZER
DC-360
07/DEC/2021 12:50
INPUT
BODY TYPE STANDARD
GENDER FEMALE
HEIGHT 160.5cm
CLOTHES WEIGHT 0.5kg
RESULT
WEIGHT 59.5kg
FAT % 34.9 %
FAT MASS 20.8kg
FFM 38.7kg
MUSCLE MASS 36.5kg
TBW 27.5kg
TBW % 46.2 %
BONE MASS 2.2kg
BMR
METABOLIC AGE
VISCERAL FAT RATING
BMI 23.1
DESIRABLE RANGE
FAT % 21.0 - 34.9 %
FAT MASS 10.3 - 20.7kg
INDICATOR
FAT %
BMI
VISCERAL FAT RATING
MUSCLE MASS
BMR
PHYSIQUE RATING
STANDARD

TANITA
BODY COMPOSITION
ANALYZER
DC-360
16/DEC/2021 10:00
INPUT
BODY TYPE STANDARD
GENDER FEMALE
AGE 31
CLOTHES WEIGHT 0.5kg
RESULT
WEIGHT
FAT % 44.3 %
FAT MASS 27.4kg
FFM 34.5kg
MUSCLE MASS 32.8kg
TBW 25.5kg
TBW % 41.2 %
BONE MASS 1.9kg
BMR 4620 kJ
1106kcal
METABOLIC AGE 56
VISCERAL FAT RATING 8
BMI 27.8
DESIRABLE RANGE
FAT % 21.0 - 34.9 %
FAT MASS
INDICATOR
FAT %
BMI
VISCERAL FAT RATING
MUSCLE MASS
BMR
PHYSIQUE RATING
OBESE
BIOELECTRICAL DATA

12. SPSS Results

Appendix

1. Sociodemographic between intervention and control group

a. Age between intervention and control group

Descriptives

			Statistic	Std. Error
age_g1	Mean		21.70	.178
	95% Confidence Interval for Mean	Lower Bound	21.34	
		Upper Bound	22.05	
	5% Trimmed Mean		21.72	
	Median		22.00	
	Variance		1.988	
	Std. Deviation		1.410	
	Minimum		19	
	Maximum		24	
	Range		5	
	Interquartile Range		2	
	Skewness		-.474	.302
	Kurtosis		-.341	.595

Descriptives

			Statistic	Std. Error
age_g2	Mean		21.37	.199
	95% Confidence Interval for Mean	Lower Bound	20.97	
		Upper Bound	21.76	
	5% Trimmed Mean		21.39	
	Median		21.50	
	Variance		2.372	
	Std. Deviation		1.540	
	Minimum		18	
	Maximum		24	
	Range		6	
	Interquartile Range		3	
	Skewness		-.215	.309
	Kurtosis		-.864	.608

จุฬาลงกรณ์มหาวิทยาลั

95% Confidence Interval for Mean	Lower Bound	21.27
	Upper Bound	21.80

Test Statistics[a]

	age
Mann-Whitney U	1669,000
Wilcoxon W	3499,000
Z	-1,141
Asymp. Sig. (2-tailed)	,254

a. Grouping Variable: group

b. Hometown between intervention and control group

hometown * group Crosstabulation

			group		
			group 1	group 2	Total
hometown	rural	Count	34	39	73
		% within hometown	46.6%	53.4%	100.0%
	urban	Count	29	21	50
		% within hometown	58.0%	42.0%	100.0%
Total		Count	63	60	123
		% within hometown	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1,550[a]	1	,213		
Continuity Correction[b]	1,127	1	,288		
Likelihood Ratio	1,555	1	,212		
Fisher's Exact Test				,271	,144
Linear-by-Linear Association	1,538	1	,215		
N of Valid Cases	123				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 24,39.

b. Computed only for a 2x2 table

c. Religion between intervention and control group

religion_new * group Crosstabulation

			group		
			group 1	group 2	Total
religion_new	Islam	Count	63	56	119
		% within religion_new	52.9%	47.1%	100.0%
	Non Islam	Count	0	4	4
		% within religion_new	0.0%	100.0%	100.0%
Total		Count	63	60	123
		% within religion_new	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.341[a]	1	.037		
Continuity Correction[b]	2.481	1	.115		
Likelihood Ratio	5.884	1	.015		
Fisher's Exact Test				.054	.054
Linear-by-Linear Association	4.306	1	.038		
N of Valid Cases	123				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.95.

b. Computed only for a 2x2 table

d. Education intervention and control group

education * group Crosstabulation

			group		
			group 1	group 2	Total
education	bachelor	Count	60	60	120
		% within education	50.0%	50.0%	100.0%
	master	Count	3	0	3
		% within education	100.0%	0.0%	100.0%
Total		Count	63	60	123
		% within education	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2,929[a]	1	,087		
Continuity Correction[b]	1,269	1	,260		
Likelihood Ratio	4,086	1	,043		
Fisher's Exact Test				,244	,131
Linear-by-Linear Association	2,905	1	,088		
N of Valid Cases	123				

a. 2 cells (50,0%) have expected count less than 5. The minimum expected count is 1,46.

b. Computed only for a 2x2 table

e. Academic year intervention and control group

academicyear_new * group Crosstabulation

			group 1	group 2	Total
academicyear_new	< 4 years	Count	23	22	45
		% within academicyear_new	51.1%	48.9%	100.0%
	>= 4 years	Count	40	38	78
		% within academicyear_new	51.3%	48.7%	100.0%
Total		Count	63	60	123
		% within academicyear_new	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.000[a]	1	.985		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.000	1	.985		
Fisher's Exact Test				1.000	.567
Linear-by-Linear Association	.000	1	.985		
N of Valid Cases	123				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 21.95.

b. Computed only for a 2x2 table

f. Major of study intervention and control group

major_of_study * group Crosstabulation

			group 1	group 2	Total
major_of_study	health	Count	18	20	38
		% within major_of_study	47.4%	52.6%	100.0%
	non health	Count	45	40	85
		% within major_of_study	52.9%	47.1%	100.0%
Total		Count	63	60	123
		% within major_of_study	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,326[a]	1	,568		
Continuity Correction[b]	,141	1	,707		
Likelihood Ratio	,326	1	,568		
Fisher's Exact Test				,697	,353
Linear-by-Linear Association	,324	1	,569		
N of Valid Cases	123				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 18,54.

b. Computed only for a 2x2 table

g. Relationship status intervention and control group

relationshipstatus_new * group Crosstabulation

			group 1	group 2	Total
relationshipstatus_new	1.00	Count	45	51	96
		% within relationshipstatus_new	46.9%	53.1%	100.0%
	2.00	Count	18	9	27
		% within relationshipstatus_new	66.7%	33.3%	100.0%
Total		Count	63	60	123
		% within relationshipstatus_new	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.304[a]	1	.069		
Continuity Correction[b]	2.559	1	.110		
Likelihood Ratio	3.360	1	.067		
Fisher's Exact Test				.083	.054
Linear-by-Linear Association	3.277	1	.070		
N of Valid Cases	123				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.17.

b. Computed only for a 2x2 table

h. Living allowance intervention and control group

Descriptives

			Statistic	Std. Error
livingallowance_g1	Mean		869055.56	88707.326
	95% Confidence Interval for Mean	Lower Bound	691732.14	
		Upper Bound	1046378.97	
	5% Trimmed Mean		798677.25	
	Median		700000.00	
	Variance		4.957E+11	
	Std. Deviation		704092.576	
	Minimum		500	
	Maximum		4000000	
	Range		3999500	
	Interquartile Range		500000	
	Skewness		2.050	.302
	Kurtosis		6.114	.595

Descriptives

			Statistic	Std. Error
livingallowance_g2	Mean		849166.67	89942.634
	95% Confidence Interval for Mean	Lower Bound	669191.87	
		Upper Bound	1029141.46	
	5% Trimmed Mean		776851.85	
	Median		650000.00	
	Variance		4.854E+11	
	Std. Deviation		696692.651	
	Minimum		100000	
	Maximum		4500000	
	Range		4400000	
	Interquartile Range		600000	
	Skewness		2.803	.309
	Kurtosis		11.897	.608

95% Confidence Interval for Mean	Lower Bound	734820.05
	Upper Bound	983887.27

Test Statistics[a]

	living_allowance
Mann-Whitney U	1839.000
Wilcoxon W	3669.000
Z	-.260
Asymp. Sig. (2-tailed)	.795

a. Grouping Variable: group

2. Genetic intervention and control group

genetic * group Crosstabulation

			group 1	group 2	Total
genetic	no, they aren't	Count	26	26	52
		% within genetic	50.0%	50.0%	100.0%
	yes, my mom	Count	23	23	46
		% within genetic	50.0%	50.0%	100.0%
	yes, my dad	Count	6	6	12
		% within genetic	50.0%	50.0%	100.0%
	yes, both of them	Count	8	5	13
		% within genetic	61.5%	38.5%	100.0%
Total		Count	63	60	123
		% within genetic	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,620[a]	3	,892
Likelihood Ratio	,625	3	,891
Linear-by-Linear Association	,349	1	,555
N of Valid Cases	123		

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 5,85.

3. Eating self-efficacy intervention and contol groups

CategoryTotalScoreESE_new * group Crosstabulation

			group 1	group 2	Total
CategoryTotalScoreESE_new	moderate	Count	40	29	69
		% within CategoryTotalScoreESE_new	58.0%	42.0%	100.0%
	high	Count	23	31	54
		% within CategoryTotalScoreESE_new	42.6%	57.4%	100.0%
Total		Count	63	60	123
		% within CategoryTotalScoreESE_new	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.867[a]	1	.090		
Continuity Correction[b]	2.285	1	.131		
Likelihood Ratio	2.878	1	.090		
Fisher's Exact Test				.104	.065
Linear-by-Linear Association	2.844	1	.092		
N of Valid Cases	123				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 26.34.

b. Computed only for a 2x2 table

4. Behavior factors

a. Exercise activity (BF 31) intervention and control group

BF_31 * group Crosstabulation

			group 1	group 2	Total
BF_31	yes	Count	49	50	99
		% of Total	39,8%	40,7%	80,5%
	no	Count	14	10	24
		% of Total	11,4%	8,1%	19,5%
Total		Count	63	60	123
		% of Total	51,2%	48,8%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,604[a]	1	,437		
Continuity Correction[b]	,302	1	,583		
Likelihood Ratio	,607	1	,436		
Fisher's Exact Test				,499	,292
Linear-by-Linear Association	,599	1	,439		
N of Valid Cases	123				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 11,71.

b. Computed only for a 2x2 table

CHULALONGKORN UNIVERSITY

b. Exercise per week (BF 33) intervention and control group

BF33ExercisePerWeek_new * group Crosstabulation

			group 1	group 2	Total
BF33ExercisePerWeek_new	<= 4 times per week	Count	58	55	113
		% within BF33ExercisePerWeek_new	51.3%	48.7%	100.0%
	> 4 times per week	Count	5	5	10
		% within BF33ExercisePerWeek_new	50.0%	50.0%	100.0%
Total		Count	63	60	123
		% within BF33ExercisePerWeek_new	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.006[a]	1	.936		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.006	1	.936		
Fisher's Exact Test				1.000	.597
Linear-by-Linear Association	.006	1	.936		
N of Valid Cases	123				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.88.

b. Computed only for a 2x2 table

c. Exercise time (BF 34) intervention and control group

BF34ExerciseTime_new * group Crosstabulation

			group		Total
			group 1	group 2	
BF34ExerciseTime_new	< 30 minutes	Count	29	32	61
		% within BF34ExerciseTime_new	47.5%	52.5%	100.0%
	>= 30 minutes	Count	34	28	62
		% within BF34ExerciseTime_new	54.8%	45.2%	100.0%
Total		Count	63	60	123
		% within BF34ExerciseTime_new	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.655[a]	1	.418		
Continuity Correction[b]	.396	1	.529		
Likelihood Ratio	.656	1	.418		
Fisher's Exact Test				.473	.265
Linear-by-Linear Association	.650	1	.420		
N of Valid Cases	123				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 29.76.

b. Computed only for a 2x2 table

CHULALONGKORN UNIVERSITY

d. Sleep time (BF 35) per week intervention and control group

BF35SleepTime_new * group Crosstabulation

			group		Total
			group 1	group 2	
BF35SleepTime_new	<= 8 hours	Count	61	57	118
		% within BF35SleepTime_new	51.7%	48.3%	100.0%
	> 8 hours	Count	2	3	5
		% within BF35SleepTime_new	40.0%	60.0%	100.0%
Total		Count	63	60	123
		% within BF35SleepTime_new	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.263[a]	1	.608		
Continuity Correction[b]	.003	1	.956		
Likelihood Ratio	.264	1	.608		
Fisher's Exact Test				.675	.477
Linear-by-Linear Association	.260	1	.610		
N of Valid Cases	123				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.44.

b. Computed only for a 2x2 table

e. Smoke (BF 36) intervention and control group

BF36Smoke_new * group Crosstabulation

			group		
			group 1	group 2	Total
BF36Smoke_new	never smoke	Count	60	57	117
		% within BF36Smoke_new	51.3%	48.7%	100.0%
	ever smoke	Count	3	3	6
		% within BF36Smoke_new	50.0%	50.0%	100.0%
Total		Count	63	60	123
		% within BF36Smoke_new	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.004[a]	1	.951		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.004	1	.951		
Fisher's Exact Test				1.000	.637
Linear-by-Linear Association	.004	1	.951		
N of Valid Cases	123				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.93.

b. Computed only for a 2x2 table

f. Drink alcohol (BF 38) intervention and control group

CHULALONGKORN UNIVERSITY

BF38DrinkAlcohol_new * group Crosstabulation

			group		
			group 1	group 2	Total
BF38DrinkAlcohol_new	never drink alcohol	Count	63	58	121
		% within BF38DrinkAlcohol_new	52.1%	47.9%	100.0%
	ever drink alcohol	Count	0	2	2
		% within BF38DrinkAlcohol_new	0.0%	100.0%	100.0%
Total		Count	63	60	123
		% within BF38DrinkAlcohol_new	51.2%	48.8%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.135[a]	1	.144		
Continuity Correction[b]	.559	1	.455		
Likelihood Ratio	2.906	1	.088		
Fisher's Exact Test				.236	.236
Linear-by-Linear Association	2.117	1	.146		
N of Valid Cases	123				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .98.

b. Computed only for a 2x2 table

5. FFQ

Chi Square Test

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,734[a]	5	,449
Likelihood Ratio	4,829	5	,437
Linear-by-Linear Association	1,151	1	,283
N of Valid Cases	123		

a. 2 cells (16,7%) have expected count less than 5. The minimum expected count is ,98.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,027[a]	6	,540
Likelihood Ratio	5,824	6	,443
Linear-by-Linear Association	,000	1	,990
N of Valid Cases	123		

a. 2 cells (14,3%) have expected count less than 5. The minimum expected count is ,98.

6. Baseline

a. Baseline carbohydrate intervention and control group

Descriptives

			Statistic	Std. Error
carbo_w0_g1	Mean		958.0852	34.36917
	95% Confidence Interval for Mean	Lower Bound	889.3822	
		Upper Bound	1026.7882	
	5% Trimmed Mean		950.1548	
	Median		909.2800	
	Variance		74418.125	
	Std. Deviation		272.79686	
	Minimum		460.67	
	Maximum		1705.10	
	Range		1244.43	
	Interquartile Range		364.94	
	Skewness		.535	.302
	Kurtosis		-.274	.595

Descriptives

			Statistic	Std. Error
carbo_w0_g2	Mean		960.0492	41.57928
	95% Confidence Interval for Mean	Lower Bound	876.8492	
		Upper Bound	1043.2491	
	5% Trimmed Mean		945.5833	
	Median		868.1700	
	Variance		103730.172	
	Std. Deviation		322.07169	
	Minimum		476.22	
	Maximum		1727.03	
	Range		1250.81	
	Interquartile Range		451.29	
	Skewness		.728	.309
	Kurtosis		-.390	.608

	95% Confidence Interval for Mean	Lower Bound	906.0979	
		Upper Bound	1011.9887	

Test Statistics[a]

	carbo_w0
Mann-Whitney U	1830.500
Wilcoxon W	3660.500
Z	-.301
Asymp. Sig. (2-tailed)	.763

a. Grouping Variable: group

b. Baseline protein intervention and control group

Descriptives

			Statistic	Std. Error
protein_w0_g1	Mean		271.4019	11.98809
	95% Confidence Interval for Mean	Lower Bound	247.4381	
		Upper Bound	295.3658	
	5% Trimmed Mean		268.0160	
	Median		260.8900	
	Variance		9053.997	
	Std. Deviation		95.15249	
	Minimum		113.63	
	Maximum		504.92	
	Range		391.29	
	Interquartile Range		139.52	
	Skewness		.509	.302
	Kurtosis		-.267	.595

Descriptives

			Statistic	Std. Error
protein_w0_g2	Mean		245.2730	12.41214
	95% Confidence Interval for Mean	Lower Bound	220.4364	
		Upper Bound	270.1096	
	5% Trimmed Mean		237.8494	
	Median		212.7200	
	Variance		9243.672	
	Std. Deviation		96.14402	
	Minimum		118.14	
	Maximum		556.73	
	Range		438.59	
	Interquartile Range		130.35	
	Skewness		1.202	.309
	Kurtosis		1.347	.608

	95% Confidence Interval for Mean	Lower Bound	241.4951	
		Upper Bound	275.8171	

Test Statistics[a]

	protein_w0
Mann-Whitney U	1537.500
Wilcoxon W	3367.500
Z	-1.784
Asymp. Sig. (2-tailed)	.074

a. Grouping Variable: group

c. Baseline fat intervention and control group

Descriptives

			Statistic	Std. Error
fat_w0_g1	Mean		628.3371	35.43930
	95% Confidence Interval for Mean	Lower Bound	557.4950	
		Upper Bound	699.1793	
	5% Trimmed Mean		604.9594	
	Median		525.1800	
	Variance		79124.485	
	Std. Deviation		281.29075	
	Minimum		222.81	
	Maximum		1499.81	
	Range		1277.00	
	Interquartile Range		314.98	
	Skewness		1.325	.302
	Kurtosis		1.524	.595

Descriptives

			Statistic	Std. Error
fat_w0_g2	Mean		594.8027	36.85872
	95% Confidence Interval for Mean	Lower Bound	521.0485	
		Upper Bound	668.5568	
	5% Trimmed Mean		568.0344	
	Median		509.2350	
	Variance		81513.917	
	Std. Deviation		285.50642	
	Minimum		251.52	
	Maximum		1442.99	
	Range		1191.47	
	Interquartile Range		302.38	
	Skewness		1.407	.309
	Kurtosis		1.566	.608

	95% Confidence Interval for Mean	Lower Bound	561.5199	
		Upper Bound	662.4378	

Test Statistics[a]

	fat_w0
Mann-Whitney U	1679.500
Wilcoxon W	3509.500
Z	-1.065
Asymp. Sig. (2-tailed)	.287

a. Grouping Variable: group

d. Baseline total calories intervention and control group

Descriptives

			Statistic	Std. Error
totalcal_w0_g1	Mean		1857.8243	69.40743
	95% Confidence Interval for Mean	Lower Bound	1719.0808	
		Upper Bound	1996.5678	
	5% Trimmed Mean		1828.0776	
	Median		1736.4900	
	Variance		303495.675	
	Std. Deviation		550.90442	
	Minimum		1012.85	
	Maximum		3340.63	
	Range		2327.78	
	Interquartile Range		652.49	
	Skewness		.894	.302
	Kurtosis		.189	.595

Descriptives

			Statistic	Std. Error
totalcal_w0_g2	Mean		1800.1248	76.04648
	95% Confidence Interval for Mean	Lower Bound	1647.9562	
		Upper Bound	1952.2935	
	5% Trimmed Mean		1761.2624	
	Median		1657.3350	
	Variance		346984.003	
	Std. Deviation		589.05348	
	Minimum		1001.35	
	Maximum		3408.54	
	Range		2407.19	
	Interquartile Range		792.98	
	Skewness		1.003	.309
	Kurtosis		.403	.608

95% Confidence Interval for Mean	Lower Bound	1728.2534
	Upper Bound	1931.1030

Test Statistics[a]

	totalcalory_w0
Mann-Whitney U	1725.500
Wilcoxon W	3555.500
Z	-.832
Asymp. Sig. (2-tailed)	.405

a. Grouping Variable: group

e. Baseline height intervention and control group

Descriptives

			Statistic	Std. Error
height_g1	Mean		1.5703	.00701
	95% Confidence Interval for Mean	Lower Bound	1.5563	
		Upper Bound	1.5843	
	5% Trimmed Mean		1.5705	
	Median		1.5700	
	Variance		.003	
	Std. Deviation		.05568	
	Minimum		1.41	
	Maximum		1.68	
	Range		.27	
	Interquartile Range		.08	
	Skewness		-.166	.302
	Kurtosis		.063	.595

Descriptives

			Statistic	Std. Error
height_w0_g2	Mean		1.5688	.00786
	95% Confidence Interval for Mean	Lower Bound	1.5531	
		Upper Bound	1.5846	
	5% Trimmed Mean		1.5696	
	Median		1.5750	
	Variance		.004	
	Std. Deviation		.06090	
	Minimum		1.40	
	Maximum		1.73	
	Range		.33	
	Interquartile Range		.07	
	Skewness		-.285	.309
	Kurtosis		.429	.608

95% Confidence Interval for Mean	Lower Bound	1.5592
	Upper Bound	1.5800

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
height_w0	Equal variances assumed	.416	.520	.141	121	.888	.00148	.01051	-.01933	.02230
	Equal variances not assumed			.141	118.726	.888	.00148	.01054	-.01938	.02235

f. Baseline weight intervention and control group

Descriptives

			Statistic	Std. Error
bb_w0_g1	Mean		71.6794	1.20165
	95% Confidence Interval for Mean	Lower Bound	69.2773	
		Upper Bound	74.0814	
	5% Trimmed Mean		71.2411	
	Median		69.2000	
	Variance		90.970	
	Std. Deviation		9.53781	
	Minimum		54.90	
	Maximum		98.20	
	Range		43.30	
	Interquartile Range		14.30	
	Skewness		.727	.302
	Kurtosis		.113	.595

Descriptives

			Statistic	Std. Error
bb_w0_g2	Mean		71.1283	1.15932
	95% Confidence Interval for Mean	Lower Bound	68.8085	
		Upper Bound	73.4481	
	5% Trimmed Mean		70.4167	
	Median		68.4000	
	Variance		80.642	
	Std. Deviation		8.98009	
	Minimum		60.30	
	Maximum		103.00	
	Range		42.70	
	Interquartile Range		10.80	
	Skewness		1.395	.309
	Kurtosis		1.953	.608

95% Confidence Interval for Mean	Lower Bound	69.7620
	Upper Bound	73.0592

Test Statistics[a]

	weight_w0
Mann-Whitney U	1814,500
Wilcoxon W	3644,500
Z	-,382
Asymp. Sig. (2-tailed)	,702

a. Grouping Variable: group

Chulalongkorn University

g. Baseline BMI intervention and control group

Descriptives

			Statistic	Std. Error
bmi_w0_g1	Mean		29.0114	.38065
	95% Confidence Interval for Mean	Lower Bound	28.2505	
		Upper Bound	29.7723	
	5% Trimmed Mean		28.8540	
	Median		28.2900	
	Variance		9.128	
	Std. Deviation		3.02133	
	Minimum		25.14	
	Maximum		36.96	
	Range		11.82	
	Interquartile Range		4.01	
	Skewness		.702	.302
	Kurtosis		-.364	.595

Descriptives

			Statistic	Std. Error
bmi_w0_g2	Mean		28.9217	.44126
	95% Confidence Interval for Mean	Lower Bound	28.0387	
		Upper Bound	29.8046	
	5% Trimmed Mean		28.6319	
	Median		28.1150	
	Variance		11.683	
	Std. Deviation		3.41798	
	Minimum		25.10	
	Maximum		38.42	
	Range		13.32	
	Interquartile Range		4.93	
	Skewness		1.107	.309
	Kurtosis		.426	.608

95% Confidence Interval for Mean	Lower Bound	27.0192
	Upper Bound	29.1130

Test Statistics[a]

	BMI_w0
Mann-Whitney U	1675,000
Wilcoxon W	3505,000
Z	-1,088
Asymp. Sig. (2-tailed)	,277

a. Grouping Variable: group

7. Outcomes dietary intake

a. Dietary intake comparison within intervention group (group 1)

- Carbohydrate, protein and fat

Descriptives

			Statistic	Std. Error
carbo_w0_g1	Mean		958.0852	34.36917
	95% Confidence Interval for Mean	Lower Bound	889.3822	
		Upper Bound	1026.7882	
	5% Trimmed Mean		950.1548	
	Median		909.2800	
	Variance		74418.125	
	Std. Deviation		272.79686	
	Minimum		460.67	
	Maximum		1705.10	
	Range		1244.43	
	Interquartile Range		364.94	
	Skewness		.535	.302
	Kurtosis		-.274	.595

Descriptives

			Statistic	Std. Error
carbo_g1	Mean		905.2641	35.13099
	95% Confidence Interval for Mean	Lower Bound	835.0383	
		Upper Bound	975.4900	
	5% Trimmed Mean		897.6148	
	Median		850.6400	
	Variance		77753.749	
	Std. Deviation		278.84359	
	Minimum		388.04	
	Maximum		1598.55	
	Range		1210.51	
	Interquartile Range		407.94	
	Skewness		.422	.302
	Kurtosis		-.403	.595

Test Statistics[a]

	carbo_g1 - carbo_w0_g1
Z	-1.664[b]
Asymp. Sig. (2-tailed)	.096

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Descriptives

			Statistic	Std. Error
protein_g1	Mean		239.1689	10.89521
	95% Confidence Interval for Mean	Lower Bound	217.3897	
		Upper Bound	260.9481	
	5% Trimmed Mean		232.5633	
	Median		217.5800	
	Variance		7478.449	
	Std. Deviation		86.47803	
	Minimum		101.86	
	Maximum		501.52	
	Range		399.66	
	Interquartile Range		102.42	
	Skewness		1.123	.302
	Kurtosis		1.226	.595

Descriptives

			Statistic	Std. Error
protein_w0_g1	Mean		271.4019	11.98809
	95% Confidence Interval for Mean	Lower Bound	247.4381	
		Upper Bound	295.3658	
	5% Trimmed Mean		268.0160	
	Median		260.8900	
	Variance		9053.997	
	Std. Deviation		95.15249	
	Minimum		113.63	
	Maximum		504.92	
	Range		391.29	
	Interquartile Range		139.52	
	Skewness		.509	.302
	Kurtosis		-.267	.595

Ranks

		N	Mean Rank	Sum of Ranks
protein_gram9 - protein_gram0	Negative Ranks	31[a]	42.23	1309.00
	Positive Ranks	32[b]	22.09	707.00
	Ties	0[c]		
	Total	63		

a. protein_gram9 < protein_gram0

b. protein_gram9 > protein_gram0

c. protein_gram9 = protein_gram0

Test Statistics[a]

	protein_gram9 - protein_gram0
Z	-2.061[b]
Asymp. Sig. (2-tailed)	.039

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Descriptives

			Statistic	Std. Error
fat_w0_g1	Mean		628.3371	35.43930
	95% Confidence Interval for Mean	Lower Bound	557.4950	
		Upper Bound	699.1793	
	5% Trimmed Mean		604.9594	
	Median		525.1800	
	Variance		79124.485	
	Std. Deviation		281.29075	
	Minimum		222.81	
	Maximum		1499.81	
	Range		1277.00	
	Interquartile Range		314.98	
	Skewness		1.325	.302
	Kurtosis		1.524	.595

Descriptives

			Statistic	Std. Error
fat_g1	Mean		681.6871	44.21190
	95% Confidence Interval for Mean	Lower Bound	593.3088	
		Upper Bound	770.0655	
	5% Trimmed Mean		649.8641	
	Median		592.8300	
	Variance		123145.606	
	Std. Deviation		350.92108	
	Minimum		116.44	
	Maximum		2120.18	
	Range		2003.74	
	Interquartile Range		379.97	
	Skewness		1.707	.302
	Kurtosis		4.124	.595

Ranks

		N	Mean Rank	Sum of Ranks
fat_gram9 - fat_gram0	Negative Ranks	27[a]	29.00	783.00
	Positive Ranks	36[b]	34.25	1233.00
	Ties	0[c]		
	Total	63		

a. fat_gram9 < fat_gram0

b. fat_gram9 > fat_gram0

c. fat_gram9 = fat_gram0

Test Statistics[a]

	fat_gram9 - fat_gram0
Z	-1.540[b]
Asymp. Sig. (2-tailed)	.123

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

- Total calories (Wilcoxon)

Wilcoxon:

Descriptives

			Statistic	Std. Error
totalcal_w0_g1	Mean		1857.8243	69.40743
	95% Confidence Interval for Mean	Lower Bound	1719.0808	
		Upper Bound	1996.5678	
	5% Trimmed Mean		1828.0776	
	Median		1736.4900	
	Variance		303495.675	
	Std. Deviation		550.90442	
	Minimum		1012.85	
	Maximum		3340.63	
	Range		2327.78	
	Interquartile Range		652.49	
	Skewness		.894	.302
	Kurtosis		.189	.595

Descriptives

			Statistic	Std. Error
totalcal_g1	Mean		1826.1202	78.08006
	95% Confidence Interval for Mean	Lower Bound	1670.0403	
		Upper Bound	1982.2000	
	5% Trimmed Mean		1778.5342	
	Median		1671.8600	
	Variance		384079.220	
	Std. Deviation		619.74125	
	Minimum		1012.26	
	Maximum		3870.33	
	Range		2858.07	
	Interquartile Range		798.22	
	Skewness		1.071	.302
	Kurtosis		1.091	.595

Test Statistics[a]

	totalcal_g1 - totalcal_w0_g1
Z	-,685[b]
Asymp. Sig. (2-tailed)	,494

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

b. Dietary intake comparison within control group (group 2)

Descriptives

			Statistic	Std. Error
carbo_w0_g2	Mean		960.0492	41.57928
	95% Confidence Interval for Mean	Lower Bound	876.8492	
		Upper Bound	1043.2491	
	5% Trimmed Mean		945.5833	
	Median		868.1700	
	Variance		103730.172	
	Std. Deviation		322.07169	
	Minimum		476.22	
	Maximum		1727.03	
	Range		1250.81	
	Interquartile Range		451.29	
	Skewness		.728	.309
	Kurtosis		-.390	.608

Descriptives

			Statistic	Std. Error
carbo_g2	Mean		1038.1402	48.27396
	95% Confidence Interval for Mean	Lower Bound	941.5442	
		Upper Bound	1134.7361	
	5% Trimmed Mean		1030.6507	
	Median		1019.9550	
	Variance		139822.493	
	Std. Deviation		373.92846	
	Minimum		388.04	
	Maximum		1974.14	
	Range		1586.10	
	Interquartile Range		551.41	
	Skewness		.209	.309
	Kurtosis		-.633	.608

Descriptives

			Statistic	Std. Error
fat_g2	Mean		671.8682	45.04967
	95% Confidence Interval for Mean	Lower Bound	581.7240	
		Upper Bound	762.0124	
	5% Trimmed Mean		635.6796	
	Median		602.7100	
	Variance		121768.393	
	Std. Deviation		348.95328	
	Minimum		185.49	
	Maximum		1816.19	
	Range		1630.70	
	Interquartile Range		338.71	
	Skewness		1.832	.309
	Kurtosis		3.532	.608

Descriptives

			Statistic	Std. Error
protein_w0_g2	Mean		245.2730	12.41214
	95% Confidence Interval for Mean	Lower Bound	220.4364	
		Upper Bound	270.1096	
	5% Trimmed Mean		237.8494	
	Median		212.7200	
	Variance		9243.672	
	Std. Deviation		96.14402	
	Minimum		118.14	
	Maximum		556.73	
	Range		438.59	
	Interquartile Range		130.35	
	Skewness		1.202	.309
	Kurtosis		1.347	.608

Descriptives

			Statistic	Std. Error
protein_g2	Mean		323.9052	27.31166
	95% Confidence Interval for Mean	Lower Bound	269.2547	
		Upper Bound	378.5557	
	5% Trimmed Mean		301.9506	
	Median		292.7950	
	Variance		44755.613	
	Std. Deviation		211.55522	
	Minimum		100.83	
	Maximum		1654.33	
	Range		1553.50	
	Interquartile Range		187.48	
	Skewness		4.315	.309
	Kurtosis		26.447	.608

Descriptives

			Statistic	Std. Error
fat_w0_g1	Mean		628.3371	35.43930
	95% Confidence Interval for Mean	Lower Bound	557.4950	
		Upper Bound	699.1793	
	5% Trimmed Mean		604.9594	
	Median		525.1800	
	Variance		79124.485	
	Std. Deviation		281.29075	
	Minimum		222.81	
	Maximum		1499.81	
	Range		1277.00	
	Interquartile Range		314.98	
	Skewness		1.325	.302
	Kurtosis		1.524	.595

Ranks

		N	Mean Rank	Sum of Ranks
carbo_gram9 - carbo_gram0	Negative Ranks	29[a]	25.00	725.00
	Positive Ranks	31[b]	35.65	1105.00
	Ties	0[c]		
	Total	60		
fat_gram9 - fat_gram0	Negative Ranks	26[d]	24.31	632.00
	Positive Ranks	34[e]	35.24	1198.00
	Ties	0[f]		
	Total	60		
protein_gram9 - protein_gram0	Negative Ranks	21[g]	21.12	443.50
	Positive Ranks	39[h]	35.55	1386.50
	Ties	0[i]		
	Total	60		

a. carbo_gram9 < carbo_gram0

b. carbo_gram9 > carbo_gram0

c. carbo_gram9 = carbo_gram0

d. fat_gram9 < fat_gram0

e. fat_gram9 > fat_gram0

f. fat_gram9 = fat_gram0

g. protein_gram9 < protein_gram0

h. protein_gram9 > protein_gram0

i. protein_gram9 = protein_gram0

Test Statistics[a]

	carbo_gram9 - carbo_gram0	fat_gram9 - fat_gram0	protein_gram 9 - protein_gram 0
Z	-1.399[b]	-2.083[b]	-3.471[b]
Asymp. Sig. (2-tailed)	.162	.037	.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

• Total calories-wilcoxon

Descriptives

			Statistic	Std. Error
totalcal_w0_g1	Mean		1857.8243	69.40743
	95% Confidence Interval for Mean	Lower Bound	1719.0808	
		Upper Bound	1996.5678	
	5% Trimmed Mean		1828.0776	
	Median		1736.4900	
	Variance		303495.675	
	Std. Deviation		550.90442	
	Minimum		1012.85	
	Maximum		3340.63	
	Range		2327.78	
	Interquartile Range		652.49	
	Skewness		.894	.302
	Kurtosis		.189	.595

Descriptives

			Statistic	Std. Error
totalcal_g2	Mean		2033.9135	91.04390
	95% Confidence Interval for Mean	Lower Bound	1851.7351	
		Upper Bound	2216.0919	
	5% Trimmed Mean		2000.7228	
	Median		2008.2700	
	Variance		497339.526	
	Std. Deviation		705.22303	
	Minimum		1024.68	
	Maximum		3612.96	
	Range		2588.28	
	Interquartile Range		1100.06	
	Skewness		.460	.309
	Kurtosis		-.603	.608

Test Statistics[a]

	totalcal_g2 - totalcal_w0_g2
Z	-2,746[b]
Asymp. Sig. (2-tailed)	,006

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. **Dietary intake changing value comparison between intervention and control group**

• carbo

Descriptives

			Statistic	Std. Error
carbo_diff_g1	Mean		-52.8211	36.29626
	95% Confidence Interval for Mean	Lower Bound	-125.3763	
		Upper Bound	19.7341	
	5% Trimmed Mean		-58.5143	
	Median		-57.5200	
	Variance		82997.343	
	Std. Deviation		288.09259	
	Minimum		-619.81	
	Maximum		656.59	
	Range		1276.40	
	Interquartile Range		342.46	
	Skewness		.255	.302
	Kurtosis		.064	.595

Descriptives

			Statistic	Std. Error
carbo_diff_g2	Mean		78.0910	52.32838
	95% Confidence Interval for Mean	Lower Bound	-26.6179	
		Upper Bound	182.7999	
	5% Trimmed Mean		77.5857	
	Median		10.2000	
	Variance		164295.578	
	Std. Deviation		405.33391	
	Minimum		-774.01	
	Maximum		911.59	
	Range		1685.60	
	Interquartile Range		585.48	
	Skewness		.145	.309
	Kurtosis		-.567	.608

95% Confidence Interval for Mean	Lower Bound	-52.3083
	Upper Bound	74.3853

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Selisih_carbogram	Equal variances assumed	11.137	.001	-2.072	121	.040	-32.72847	15.79287	-63.99462	-1.46233
	Equal variances not assumed			-2.056	106.065	.042	-32.72847	15.92108	-64.29333	-1.16361

• fat, protein

Descriptives

			Statistic	Std. Error
protein_diff_g1	Mean		-32.2330	11.70933
	95% Confidence Interval for Mean	Lower Bound	-55.6396	
		Upper Bound	-8.8264	
	5% Trimmed Mean		-31.8038	
	Median		1.4700	
	Variance		8637.837	
	Std. Deviation		92.93996	
	Minimum		-285.37	
	Maximum		186.61	
	Range		471.98	
	Interquartile Range		133.53	
	Skewness		-.308	.302
	Kurtosis		-.228	.595

Descriptives

			Statistic	Std. Error
protein_diff_g2	Mean		78.6322	26.94170
	95% Confidence Interval for Mean	Lower Bound	24.7219	
		Upper Bound	132.5424	
	5% Trimmed Mean		58.2270	
	Median		60.1950	
	Variance		43551.313	
	Std. Deviation		208.68951	
	Minimum		-303.36	
	Maximum		1383.28	
	Range		1686.64	
	Interquartile Range		172.50	
	Skewness		4.209	.309
	Kurtosis		25.945	.608

95% Confidence Interval for Mean	Lower Bound	-8.3109
	Upper Bound	52.0060

Descriptives

			Statistic	Std. Error
fat_diff_g1	Mean		53.3500	37.75543
	95% Confidence Interval for Mean	Lower Bound	-22.1220	
		Upper Bound	128.8220	
	5% Trimmed Mean		49.3105	
	Median		37.5900	
	Variance		89804.780	
	Std. Deviation		299.67446	
	Minimum		-917.45	
	Maximum		1129.59	
	Range		2047.04	
	Interquartile Range		239.47	
	Skewness		.373	.302
	Kurtosis		3.505	.595

Descriptives

			Statistic	Std. Error
fat_diff_g2	Mean		77.0655	31.26031
	95% Confidence Interval for Mean	Lower Bound	14.5138	
		Upper Bound	139.6172	
	5% Trimmed Mean		75.8659	
	Median		31.1250	
	Variance		58632.406	
	Std. Deviation		242.14129	
	Minimum		-475.82	
	Maximum		705.79	
	Range		1181.61	
	Interquartile Range		342.75	
	Skewness		.133	.309
	Kurtosis		.018	.608

95% Confidence Interval for Mean	Lower Bound	16.3184
	Upper Bound	113.5186

Ranks

	group	N	Mean Rank	Sum of Ranks
Selisih_fatgram	group 1	63	60.57	3816.00
	group 2	60	63.50	3810.00
	Total	123		
Selisih_proteingram	group 1	63	48.95	3084.00
	group 2	60	75.70	4542.00
	Total	123		

Test Statistics[a]

	Selisih_fatgram	Selisih_proteingram
Mann-Whitney U	1800.000	1068.000
Wilcoxon W	3816.000	3084.000
Z	-.455	-4.159
Asymp. Sig. (2-tailed)	.649	.000

a. Grouping Variable: group

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

• Total calories

Descriptives

			Statistic	Std. Error
totalcal_diff_g1	Mean		-31.7041	70.70652
	95% Confidence Interval for Mean	Lower Bound	-173.0444	
		Upper Bound	109.6362	
	5% Trimmed Mean		-36.9314	
	Median		-100.9300	
	Variance		314962.937	
	Std. Deviation		561.21559	
	Minimum		-1392.17	
	Maximum		1319.13	
	Range		2711.30	
	Interquartile Range		657.34	
	Skewness		.185	.302
	Kurtosis		.190	.595

Descriptives

			Statistic	Std. Error
totalcal_diff_g2	Mean		233.7887	79.23184
	95% Confidence Interval for Mean	Lower Bound	75.2461	
		Upper Bound	392.3312	
	5% Trimmed Mean		246.1102	
	Median		303.3800	
	Variance		376661.070	
	Std. Deviation		613.72719	
	Minimum		-903.70	
	Maximum		1293.83	
	Range		2197.53	
	Interquartile Range		1218.56	
	Skewness		-.179	.309
	Kurtosis		-1.237	.608

95% Confidence Interval for Mean	Lower Bound	-9.2883
	Upper Bound	204.8974

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
totalcalory_difference	Equal variances assumed	2,722	,102	-2,506	121	,014	-265,49279	105,96096	-475,27046	-55,71513
	Equal variances not assumed			-2,500	118,733	,014	-265,49279	106,19367	-475,77173	-55,21385

CHULALONGKORN UNIVERSITY

8. Outcomes BMI

a. BMI comparison within intervention group (group 1)

- Weight

Descriptives

			Statistic	Std. Error
bb_w0_g1	Mean		71.6794	1.20165
	95% Confidence Interval for Mean	Lower Bound	69.2773	
		Upper Bound	74.0814	
	5% Trimmed Mean		71.2411	
	Median		69.2000	
	Variance		90.970	
	Std. Deviation		9.53781	
	Minimum		54.90	
	Maximum		98.20	
	Range		43.30	
	Interquartile Range		14.30	
	Skewness		.727	.302
	Kurtosis		.113	.595

Descriptives

			Statistic	Std. Error
bb_g1	Mean		71.2063	1.21920
	95% Confidence Interval for Mean	Lower Bound	68.7692	
		Upper Bound	73.6435	
	5% Trimmed Mean		70.8218	
	Median		69.0000	
	Variance		93.646	
	Std. Deviation		9.67709	
	Minimum		53.80	
	Maximum		98.70	
	Range		44.90	
	Interquartile Range		13.30	
	Skewness		.657	.302
	Kurtosis		.068	.595

Test Statistics[a]

	weight_w9 - weight_w0
Z	-2.760[b]
Asymp. Sig. (2-tailed)	.006

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

- BMI

Descriptives

			Statistic	Std. Error
bmi_w0_g1	Mean		29.0114	.38065
	95% Confidence Interval for Mean	Lower Bound	28.2505	
		Upper Bound	29.7723	
	5% Trimmed Mean		28.8540	
	Median		28.2900	
	Variance		9.128	
	Std. Deviation		3.02133	
	Minimum		25.14	
	Maximum		36.96	
	Range		11.82	
	Interquartile Range		4.01	
	Skewness		.702	.302
	Kurtosis		-.364	.595

Descriptives

			Statistic	Std. Error
bmi_w9_g1	Mean		28.5848	.38926
	95% Confidence Interval for Mean	Lower Bound	27.8067	
		Upper Bound	29.3629	
	5% Trimmed Mean		28.4560	
	Median		28.2094	
	Variance		9.546	
	Std. Deviation		3.08967	
	Minimum		23.91	
	Maximum		36.79	
	Range		12.88	
	Interquartile Range		4.68	
	Skewness		.571	.302
	Kurtosis		-.217	.595

Test Statistics[a]

	BMI_w9 - BMI_w0
Z	-4.553[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

b. BMI comparison within control group (group 2)

- Weight

Descriptives

			Statistic	Std. Error
bb_w0_g1	Mean		71.6794	1.20165
	95% Confidence Interval for Mean	Lower Bound	69.2773	
		Upper Bound	74.0814	
	5% Trimmed Mean		71.2411	
	Median		69.2000	
	Variance		90.970	
	Std. Deviation		9.53781	
	Minimum		54.90	
	Maximum		98.20	
	Range		43.30	
	Interquartile Range		14.30	
	Skewness		.727	.302
	Kurtosis		.113	.595

Descriptives

			Statistic	Std. Error
bb_g2	Mean		71.2607	1.13963
	95% Confidence Interval for Mean	Lower Bound	68.9803	
		Upper Bound	73.5411	
	5% Trimmed Mean		70.6878	
	Median		69.7500	
	Variance		77.925	
	Std. Deviation		8.82752	
	Minimum		58.50	
	Maximum		100.00	
	Range		41.50	
	Interquartile Range		11.61	
	Skewness		1.106	.309
	Kurtosis		1.254	.608

Test Statistics[a]

	bb_g2 - bb_w0_g2
Z	-,679[b]
Asymp. Sig. (2-tailed)	,497

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

- BMI

Descriptives

			Statistic	Std. Error
bmi_w0_g1	Mean		29.0114	.38065
	95% Confidence Interval for Mean	Lower Bound	28.2505	
		Upper Bound	29.7723	
	5% Trimmed Mean		28.8540	
	Median		28.2900	
	Variance		9.128	
	Std. Deviation		3.02133	
	Minimum		25.14	
	Maximum		36.96	
	Range		11.82	
	Interquartile Range		4.01	
	Skewness		.702	.302
	Kurtosis		-.364	.595

Descriptives

			Statistic	Std. Error
bmi_w9_g2	Mean		28.7864	.44412
	95% Confidence Interval for Mean	Lower Bound	27.8977	
		Upper Bound	29.6751	
	5% Trimmed Mean		28.6023	
	Median		27.5397	
	Variance		11.835	
	Std. Deviation		3.44018	
	Minimum		24.04	
	Maximum		37.25	
	Range		13.21	
	Interquartile Range		4.83	
	Skewness		.799	.309
	Kurtosis		-.356	.608

Test Statistics[a]

	bmi_w9_g2 - bmi_w0_g2
Z	-,464[b]
Asymp. Sig. (2-tailed)	,643

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. BMI changing comparison between intervention and control group

- Weight

Descriptives

			Statistic	Std. Error
weight_diff_g1	Mean		-.4730	.16698
	95% Confidence Interval for Mean	Lower Bound	-.8068	
		Upper Bound	-.1392	
	5% Trimmed Mean		-.4406	
	Median		-.5000	
	Variance		1.757	
	Std. Deviation		1.32534	
	Minimum		-4.50	
	Maximum		2.60	
	Range		7.10	
	Interquartile Range		1.40	
	Skewness		-.219	.302
	Kurtosis		.710	.595

Descriptives

			Statistic	Std. Error
weight_diff_g2	Mean		.1323	.30553
	95% Confidence Interval for Mean	Lower Bound	-.4790	
		Upper Bound	.7437	
	5% Trimmed Mean		.1646	
	Median		.0500	
	Variance		5.601	
	Std. Deviation		2.36660	
	Minimum		-5.70	
	Maximum		5.60	
	Range		11.30	
	Interquartile Range		3.27	
	Skewness		-.299	.309
	Kurtosis		.251	.608

Test Statistics[a]

	weight_difference
Mann-Whitney U	1351,500
Wilcoxon W	3367,500
Z	-2,726
Asymp. Sig. (2-tailed)	,006

a. Grouping Variable: group

95% Confidence Interval for Mean	Lower Bound	-.1441
	Upper Bound	4.3100

- BMI

Descriptives

			Statistic	Std. Error
bmi_diff_g1	Mean		-.4266	.10637
	95% Confidence Interval for Mean	Lower Bound	-.6393	
		Upper Bound	-.2140	
	5% Trimmed Mean		-.4399	
	Median		-.3507	
	Variance		.713	
	Std. Deviation		.84425	
	Minimum		-2.26	
	Maximum		1.81	
	Range		4.07	
	Interquartile Range		1.10	
	Skewness		.148	.302
	Kurtosis		.422	.595

Descriptives

			Statistic	Std. Error
bmi_diff_g2	Mean		-.1353	.13652
	95% Confidence Interval for Mean	Lower Bound	-.4084	
		Upper Bound	.1379	
	5% Trimmed Mean		-.1014	
	Median		.0232	
	Variance		1.118	
	Std. Deviation		1.05746	
	Minimum		-3.08	
	Maximum		2.26	
	Range		5.34	
	Interquartile Range		1.44	
	Skewness		-.597	.309
	Kurtosis		.648	.608

Test Statistics[a]

	BMI_difference
Mann-Whitney U	1367,500
Wilcoxon W	3383,500
Z	-2,644
Asymp. Sig. (2-tailed)	,008

a. Grouping Variable: group

95% Confidence Interval for Mean	Lower Bound	-.2783
	Upper Bound	1.5124

9. Correlation between engagement of Application with Difference Dietary Intake

a. Carbohydrate

- Opening reminder

Correlations

			selisihcarbo_g1	openingreminder
Spearman's rho	selisihcarbo_g1	Correlation Coefficient	1,000	-,207
		Sig. (2-tailed)	.	,104
		N	63	63
	openingreminder	Correlation Coefficient	-,207	1,000
		Sig. (2-tailed)	,104	.
		N	63	63

- Meal diary

Correlations

		selisihcarbo_g1	mealdiary
selisihcarbo_g1	Pearson Correlation	1	-,222
	Sig. (2-tailed)		,080
	N	63	63
mealdiary	Pearson Correlation	-,222	1
	Sig. (2-tailed)	,080	
	N	63	63

- Mean of score

Correlations

			selisihcarbo_g1	meanofscore
Spearman's rho	selisihcarbo_g1	Correlation Coefficient	1,000	-,004
		Sig. (2-tailed)	.	,975
		N	63	63
	meanofscore	Correlation Coefficient	-,004	1,000
		Sig. (2-tailed)	,975	.
		N	63	63

Quiz participation

Correlations

			selisihcarbo_g1	quizparticipation
Spearman's rho	selisihcarbo_g1	Correlation Coefficient	1,000	-,045
		Sig. (2-tailed)	.	,729
		N	63	63
	quizparticipation	Correlation Coefficient	-,045	1,000
		Sig. (2-tailed)	,729	.
		N	63	63

Engagement

Correlations

		selisihcarbo_g1	engagement
selisihcarbo_g1	Pearson Correlation	1	-,157
	Sig. (2-tailed)		,220
	N	63	63
engagement	Pearson Correlation	-,157	1
	Sig. (2-tailed)	,220	
	N	63	63

Fat

- Opening reminder

Correlations

			selisihfat_g1	openingreminder
Spearman's rho	selisihfat_g1	Correlation Coefficient	1,000	-,207
		Sig. (2-tailed)	.	,104
		N	63	63
	openingreminder	Correlation Coefficient	-,207	1,000
		Sig. (2-tailed)	,104	.
		N	63	63

- Meal diary

Correlations

			selisihfat_g1	mealdiary
Spearman's rho	selisihfat_g1	Correlation Coefficient	1,000	-,292*
		Sig. (2-tailed)	.	,020
		N	63	63
	mealdiary	Correlation Coefficient	-,292*	1,000
		Sig. (2-tailed)	,020	.
		N	63	63

*. Correlation is significant at the 0.05 level (2-tailed).

- Mean of score

Correlations

			selisihfat_g1	meanofscore
Spearman's rho	selisihfat_g1	Correlation Coefficient	1,000	-,020
		Sig. (2-tailed)	.	,874
		N	63	63
	meanofscore	Correlation Coefficient	-,020	1,000
		Sig. (2-tailed)	,874	.
		N	63	63

- Quiz participation

Correlations

			selisihfat_g1	quizparticipation
Spearman's rho	selisihfat_g1	Correlation Coefficient	1,000	-,044
		Sig. (2-tailed)	.	,735
		N	63	63
	quizparticipation	Correlation Coefficient	-,044	1,000
		Sig. (2-tailed)	,735	.
		N	63	63

- Engagement

Correlations

			selisihfat_g1	engagement
Spearman's rho	selisihfat_g1	Correlation Coefficient	1,000	-,189
		Sig. (2-tailed)	.	,138
		N	63	63
	engagement	Correlation Coefficient	-,189	1,000
		Sig. (2-tailed)	,138	.
		N	63	63

b. Protein

- Opening reminder

Correlations

			selisihprotein_g1	openingreminder
Spearman's rho	selisihprotein_g1	Correlation Coefficient	1,000	-,204
		Sig. (2-tailed)	.	,109
		N	63	63
	openingreminder	Correlation Coefficient	-,204	1,000
		Sig. (2-tailed)	,109	.
		N	63	63

- Meal diary

Correlations

			selisihprotein_g1	mealdiary
Spearman's rho	selisihprotein_g1	Correlation Coefficient	1,000	-,193
		Sig. (2-tailed)	.	,129
		N	63	63
	mealdiary	Correlation Coefficient	-,193	1,000
		Sig. (2-tailed)	,129	.
		N	63	63

- Mean of score

Correlations

			selisihprotein_g1	meanofscore
Spearman's rho	selisihprotein_g1	Correlation Coefficient	1,000	,153
		Sig. (2-tailed)	.	,232
		N	63	63
	meanofscore	Correlation Coefficient	,153	1,000
		Sig. (2-tailed)	,232	.
		N	63	63

- Quiz participation

Correlations

			selisihprotein_g1	quizparticipation
Spearman's rho	selisihprotein_g1	Correlation Coefficient	1,000	,128
		Sig. (2-tailed)	.	,318
		N	63	63
	quizparticipation	Correlation Coefficient	,128	1,000
		Sig. (2-tailed)	,318	.
		N	63	63

- Engagement

Correlations

			selisihprotein_g1	engagement
Spearman's rho	selisihprotein_g1	Correlation Coefficient	1,000	-,036
		Sig. (2-tailed)	.	,778
		N	63	63
	engagement	Correlation Coefficient	-,036	1,000
		Sig. (2-tailed)	,778	.
		N	63	63

c. Total Calories

- Opening reminder

Correlations

			selisihtotalcal_g1	openingreminder
Spearman's rho	selisihtotalcal_g1	Correlation Coefficient	1,000	-,230
		Sig. (2-tailed)	.	,070
		N	63	63
	openingreminder	Correlation Coefficient	-,230	1,000
		Sig. (2-tailed)	,070	.
		N	63	63

- Meal diary

Correlations

		selisihtotalcal_g1	mealdiary
selisihtotalcal_g1	Pearson Correlation	1	-,307*
	Sig. (2-tailed)		,015
	N	63	63
mealdiary	Pearson Correlation	-,307*	1
	Sig. (2-tailed)	,015	
	N	63	63

*. Correlation is significant at the 0.05 level (2-tailed).

- Mean of score

Correlations

			selisihtotalcal_g1	meanofscore
Spearman's rho	selisihtotalcal_g1	Correlation Coefficient	1,000	,043
		Sig. (2-tailed)	.	,738
		N	63	63
	meanofscore	Correlation Coefficient	,043	1,000
		Sig. (2-tailed)	,738	.
		N	63	63

- Quiz participation

Correlations

			selisihtotalcal_g1	quizparticipation
Spearman's rho	selisihtotalcal_g1	Correlation Coefficient	1,000	,001
		Sig. (2-tailed)	.	,993
		N	63	63
	quizparticipation	Correlation Coefficient	,001	1,000
		Sig. (2-tailed)	,993	.
		N	63	63

- Engagement

Correlations

		selisihtotalcal_g1	engagement
selisihtotalcal_g1	Pearson Correlation	1	-,184
	Sig. (2-tailed)		,149
	N	63	63
engagement	Pearson Correlation	-,184	1
	Sig. (2-tailed)	,149	
	N	63	63

10. Correlation between engagement of Application with Difference of BMI

a. Weight

- Opening reminder

Correlations

			selisihbb_g1	openingreminder
Spearman's rho	selisihbb_g1	Correlation Coefficient	1,000	,130
		Sig. (2-tailed)	.	,310
		N	63	63
	openingreminder	Correlation Coefficient	,130	1,000
		Sig. (2-tailed)	,310	.
		N	63	63

- Meal diary

Correlations

			selisihbb_g1	mealdiary
Spearman's rho	selisihbb_g1	Correlation Coefficient	1,000	,031
		Sig. (2-tailed)	.	,811
		N	63	63
	mealdiary	Correlation Coefficient	,031	1,000
		Sig. (2-tailed)	,811	.
		N	63	63

- Mean of score

Correlations

			selisihbb_g1	meanofscore
Spearman's rho	selisihbb_g1	Correlation Coefficient	1,000	-,099
		Sig. (2-tailed)	.	,438
		N	63	63
	meanofscore	Correlation Coefficient	-,099	1,000
		Sig. (2-tailed)	,438	.
		N	63	63

CHULALONGKORN UNIVERSITY

- Quiz participation

Correlations

			selisihbb_g1	quizparticipation
Spearman's rho	selisihbb_g1	Correlation Coefficient	1,000	-,097
		Sig. (2-tailed)	.	,450
		N	63	63
	quizparticipation	Correlation Coefficient	-,097	1,000
		Sig. (2-tailed)	,450	.
		N	63	63

- Engagement

Correlations

			selisihbb_g1	engagement
Spearman's rho	selisihbb_g1	Correlation Coefficient	1,000	-,032
		Sig. (2-tailed)	.	,806
		N	63	63
	engagement	Correlation Coefficient	-,032	1,000
		Sig. (2-tailed)	,806	.
		N	63	63

b. BMI

- Opening reminder

Correlations

			selisih_bmi_g1	openingreminder
Spearman's rho	selisih_bmi_g1	Correlation Coefficient	1,000	,158
		Sig. (2-tailed)	.	,216
		N	63	63
	openingreminder	Correlation Coefficient	,158	1,000
		Sig. (2-tailed)	,216	.
		N	63	63

- Meal diary

Correlations

		selisih_bmi_g1	mealdiary
selisih_bmi_g1	Pearson Correlation	1	,122
	Sig. (2-tailed)		,341
	N	63	63
mealdiary	Pearson Correlation	,122	1
	Sig. (2-tailed)	,341	
	N	63	63

- Mean of score

Correlations

			selisih_bmi_g1	meanofscore
Spearman's rho	selisih_bmi_g1	Correlation Coefficient	1,000	,040
		Sig. (2-tailed)	.	,755
		N	63	63
	meanofscore	Correlation Coefficient	,040	1,000
		Sig. (2-tailed)	,755	.
		N	63	63

- Quiz participation

Correlations

			selisih_bmi_g1	quizparticipation
Spearman's rho	selisih_bmi_g1	Correlation Coefficient	1,000	,026
		Sig. (2-tailed)	.	,837
		N	63	63
	quizparticipation	Correlation Coefficient	,026	1,000
		Sig. (2-tailed)	,837	.
		N	63	63

- Engagement

Correlations

		selisih_bmi_g1	engagement
selisih_bmi_g1	Pearson Correlation	1	,123
	Sig. (2-tailed)		,335
	N	63	63
engagement	Pearson Correlation	,123	1
	Sig. (2-tailed)	,335	
	N	63	63

11. Association between engagement determinants with dietary intake among intervention group (percentiles cathegoric with mean/median cathegoric (binarylogistic regression))

a. Carbohydrate

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	category_percentile_OR			2,148	2	,342			
	category_percentile_OR(1)	1,808	1,265	2,041	1	,153	6,096	,510	72,808
	category_percentile_OR(2)	,503	,796	,399	1	,528	1,654	,347	7,872
	category_percentile_MD			2,183	2	,336			
	category_percentile_MD(1)	2,346	1,718	1,865	1	,172	10,441	,360	302,704
	category_percentile_MD(2)	,172	,840	,042	1	,837	1,188	,229	6,160
	category_percentile_MOS			4,918	2	,086			
	category_percentile_MOS(1)	-,160	1,555	,011	1	,918	,852	,040	17,951
	category_percentile_MOS(2)	-2,157	1,076	4,016	1	,045	,116	,014	,954
	category_percentile_QP			,604	2	,739			
	category_percentile_QP(1)	,475	2,010	,056	1	,813	1,608	,031	82,610
	category_percentile_QP(2)	1,390	2,258	,379	1	,538	4,014	,048	335,415
	category_percentile_E			2,531	2	,282			
	category_percentile_E(1)	-4,298	2,859	2,260	1	,133	,014	,000	3,687
	category_percentile_E(2)	-1,624	1,628	,995	1	,318	,197	,008	4,791
	Constant	,853	,958	,793	1	,373	2,348		

a. Variable(s) entered on step 1: category_percentile_OR, category_percentile_MD, category_percentile_MOS, category_percentile_QP, category_percentile_E.

b. Fat

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	category_percentile_OR			2,643	2	,267			
	category_percentile_OR (1)	-1,667	1,187	1,970	1	,160	,189	,018	1,936
	category_percentile_OR (2)	-,116	,728	,025	1	,873	,891	,214	3,708
	category_percentile_MD			,190	2	,909			
	category_percentile_MD (1)	,611	1,479	,171	1	,680	1,842	,101	33,434
	category_percentile_MD (2)	,286	,808	,126	1	,723	1,331	,273	6,483
	category_percentile_MOS			,212	2	,899			
	category_percentile_MOS (1)	-,514	1,503	,117	1	,732	,598	,031	11,382
	category_percentile_MOS (2)	-,420	,978	,184	1	,668	,657	,097	4,469
	category_percentile_QP			1,598	2	,450			
	category_percentile_QP (1)	-1,205	1,868	,416	1	,519	,300	,008	11,656
	category_percentile_QP (2)	,231	2,140	,012	1	,914	1,260	,019	83,572
	category_percentile_E			1,266	2	,531			
	category_percentile_E(1)	2,435	2,237	1,185	1	,276	11,416	,142	914,705
	category_percentile_E(2)	1,514	1,431	1,118	1	,290	4,543	,275	75,119
	Constant	-,179	,872	,042	1	,837	,836		

a. Variable(s) entered on step 1: category_percentile_OR, category_percentile_MD, category_percentile_MOS, category_percentile_QP, category_percentile_E.

c. Protein

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	category_percentile_OR			,454	2	,797			
	category_percentile_OR (1)	,814	1,212	,451	1	,502	2,257	,210	24,286
	category_percentile_OR (2)	,370	,799	,214	1	,644	1,447	,302	6,928
	category_percentile_MD			2,379	2	,304			
	category_percentile_MD (1)	2,435	1,700	2,052	1	,152	11,413	,408	319,383
	category_percentile_MD (2)	1,280	,971	1,737	1	,188	3,598	,536	24,153
	category_percentile_MOS			,391	2	,823			
	category_percentile_MOS (1)	-21,312	23205,425	,000	1	,999	,000	,000	.
	category_percentile_MOS (2)	-,694	1,110	,391	1	,532	,500	,057	4,402
	category_percentile_QP			1,949	2	,377			
	category_percentile_QP (1)	-,723	28907,247	,000	1	1,000	,485	,000	.
	category_percentile_QP (2)	1,298	28907,247	,000	1	1,000	3,664	,000	.
	category_percentile_E			,008	2	,996			
	category_percentile_E(1)	19,540	17237,673	,000	1	,999	306140061,8	,000	.
	category_percentile_E(2)	19,674	17237,673	,000	1	,999	350069049,5	,000	.
	Constant	,109	,954	,013	1	,909	1,116		

a. Variable(s) entered on step 1: category_percentile_OR, category_percentile_MD, category_percentile_MOS, category_percentile_QP, category_percentile_E.

d. Total calories

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	category_percentile_OR			,209	2	,901			
	category_percentile_OR (1)	,516	1,177	,193	1	,661	1,676	,167	16,821
	category_percentile_OR (2)	,130	,757	,030	1	,863	1,139	,259	5,017
	category_percentile_MD			1,940	2	,379			
	category_percentile_MD (1)	2,183	1,567	1,940	1	,164	8,872	,411	191,508
	category_percentile_MD (2)	,679	,851	,637	1	,425	1,972	,372	10,444
	category_percentile_MOS			2,770	2	,250			
	category_percentile_MOS (1)	-1,241	1,530	,658	1	,417	,289	,014	5,796
	category_percentile_MOS (2)	-1,710	1,028	2,766	1	,096	,181	,024	1,357
	category_percentile_QP			1,166	2	,558			
	category_percentile_QP (1)	,034	1,832	,000	1	,985	1,034	,028	37,534
	category_percentile_QP (2)	1,421	2,118	,450	1	,502	4,140	,065	263,071
	category_percentile_E			,768	2	,681			
	category_percentile_E(1)	-1,593	2,289	,484	1	,487	,203	,002	18,075
	category_percentile_E(2)	-,330	1,384	,057	1	,812	,719	,048	10,833
	Constant	,548	,916	,357	1	,550	1,729		

a. Variable(s) entered on step 1: category_percentile_OR, category_percentile_MD, category_percentile_MOS, category_percentile_QP, category_percentile_E.

e. Weight

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	category_percentile_OR			7,474	2	,024			
	category_percentile_OR (1)	-3,698	1,353	7,473	1	,006	,025	,002	,351
	category_percentile_OR (2)	-1,285	,788	2,661	1	,103	,277	,059	1,296
	category_percentile_MD			1,475	2	,478			
	category_percentile_MD (1)	-2,031	1,673	1,474	1	,225	,131	,005	3,484
	category_percentile_MD (2)	-,582	,864	,453	1	,501	,559	,103	3,037
	category_percentile_MOS			1,505	2	,471			
	category_percentile_MOS (1)	-,257	1,536	,028	1	,867	,773	,038	15,696
	category_percentile_MOS (2)	1,014	1,026	,977	1	,323	2,756	,369	20,579
	category_percentile_QP			,307	2	,858			
	category_percentile_QP (1)	,196	1,862	,011	1	,916	1,216	,032	46,764
	category_percentile_QP (2)	,844	2,082	,164	1	,685	2,325	,039	137,612
	category_percentile_E			3,464	2	,177			
	category_percentile_E(1)	4,572	2,597	3,100	1	,078	96,722	,596	15696,399
	category_percentile_E(2)	1,501	1,458	1,061	1	,303	4,488	,258	78,171
	Constant	-,436	,927	,222	1	,638	,646		

a. Variable(s) entered on step 1: category_percentile_OR, category_percentile_MD, category_percentile_MOS, category_percentile_QP, category_percentile_E.

f. BMI

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	category_percentile_OR			3,155	2	,206			
	category_percentile_OR (1)	-2,093	1,179	3,152	1	,076	,123	,012	1,243
	category_percentile_OR (2)	-,810	,734	1,219	1	,270	,445	,106	1,874
	category_percentile_MD			,050	2	,975			
	category_percentile_MD (1)	,328	1,474	,050	1	,824	1,389	,077	24,937
	category_percentile_MD (2)	,113	,817	,019	1	,890	1,120	,226	5,552
	category_percentile_MOS			,292	2	,864			
	category_percentile_MOS (1)	-,162	1,534	,011	1	,916	,851	,042	17,188
	category_percentile_MOS (2)	-,521	1,011	,266	1	,606	,594	,082	4,306
	category_percentile_QP			1,382	2	,501			
	category_percentile_QP (1)	-1,627	1,888	,742	1	,389	,197	,005	7,958
	category_percentile_QP (2)	-2,520	2,159	1,363	1	,243	,080	,001	5,535
	category_percentile_E			,846	2	,655			
	category_percentile_E(1)	1,946	2,296	,719	1	,397	7,000	,078	629,624
	category_percentile_E(2)	1,321	1,461	,818	1	,366	3,748	,214	65,675
	Constant	,855	,923	,858	1	,354	2,351		

a. Variable(s) entered on step 1: category_percentile_OR, category_percentile_MD, category_percentile_MOS, category_percentile_QP, category_percentile_E.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

REFERENCES

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

NAME	
DATE OF BIRTH	04 June 1988
PLACE OF BIRTH	Mojokerto, East Java, Indonesia
INSTITUTIONS ATTENDED	1. Public health Faculty, Jember University, Jember, East Java Indonesia 2. Public health Faculty, Airlangga University, Surabaya, East Java, Indonesia
HOME ADDRESS	TROWULAN MOJOKERTO, EAST JAVA, INDONESIA
PUBLICATION	Ulfah, N. H., & Wongsasuluk, P. (2022). The consumption of Indonesian Local Food and Its Relationship with Body Mass Index Among Female University Students. International Journal of Public Health Science (IJPHS), 11(3), 911-919. https://doi.org/http://doi.org/10.11591/ijphs.v11i3.21618

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY