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APPENDIX I

QUESTIONNAIRE ON INDIVIDUAL HEALTH STATUS PRIOR TO EXERCISE PROGRAM

This questionnaire is provided to serve your physical examination in order that the exercise program can be set up in a form appropriate for your health and for safety during the physical fitness test and exercise program.

How To Inform The Questionnaire

There are two sections :

Section 1 (personal data) Section 2 (health data)

Health data will indicate the obstacle or contraindications for your exercise. Prevention should consequently be in mind.

Please fill your data in the blank and also mark the sign " / " in the "__", corresponding to your data. Somehow, you can choose more than one choice for each question. If some questions are not so clear to you, please ask the person who hands out this questionnaire.

Section 1

1. Name____

2. Aged______________Years Birthday_____________________________

3. Address____

Tel.____

4. Sex ___ Male ___ Female

5. Religion____

6. Educational level ___ Primary school

___ Secondary school

___ Under graduate

___ Others (please specified) ____________________

7. Marital status ___ Single

___ Married

___ Others (please specified)______________________

8. Occupation ___ Bureaucracy

___ Employee

___ Others (please specified)______________________

9. Occupational rank ___ Owner

___ Executive

___ Supervisor

___ Labor

___ Others (please specified)__________________

10. Salary ___ Less than 1000 Baht/mth ___ 1001-3000 Baht/mth

___ 3001-5000 Baht/mth ___ More than 5001 Baht/mth

Section 2

1. Smoking ___ No (go to 2.)

___ Yes

___ Every day about ___/ day

Period of smoking ___ More than 10 years

___ 5-10 years

___ 1-5 years

___ Less than 1 year

___ Some times about ___/ wk

Period of smoking ___ more than 10 years

___ 5-10 years

___ 1-5 years

___ Less than 1 year

___ Seldom about ___/ month

Period of smoking ___ More than 10 years

___ 5-10 years

___ 1-5 years

___ Less than 1 year

2. Sleeping period about_____Hr/day

3. Exercise habit ___ No (Go to No.7)

___ Used to ,but stopped for____months

___ Yes about_____Times/wk

About_____Minutes/time

How long ___ More than 1 year

___ 4-12 mth

___ 3-4 mth

___ Less than 2 mth

4. Daily activities or types of sports
(more than one choice can be chosen)

___ Jogging
___ Running
___ Cycling
___ Aerobic dance
___ Yoga
___ Swimming
___ Badminton
___ Volleyball
___ Football
___ Tennis
___ Others (please specified)___________________

5. Chest pain during exercise ___ No

___ Yes

6. Sportsmanship ___ No

___ Yes

Type of sport____________________

Last______Year

7. Health status ___ Healthy (Go to No.8)

___ Not healthy or medical history of

___ Asthma ___ Heart disease

___ Lung disease ___ Hypertension

___ Renal disease ___ Diabetes mellitus

___ Arthritis

___ Others (please specified)_____________

8. Character of your job

___ Sedentary

___ More walking here and there

___ Much muscle power utilized, that is_____________

___ Some muscle power utilized, that is_____________

9. Working place ___ At your house (go to No.11)

___ In the office

10. How to go to the office

___ On foot

Period of walking about______Min.

___ By car ___ By bus

___ Bicycle

Period of cycling about_____Min.

11. Eating habit

___ All 3 meals consist of rice and a few accessories

___ All 3 meals consist of meat, vegetable, rice with complete nutrient group, but quantity limited

___ All 3 meals consist of meat, vegetable, rice with complete nutrient group, in both quantity and quality

___ Vegetary excluded from your meals

___ Vegetarians

___ Others (please specified)_________________________

12. You can take physical fitness test at sports science center sports authority of Thailand

___ Today

___ Another day (please specified)____________________

I have approved that this research and the physical fitness test will be useful for me and for another persons. I am very pleased to take physical fitness test and be in part of this research.

____

( )

Date_____________

APPENDIX II

CRITERION FOR TERMINATION OF EXERCISE TEST

1. **Maximal oxygen uptake** : If the oxygen uptake fails to show an increase with further augmentation of loading (Shephard, 1982) even the subject try his good.

2. **Physical conditions** : The elderly subjects whose physical condition not so fit as the young. so when their heart rate reach **eighty percentage of maximum heart rate**, exercise tests will then be stopped and go on for cool down period.

$$80\% \ \text{maxHR} = (220 - \text{Age}) \times 0.8$$

3. **Exercise test** : Exercise test was considered to stop by the physician or certified professional staff because of the appearance of participant discomfort or exertional intolerance such as

- Dizziness or near syncope
- Angina, regardless of the presence or absence of ECG abnormalities
- Nausea or vomiting
- Rapid, distressful breathing
- Unusual or intolerable fatigue
- Severe claudication or muscle pain
- Staggering or unsteadiness
- Mental confusion
- Facial expression signifying disorders (strained or blank faces)
- Cyanosis or pallor (facial or elsewhere) (deVaries, 1983)

4. **Electrocardiographic changes**

- ST-T segment horizontal or "divergent" displacement of 0.2 mV above or below the resting isoelectric line for at least 0.08 second duration after the junction "J" point.

- Ventricular arrythmia

(1) Ventricular tachycardia (three or more successive premature ventricular contraction).

(2) Continuous bigeminal or trigeminal premature ventricular contraction.

(3) Frequent unifocal or multifocal premature ventricular contraction amounting to greater than 30% (trigeminy) of the total beats per minute.

(4) Due to the difficulty in differentiating between supraventricular atrial contraction with aberrant ventricular conduction should be interpreted in the same way as premature ventricular beats.

5. Blood pressure responses

If systolic blood pressure (SBP) fails to rise with increasing exercise intensities (except as a result of familiarization in the early stages) or if SBP shows a drop of 10 mmHg or more, termination of the exercise test is usually indicated. An increase in SBP to the range of 250 mmHg or above is considered by some authorities as an indication for stopping exercise A diastolic pressure of more than 20 mmHg or a rising above 110 to 120 mmHg is often considered to be an indication that the test should be terminated.

6. Malfunctioning equipment

In the event that there is an equipment malfunction or the ECG monitoring system fails to give and interpretable ECG, the test should be terminated and the problem be corrected before proceeding with the graded exercise test.

APPENDIX III

FORMULAS FOR GAS ANALYSIS

From polygraph recorder, the values of expired air volume ($V_{E,\ ATPS}$), % expired oxygen ($\%O_{2\ E,S}$), % expired carbon dioxide ($\%\ CO_{2\ E,S}$), air temperature ($T_{V_{E,\ STPD}}$), and gas temperature ($T_{\%gas}$) were changed to all values at STPD by Lotus-based spread sheet (Lotus Development Corp., U.S.A.) using the following equations :

Step 1.

Change $V_{E,\ ATPS}$ from recorder to expired air volume at standard temperature (O°C), standard pressure (760 mmHg), and dry (0% Relative humidity) ($V_{E,\ STPD}$) by equation (3) :

$$V_{E,\ STPD} = V_{E,\ ATPS} * \frac{273}{(273+T_A)} * \frac{(P_A - P_{H_2O,\ T_A})}{100} \qquad (3)$$

When : T_A : ambient temperature

P_A : ambient pressure (760 mmHg)

$P_{H_2O},\ T_A$: Vapour pressure at ambient temperature

Step 2.

Change $\%O_{2\ E,S}$ and $\%CO_{2\ E,S}$ from recorder to % dry expired oxygen ($\%O_{2\ E,D}$) and % dry expired carbon dioxide ($\%CO_{2\ E,D}$) by equation (4) and (5), respectively :

$$\%O_{2\ E,D} = \%O_{2\ E,S} * \frac{760}{(P_A - P_{H_2O,\ T_M})} \qquad (4)$$

$$\%CO_{2\,E,D} = \%CO_{2\,E,S} * \frac{760}{(P_A - P_{H_2O,\,T_M})} \qquad (5)$$

Step 3.

Change % inspired oxygen ($\%O_2$) and % inspired carbon dioxide ($\%CO_{2\,I}$) from room air that we recorded at the starting experiment to % dry inspired oxygen ($\%O_{2\,I,D}$) and % dry inspired carbon dioxide ($\%CO_{2\,I,D}$) by equation (6) and (7), respectively :

$$\%O_{2\,I,D} = \%O_{2\,I} * \frac{760}{[P_A - (P_{H_2O,\,T_A} * \frac{\%RH_A}{100})]} \qquad (6)$$

$$\%CO_{2\,I,D} = \%CO_{2\,I} * \frac{760}{[P_A - (P_{H_2O,\,T_A} * \frac{\%RH_A}{100})]} \qquad (7)$$

when : RH_A : Relative humidity at ambient temperature.

Step 4.

Inspired air volume (V_I) was calculated by assumed that negligible amounts of nitrogen (N_2) were absorbed and excreted. And 100% of air was composed of O_2, CO_2 and N_2. So $V_{I,STPD}$ could be calculated from substituting the results of equations (3), (4), (5), (6) and (7) into equation (8) as follow :

$$V_{I,\,STPD} = V_{E,\,STPD} * \frac{(100 - \%O_{2\,E,D} - \%CO_{2\,E,D})}{(100 - \%O_{2\,I,D} - \%CO_{2\,I,D})} \qquad (8)$$

Step 5.

The values of volume of oxygen (Vo_2) (oxygen that was disappeared from V_E) and volume of carbon dioxide (Vco_2) (carbon dioxide that was increased from V_E) were calculated by equation (9) and (10), respectively :

$$V_{O_2} = (V_{I,STPD} * \frac{\%O_{2\,I,D}}{100}) - (V_{E,STPD} * \frac{\%O_{2\,E,D}}{100}) \qquad (9)$$

$$V_{CO_2} = (V_{E,STPD} * \frac{\%CO_{2\,E,D}}{100}) - (V_{I,STPD} * \frac{\%CO_{2\,I,D}}{100}) \qquad (10)$$

APPENDIX IV

NON-LINEAR LEAST-SQUARES ANALYSIS BY MARQUARDT METHOD

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Introduction

Data analysis is an activity that all scientists must undertake at one time or another. Often this takes the form of regression analysis. The scientist has a mathematical relationship, called a model, that expresses how one experimental variable, the dependent variable, depends on one or more other variables, the independent variables. The model contains unknown constants, called parameters, which are required to be estimated from the data.

Define $$y = f(x,z...;\ a,b,...) \qquad (1)$$

where
y = the dependent variable
$x,z,..$ = the set of independent variables
$a,b,..$ = the set of parameters

e.g.

$$y = ax + b \qquad (2)$$

$$y = ax/(b + x) \qquad (3)$$

$$y = a.\exp(bx) \qquad (4)$$

In theory, if the experiment can be carried out with negligible error, then it only requires p measurements to evaluate p numbers of parameters. However experimental errors cause the results to deviate from the predicted model, and more data are collected than the minimum p number of points.

Each experimental data (Yi, Xi, Zi,...) has an unknown error Ri associated with it.

i.e. $$Yi = f(Xi, Zi, ; a,b) + Ri \quad (5)$$

If the errors are assumed to be random in nature, then the Method of Least-Squares can be theoretically justified to give the "best-fit" estimates to the parameters.

The method of least-squares states that the optimal values of the parameters are those which minimize the sum of the squares of the residual error terms in the model equation.

Define $$S(a,b) = \text{sum } Ri^2 \quad (6)$$
$$= \text{sum}(f(Xi ,Zi ;a,b) - Yi)^2 \quad (7)$$

The summation is over all the data points, i = 1 to n.
The values of the parameters (a* ,b*) are those which make the function S a minimum, i.e. S(a* ,b*) = minimum value.

Non-Linear Least-Squares

The parameters in a non-linear model often appear in a single term.

e.g. $$y = ax/(b + x) \quad (8)$$
$$y = a.\exp(-bx) \quad (9)$$

The simultaneous equations cannot be solved explicitly and numerical iteration methods must be employed (i.e. computing techniques are required).

Various computing methods are now available for minimizing a function, S(a,b), e.g. method of Steepest Descent, Gauss-Newton method, Marquardt-Levenberg algorithm. They all involve iteration methods, whereby starting from initial guess values, (a0 ,b0), for the parameters, the computer program will then calculate the next values (a1 ,b1), such that S(a1 ,b1) < S(a0 ,b0). The process is repeated for as many iterations as required or until S reaches a minimum value. Of course there is no guarantee that starting from the initial guess value (a0 ,b0), the program can find the absolute minimum (a* ,b*) and not some local minimum (ag, bj), which also satisfy eqns. 11, 12. That is, the model may give rise to many minima for the equation S(a,b).

The Marquardt algorithm is a compromise between the Steepest Descent method, which converges very slowly as S(a,b) approaches the minimum, and the Gauss-Newton method, which tends not to converge for initial guesses far from the minimum but converges rapidly as the minimum is approached. The Marquardt algorithm introduces a parameter l which can change value from one iteration to the next. The algorithm starts with a large value of l, which is equivalent to the Steepest Descent method, and then decreases the value with each iteration so that the method converges upon the Gauss-Newton method. When an iteration produces an increase in the value of S, l is again increased until S decreases once more. In this way values of the parameters (a,b) are generated such that the function S approaches a minimum rapidly and reliable. The algorithm requires partial derivatives of S with respect to the parameters, but the program calculates these numerically.

Like any iteration procedure, the program may converge very slowly or not at all for some equation f(x,z ; a,b), or for some data set. However if the data are good (i.e. residual errors are small) and starting approximations are realistic, then the Marquardt algorithm is one of the best algorithm available for microcomputers.

Transformation of the Equation

It is sometime possible to re-arrange a non-linear equation in such as way that the new equation is a linear model. For example, the equation

$$y = ax/(b + x) \qquad (3)$$

may be re-written as

$$1/y = (b/a)(1/x) + (1/a) \qquad (10)$$

Thus linear least-squares method may be applied to the data set (1/x,1/y) and values for (b/a) and (1/a) obtained. Hence the parameters (a,b) can be calculated.

However the estimates of(a,b) obtained from the transformed linear equation are not the same as the least- squares estimates using the original equation, eqn.3. This is because the function

$$\mathrm{sum}\{(1/Yi) - (b/a)(1/Xi) - (1/a)\}^2 \qquad (11)$$

is minimized, and not the function

$$\mathrm{sum}\{Yi - (AXi/(b + Xi)\}^2 \qquad (12)$$

For many experimental data, the estimates from the transformed linear equation may be satisfactory, particularly if the error terms are small. Also where re-arrangement to a linear form is possible, these estimates may be used as the initial values in the iteration process of the non-linear program.

Use of Program NONLG3 (Version for 16-bit microcomputer)

1. Load the DOS and BASIC interpreter programs (see computer manual for instructions).
2. Load the non-linear least-squares program by typing LOAD "NONLG3.BAS" and then press <ENTER>.
3. The user must now write a subroutine in BASIC that is specific for the equation to be fitted. The subroutine begins at line number 5000 and must end with a RETURN statement.

The convention used for the variables, parameters, constants and residuals are as follows :

Residual : F

Variable : X(I,1), X(I,2), ...

Parameter : P(1), P(2), ...

Constant : C(1), C(2), ...

There may be up to 5 variables, 8 parameters, 50 constant and 100 data points, but these numbers can be modified, if necessary.

The subroutine is written as follows:

Give the equation

$$y = AX/(b + x)$$

with $$Ri = AXi/(b + Xi) - Yi$$

This is written in BASIC, using the above convention:

```
5000 F = P(1)*X(I,1)/(P(2) + X(I,1)) - X(I,2)
5010 RETURN
```

There are no constants in the subroutine. We have also chosen to denote the independent variable x as X(I,1) (i.e. point i, variable 1) and the dependent variable y as X(I,2) (i.e. point i, variable 2). The variable number may be interchanged.

The use of constants, C(1), C(2) etc., in the subroutine is useful when fitting equations having the same form but differing values of certain constants (e.g. pKa's). It removes the necessity of rewriting the subroutine for each equation.

Please consult the computer's BASIC manual on how to modify the program.

4. Type RUN and press <ENTER>.

5. The program will display the following on the monitor.

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APPENDIX V

RAW DATA AND STATISTICAL RESULTS

Table 1. Physical characters and aerobic parameters of 17-30 year-old untrained subjects.

Number	**Age** (years)	**Weight** (Kg)	**Height** (cm)	$\dot{V}O_2$ **max.** (ml / min / Kg)	**Anaerobic threshold** (ml / min / Kg)	τ (sec)
1	27	62	172	45.1	29.25	45.87
2	25	50	171	47.19	36.86	63.69
3	25	58	170	42.33	33.08	53.48
4	25	62.5	169	36.92	24.73	44.44
5	27	58	170	46.14	32.89	59.17
6	26	54	169	38.46	28.15	50.51
7	22	69	174	49.41	37.36	50.51
8	25	69	169	49.75	32.58	56.18
9	30	69	169	48.86	39.72	49.75
10	28	51.5	170	41.05	38.55	51.28
11	25	58.5	169	49.14	38.75	46.75
12	20	66	172	47.11	33.29	51.25
13	25	80	178	40.02	35.44	42.55
14	24	60	163	44.4	29.91	45.87
15	28	57	166	47.08	32.23	54.05
mean	**24.47**	**61.5**	**170.07**	**44.86**	**33.52**	**51.02**
SD	**2.45**	**7.91**	**3.37**	**4.18**	**18.63**	**5.72**

Table 2. Physical characters and aerobic parameters of 31-40 year-old untrained subjects.

Number	Age (years)	Weight (Kg)	Height (cm)	$\dot{V}O_2$ max. (ml / min / Kg)	Anaerobic threshold (ml / min / Kg)	τ (sec)
1	40	62	171	34.95	27.87	64.52
2	36	64	168	36.92	20.83	52.63
3	35	85	169	60.11	29.18	55.25
4	35	70	172	41.08	30.59	50
5	37	72.5	160	74.04	22.98	57.11
6	39	62	168	46.92	26.48	50
7	35	81.5	180	44.20	23.59	48.78
8	33	74	165	36.1	19.57	51.81
9	38	52	170	49.29	31.91	69.93
10	35	68	168	34.75	24.77	64.1
11	39	68	163	38.05	24.31	69.93
12	33	63.5	168	56.27	40.5	52.63
13	32	61	162	38.7	20.7	66.23
14	32	83	176	44.2	30	68.49
15	31	52	174	44.03	23.53	64.52
16	38	58.5	163	45.54	29.09	59.17
17	40	62	162	59.31	27.28	50
18	35	55	175	37.1	27	51.28
19	37	72	174	36.8	32	52.63
mean	**36.05**	**66.63**	**168.84**	**43.76**	**26.74**	**61.57**
SD	**2.93**	**9.72**	**5.48**	**7.97**	**4.98**	**12.32**

Table 3. Physical characters and aerobic parameters of 41-50 year-old untrained subjects.

Number	Age (years)	Weight (Kg)	Height (cm)	$\dot{V}_{O_2}$ max. (ml / min / Kg)	Anaerobic threshold (ml / min / Kg)	τ (sec)
1	49	64	173	-	27.07	63.69
2	41	71.5	164	-	28.73	56.18
3	44	75	174	-	24.93	57.14
4	47	61	166	-	22.52	51.28
5	43	66.5	165	-	24.45	59.52
6	44	75.5	172	-	28.13	64.52
7	45	84	170	-	16.2	52.63
8	47	64.5	165	-	23.22	65.36
mean	**45**	**70.25**	**168.63**	-	**24.41**	**62.85**
SD	**2.56**	**7.68**	**4.07**	-	**4**	**41.31**

Table 4. Physical characters and aerobic parameters of more than 50 year-old untrained subjects.

Number	**Age** (years)	**Weight** (Kg)	**Height** (cm)	$\dot{V}_{O_2}$ **max.** (ml / min / Kg)	**Anaerobic threshold** (ml / min / Kg)	τ (sec)
1	73	64	170	-	11.33	71.94
2	83	62.5	167	-	19.02	100
3	61	64.5	164	-	19.92	75.19
4	64	63.5	159	-	15.11	86.21
5	73	71.8	173	-	13.78	86.21
6	52	58.5	160	-	12.81	87.72
7	64	63.5	160	-	17.76	77.52
8	57	65.6	169	-	12.76	94.34
9	57	68.6	153	-	12.68	86.96
10	52	73.6	164	-	15.33	94.3
11	62	74	167	-	16.95	101
mean	**63.45**	**66.36**	**164.18**	-	**14.68**	**77.2**
SD	**9.59**	**4.98**	**5.81**	-	**2.89**	**17.49**

Table 5. Physical characters and aerobic parameters of 17-30 year-old aerobic-trained subjects.

Number	**Age** (years)	**Weight** (Kg)	**Height** (cm)	$\dot{V}_{O_2}$ **max.** (ml / min / Kg)	**Anaerobic threshold** (ml / min / Kg)	τ (sec)
1	30	54.5	165	59.35	48.45	49.75
2	28	53	165	61.25	40.16	48.54
3	24	66	174	62.88	49.39	45.87
4	23	60	164	62.07	49.48	35.34
5	21	69	178	64.25	45.5	57.14
6	25	69	170	64.47	44.31	54.05
7	19	66.5	178	62.97	41.9	33.22
8	17	55.5	169	61.73	54.82	45.87
9	23	56	165	54.89	48.1	30.67
10	30	58	180	51.71	49.95	39.22
11	25	66.5	176	64.75	48.91	56.18
12	30	60	164	59.09	40.41	35.34
13	30	60	162	56.23	34.55	36.9
14	21	62	170	65.46	42.2	33.33
15	26	56	172	58:05	40.28	45.87
mean	**24.8**	**60.8**	**170.13**	**60.61**	**45.21**	**44.69**
SD	**4.23**	**5.43**	**5.95**	**4.01**	**5.3**	**13.55**

Table 6. Physical characters and aerobic parameters of 31-40 year-old aerobic-trained subjects.

Number	Age (years)	Weight (Kg)	Height (cm)	$\dot{V}O_2$ max. (ml / min / Kg)	Anaerobic threshold (ml / min / Kg)	τ (sec)
1	31	61	168	46.86	33.82	51.55
2	31	59.5	174	47.6	26.01	52.36
3	32	60	168	62.08	35.78	35.46
4	32	61	174	59	47.14	56.18
5	36	73	169	46.11	36.65	37.31
6	39	76	175	52.24	41.76	42.55
7	34	68	171	52.13	37.7	39.84
8	39	70	168	61.3	38.21	45.87
9	39	61	162	55.15	33.33	43.29
10	34	62	174	61.2	53.22	45.66
11	40	67	162	53.38	40.38	33.44
12	39	67	169	61.31	39.48	32.79
13	39	58	172	55.72	39.32	42.19
14	40	67	174	52.36	40.14	47.62
15	31	60	175	56.32	40.39	50
16	34	62	174	52.74	35.59	49.26
mean	**36.06**	**64.53**	**170.56**	**54.72**	**38.63**	**47.92**
SD	**3.55**	**5.31**	**4.26**	**5.26**	**5.99**	**12.64**

Table 7. Physical characters and aerobic parameters of 41-50 year-old aerobic-trained subjects.

Number	Age (years)	Weight (Kg)	Height (cm)	$\dot{V}_{O_2}$ max. (ml / min / Kg)	Anaerobic threshold (ml / min / Kg)	τ (sec)
1	42	59	170	46.28	32.53	53.48
2	45	47.5	159	46.17	33.14	50
3	41	56	162	52.35	34.29	56.18
4	50	75	175	47.38	28.08	65.36
5	48	56.5	169	48.97	30.17	49.75
6	43	61.5	172	46.79	27.49	53.19
7	45	57.5	161	49.65	29.51	59.52
8	45	62	172	44.17	25.99	67.57
9	47	68.5	162	44.08	27.99	51.28
10	42	78	175	45.55	23.46	50.51
mean	**44.8**	**62.15**	**167.7**	**47.14**	**29.27**	**52.55**
SD	**2.9**	**9.27**	**6.11**	**2.57**	**3.37**	**9.54**

Table 8. Physical characters and aerobic parameters of more than 50 year-old aerobic-trained subjects.

Number	Age (years)	Weight (Kg)	Height (cm)	$\dot{V}_{O_2}$ max. (ml / min / Kg)	Anaerobic threshold (ml / min / Kg)	τ (sec)
1	65	55.5	163	31.91	24.29	63.69
2	66	75	178	35.3	24.48	59.17
3	74	60	168	42.08	24.62	59.17
4	56	56	170	30.34	23.88	64.1
5	63	65	168	43.01	21.55	61.06
6	63	66	168	42.9	24.35	56.18
7	56	72	176	31.31	23.4	54.94
8	72	67.5	160	31.01	21.75	56.18
9	63	58	167	42.83	23.63	60.21
10	64	58	169	35.27	29.61	57.8
mean	**64.2**	**63.3**	**168.7**	**36.6**	**24.16**	**54.21**
SD	**5.77**	**6.84**	**5.31**	**5.51**	**2.2**	**7.85**

Table 9. Effects of ages and activities on $\dot{V}o_{2max.}$ of 31 aerobic-trained and 34 untrained subjects.

Source of variation	Degrees of freedom	Mean square	F value
Grand average	1	166420.36	
Between ages	1	2871.10	86.3502
Between activities	1	197.18	5.9303
Interaction	1	92.08	2.7692
Within cells	61	33.25	

Age effect, One-tailed $p < 0.0001$

Activity effect, One-tailed $p = 0.0178$

Age effects on $\dot{V}o_{2max.}$ of them were statistically difference at $p < 0.001$.

Activity effects on $\dot{V}o_{2max.}$ of them were statistically difference at $p < 0.05$.

Table 10. Effects of ages on $\dot{V}o_{2max.}$ of 17-30 and 31-40 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	66558.12
Between columns	1	10.29
Within columns	32	43.36

F = 0.2374

One-tailed p = 0.6294

Age effects on $\dot{V}o_{2max.}$ of both groups were not statistically difference at $p < 0.05$.

Table 11. Effects of ages on $\dot{V}o_{2max.}$ of 4 aerobic-trained groups.

Source of variation	Degrees of freedom	Mean square
Grand average	1	134801.65
Between columns	3	1273.98
Within columns	47	20.71

$F = 61.5064$

One-tailed $p < 0.001$

Age effects on $\dot{V}o_{2max.}$ of 4 aerobic-trained groups were statistically difference at $p < 0.001$.

Table 12. Effects of ages on $\dot{V}o_{2max.}$ of 17-30 and 31-40 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	102741.15
Between columns	1	268.70
Within columns	29	22.09

F = 12.1641

One-tailed p = 0.0016

Age effects on $\dot{V}o_{2max.}$ of both groups were statistically difference at $p < 0.01$.

Table 13. Effects of ages on $\dot{V}o_{2max.}$ of 31-40 and 41-50 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	69773.56
Between columns	1	353.55
Within columns	29	19.79

F = 17.8614

One-tailed p = 0.0003

Age effects on $\dot{V}o_{2max.}$ of both groups were statistically difference at $p < 0.001$.

Table 14. Effects of ages on $\dot{V}o_{2max.}$ of 41-50 and more than 50 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	35057.75
Between columns	1	555.77
Within columns	18	18.49

F = 30.0543

One-tailed p < 0.0001

Age effects on $\dot{V}o_{2max.}$ of both groups were statistically difference at $p < 0.001$.

Table 15. Effects of ages on $\dot{V}o_{2max.}$ of 17-30and 41-50 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	72365.63
Between columns	1	1088.81
Within columns	23	12.36

F = 88.0974

One-tailed p < 0.0001

Age effects on $\dot{V}o_{2max.}$ of both groups were statistically difference at $p < 0.001$.

Table 16. Effects of ages on $\dot{V}o_{2max.}$ of 17-30 and more than 50 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	65036.22
Between columns	1	3406.03
Within columns	23	21.67

$F = 159.6757$

One-tailed $p < 0.0001$

Age effects on $\dot{V}o_{2max.}$ of both groups were statistically difference at $p < 0.001$.

Table 17. Effects of ages on $\dot{V}o_{2max.}$ of 31-40 and more than 50 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	69773.56
Between columns	1	353.55
Within columns	24	28.72

F = 70.3825

One-tailed p = 1.347e-08

Age effects on $\dot{V}o_{2max.}$ of both groups were statistically difference at $p < 0.001$.

Table 18. Effects of activities on $\dot{V}o_{2max.}$ of 17-30 year-old subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	83435.74
Between columns	1	1859.52
Within columns	28	16.77

F = 110.8981

One-tailed p < 0.0001

Activity effects on $\dot{V}o_{2max.}$ of both groups were statistically difference at $p < 0.001$.

Table 19. Effects of activities on $\dot{V}o_{2max.}$ of 31-40 year-old subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	83239.17
Between columns	1	1043.91
Within columns	33	47.23

F = 22.1007

One-tailed p = 0.0001

Activity effects on $\dot{V}o_{2max.}$ of both groups were statistically difference at $p < 0.001$.

Table 20. Effects of ages and activities on anaerobic threshold of 51 aerobic-trained and 53 untraind subjects.

Source of variation	Degrees of freedom	Mean square	F value
Grand average	1	98392.01	
Between ages	3	2104.64	102.0473
Between activities	1	1191.29	57.7618
Interaction	3	22.61	1.0963
Within cells	96	20.62	

Age effect, One-tailed $p < 0.0001$

Activity effect, One-tailed $p < 0.0001$

Age effects on anaerobic threshold of them were statistically difference at $p < 0.001$.

Activity effects on anaerobic threshold of them were statistically difference at $p < 0.001$.

Table 21. Effects of ages on anaerobic threshold of 4 untrained groups.

Source of variation	Degrees of freedom	Mean square
Grand average	1	35289.76
Between columns	3	761.70
Within columns	49	18.43

F = 41.3211

One-tailed p < 0.0001

Age effects on anaerobic threshold of 4 groups were statistically difference at p < 0.001.

Table 22. Effects of ages on anaerobic threshold of 17-31 and 31-40 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	30054.06
Between columns	1	384.37
Within columns	23	22.11

F = 17.3876

One-tailed p = 0.0002

Age effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 23. Effects of ages onanaerobic threshold of 31-40 and 41-50 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	18323.83
Between columns	1	30.76
Within columns	25	22.35

F = 1.3761

One-tailed p = 0.2518

Age effects on anaerobic threshold of both groups were not statistically difference at $p < 0.05$.

Table 24. Effects of ages on anaerobic threshold of 40-50 and more than 50 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	6698.45
Between columns	1	437.98
Within columns	17	11.52

F = 38.0171

One-tailed p = 0.0001

Age effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 25. Effects of ages on anaerobic threshold of 17-30 and 41-50 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	21181.57
Between columns	1	432.92
Within columns	21	17.77

F = 24.3679

One-tailed p = 0.0001

Age effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 26. Effects of ages on anaerobic threshold of 17-30 and more than 50 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	16969.29
Between columns	1	2250.99
Within columns	24	14.35

F = 156.8396

One-tailed p < 0.0001

Age effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 27. Effects of ages on anaerobic threshold of 31-40 and 41-50 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	14946.81
Between columns	1	1013.57
Within columns	28	18.93

F = 53.5298

One-tailed p = 5.759e-08

Age effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 28. Effects of ages on anaerobic threshold of 4 aerobic-trained groups.

Source of variation	Degrees of freedom	Mean square
Grand average	1	65755.16
Between columns	3	1081.17
Within columns	47	22.91

F	=	47.1967
One-tailed p	<	0.0001

Age effects on anaerobic throld of 4 groups were statistically difference at p < 0.001.

Table 29. Effects of ages on anaerobic threshold of 17-31 and 31-40 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	54269.82
Between columns	1	329.80
Within columns	29	32.09

F = 10.2773

One-tailed p = 0.0033

Age effects on anaerobic threshold of both groups were statistically difference at $p < 0.01$.

Table 30. Effects of ages on anaeromic threshold of 31-40 and 41-50 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	31957.00
Between columns	1	545.78
Within columns	24	26.66

F = 20.469777

One-tailed p = 0.0001

Age effects on anaerobic threshold of both groups were statistically difference at p < 0.001.

Table 31. Effects of ages on anaerobic threshold of 41-50 and more than 50 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	14268.48
Between columns	1	130.56
Within columns	18	8.11

F = 16.0914

One-tailed p = 0.0008

Age effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 32. Effects of ages on anaerobic throld of 17-30 and 41-50 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	37697.33
Between columns	1	1525.33
Within columns	23	21.54

F = 70.7978

One-tailed p = 1.786e-08

Age effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 33. Effects of ages on anaerobic threshold of 17-30 and more than 50 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	33833.19
Between columns	1	2659.71
Within columns	23	18.99

F = 140.06

One-tailed p < 0.0001

Age effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 34. Effects of ages on anaerobic threshold of 31-40 and 41-50 year-old; aerobic-trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	28477.26
Between columns	1	1298.76
Within columns	24	24.21

F = 53.6369

One-tailed p = 1.453e-07

Age effects on anaerobic threshold of both groups were statistically difference at p < 0.001.

Table 35. Effects of activities on anaerobic threshold of 17-30 year-old subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	46481.80
Between columns	1	1025.62
Within columns	28	23.36

F = 43.912860

One-tailed p = 3.449e-07

Activity effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 36. Effects of activities on anaerobic threshold of 31-40 year-old trained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	36292.62
Between columns	1	1238.02
Within columns	33	29.82

F = 41.516597

One-tailed p = 2.632e-07

Activity effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 37. Effects of activities on anaerobic threshold of 41-50 year-old subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	13224.80
Between columns	1	104.92
Within columns	16	13.42

F = 7.8209

One-tailed p = 0.0129

Activity effects on anaerobic threshold of both groups were statistically difference at $p < 0.05$.

Table 38. Effects of activities on anaerobic threshold of more than 50 year-old subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	7735.68
Between columns	1	470.07
Within columns	19	6.70

F = 70.1887

One-tailed p = 80390e-08

Activity effects on anaerobic threshold of both groups were statistically difference at $p < 0.001$.

Table 39. Effects of ages and activities on τ of 51 aerobic-trained and 53 untrained subjects.

Source of variation	Degrees of freedom	Mean square	F value
Grand average	1	322530.86	
Between ages	3	1316.03	9.0332
Between activities	1	4270.38	29.3117
Interaction	3	303.91	2.0860
Within cells	96	145.69	

Age effect, One-tailed p $<$ 0.0001

Activity effect, One-tailed p = 4.54e-07

Age effects on τ of them were statistically difference at $p < 0.001$. Activity effects on τ of them were statistically difference at $p < 0.001$.

Table 40. Effects of ages on τ of 4 untrained groups.

Source of variation	Degrees of freedom	Mean square
Grand average	1	203858.50
Between columns	3	1452.17
Within columns	49	156.77

F = 9.2631

One-tailed p = 0.0001

Age effects on τ of 4 groups were statistically difference at $p < 0.001$.

Table 41. Effects of ages on τ of 17-30 and 31-40 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	110135.65
Between columns	1	931.64
Within columns	32	99.73

F = 9.3416

One-tailed p = 0.0045

Age effects on τ of both groups were statistically difference at $p < 0.01$.

Table 42. Effects of ages on τ of 31-40 and 41-50 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	103604.56
Between columns	1	9.23
Within columns	25	166.66

F = 0.0554

One-tailed p = 0.8159

Age effects on τ of both groups were not statistically difference at $p < 0.05$.

Table 43. Effects of ages on τ of 41-50 and more than 50 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	96194.09
Between columns	1	953.64
Within columns	17	264.14

F = 3.6104

One-tailed p = 0.0745

Age effects on τ of both groups were not statistically difference at $p < 0.05$.

Table 44. Effects of ages on τ of 17-30 and 41-50 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	697918.62
Between columns	1	729.29
Within columns	21	90.00

F = 8.1033

One-tailed p = 0.0097

Age effects on τ of both groups were statistically difference at $p < 0.01$.

Table 45. Effects of ages on τ of 17-30 and more than 50 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	100254.24
Between columns	1	4346.99
Within columns	24	146.46

F = 29.6796

One-tailed p = 0.0001

Age effects on τ of both groups were statistically difference at $p < 0.001$.

Table 46. Effects of ages on τ of 31-40 and more than 50 year-old; untrained subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	135865.24
Between columns	1	1701.86
Within columns	28	206.85

F = 8.2276

One-tailed p = 0.0078

Age effects on τ of both groups were statistically difference at $p < 0.01$.

Table 47. Effects of ages on τ of 4 aerobic-trained groups.

Source of variation	Degrees of freedom	Mean square
Grand average	1	123003.36
Between columns	3	231.44
Within columns	47	134.14

$F = 1.7254$

One-tailed $p = 0.1746$

Age effects on τ of 4 groups were not statistically difference at $p < 0.05$.

Table 48. Effects of activities on τ of 17-30 year-old subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	68702.07
Between columns	1	301.21
Within columns	28	108.21

F = 2.7837

One-tailed p = 0.1064

Activity effects on τ of both groups were not statistically difference at $p < 0.05$.

Table 49. Effects of activities on τ of 31-40 year-old subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	107145.99
Between columns	1	1616.61
Within columns	33	155.44

F = 104003

One-tailed p = 0.0028

Activity effects on τ of both groups were statistically difference at $p < 0.01$.

Table 50. Effects of activities on τ of 41-50 year-old subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	58738.78
Between columns	1	471.35
Within columns	16	140.72

F = 3.3496

One-tailed p = 0.0859

Activities effects on τ of both groups were not statistically difference at $p < 0.05$.

Table 51. Effects of activities on τ of more than 50 year-old subjects.

Source of variation	Degrees of freedom	Mean square
Grand average	1	92168.99
Between columns	1	2767.69
Within columns	19	188.18

F = 14.7080

One-tailed p = 0.0011

Activity effects on τ of both groups were statistically difference at $p < 0.01$.

VITA

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