CHAPTER IV

RESEARCH FINDINGS

Among 35 subjects aged 45 to 83, 14 controls aged 60 to 83 were comparable with 7 cases aged 63 to 83 as age-matched groups in addition to comparing all controls with all cases as age-unmatched groups (see Table 1,2).

By unmatched t-test, the comparison of two groups' means of total BMD was not significant in age-matched groups ($P > 0.05$), but it was very significant in age-unmatched groups ($P < 0.01$) and the comparison of two groups' means of age in age-unmatched groups was significant, too ($P < 0.05$).

The relationship between total BMD and age, weight among all 10 cases, all 25 controls and all subjects were respectively analysed by multiple regression. Among all 10 cases(see Table 3), there was a very significant correlation between total BMD and age ($R=-0.80$, $P<0.01$), while there was no significant correlation between total BMD and weight ($P= 0.1942$). Among all 25 controls (see Table 4), there was a very significant correlation between total BMD and age ($R= -0.74$, $P< 0.001$), and between total BMD and weight ($R= 0.83$, $P< 0.01$). Among all subjects, there was a very significant correlation between total BMD and age, and between total BMD and weight (see Table 5), that bone mass has a negative correlation with advancing age ($R= -0.79$, $P< 0.0001$) and has a positive correlation with weight ($R= 0.83$, $P< 0.01$).

By linear regression, we can see the best straight lines of the relationship between total BMD and age, total BMD and weight among all 10 cases, all 25 controls and all subjects respectively (see Chart 1, 2, 3, 4, 5, 6).

Using all subjects' data of total BMD in Receiver Operating Characteristic curve (ROC), a cutoff point of BMD (<or= 0.60 g/cm^2) was selected as the threshold (sensitivity 90%, specificity 68%) of hip fracture when the elderly female fell down (see Table 6, Chart 7).

Multiple possible risk factors for hip fracture and low BMD (less than or equal 0.6 g/cm^2, the same in the below) were analysed by logistic regression model (see Table 7, 8). The odds ratio of low BMD (<or= 0.60 g/cm^2) for hip fracture is 19.11 (CI, 2 to 178, P< 0.01). Smoking, alcohol drinking, body mass, physical activity and age have no association with the risk of hip fracture (R= 0), while milk drinking has poor association with the risk of hip fracture (R = 0.135, P > 0.05). The odds ratio of age for low BMD (<or= 0.60 g/cm^2) is 1.15 (CI, 1.046 to 1.264, P< 0.01). Smoking, alcohol drinking, milk drinking and physical activity have no association with the risk of low BMD, while body mass has poor association with low BMD (R = 0.128, P>0.05).

Other possible risk factors for the tendency of fall, hip fracture or low BMD have not been analysed in logistic regression model because they are not the research questions in this study. However, as reference datum for the future study,

they were summarized in Table 9.

The various types of falling and the situation of falling moment are listed in Table 10, 11. Nearly 83% of the falls occurred on the level, including walking on the level, walking on the slope and standing up or sitting down. Sixty percent of the falls were resulted with the condition of the ground, including a slippery or uneven surface and with an obstacle. Twenty six percent of the falls were due to dizziness, too weak or painful legs. These datum were useful references for the future research.

Of 35 subjects, 27 subjects' X-ray films in healthy hip were evaluated using Singh Index by a blinded radiologist. 8 films were missed because the patients had taken their films back or some doctors had kept the films in hand. Comparing Singh Index with gold standard, DEXA, in 2 x 2 table, we got sensitivity 46% and specificity 93% for Singh Index test (see Table 12).

Table 1

COMPARISON OF MEANS BETWEEN AGE-MATCHED GROUPS

	cases		controls		
	mean	SD	mean	SD	P
Total BMD(g/cm^2)	0.5456	0.086	0.6095	0.106	0.625
Wards' BMD(g/cm^2)	0.2654	0.090	0.3293	0.098	0.893
Age (year)	71.7	7.697	71.2	7.062	0.742
Weight (kg)	55.3	12.097	48.2	9.932	0.520
Height (cm)	153.3	4.152	148.8	5.549	0.490
Menopause(year)	22.9	9.873	22.6	7.792	0.445
Number of subjects	7		14		

Notes: 1. Total BMD is the mean of the sum of neck BMD, trochanteric BMD and intertrochanteric BMD in hip (the same in the below).
2. Ward's BMD is from the ward triangle of the femoral neck. It's as a reference here(the same in the below).
3. Unmatched t-test is applied in SPSSPC+.

Table 2

COMPARISON OF MEANS BETWEEN AGE-UNMATCHED GROUPS

	All cases		All controls		
	mean	SD	mean	SD	P
Total BMD(g/cm^2)	0.5155	0.103	0.6936	0.165	0.001
Neck BMD(g/cm^2) in hip	0.4869	0.083	0.6485	0.151	0.003
Trochanteric BMD (g/cm^2)	0.3801	0.089	0.4982	0.126	0.011
Intertrochanteric BMD(g/cm^2)	0.5984	0.124	0.8176	0.200	0.003
Wards' BMD(g/cm^2)	0.2543	0.092	0.4342	0.197	0.001
Age (year)	72	8.165	62.88	11.311	0.027
Weight (kg)	52.7	12.239	52.36	10.996	0.937
Height (cm)	152.1	4.332	151.68	6.768	0.857
Menopause(year)	24.2	10.196	14.84	11.146	0.028
Number of subjects	10		25		

Notes: 1. The result in Menopause may be referred to that in Age.
2. Unmatched t-test is applied in SPSSPC+.

Table 3

THE RELATIONSHIP BETWEEN TOTAL BMD AND AGE,

TOTAL BMD AND WEIGHT IN CASES

Independent variables	R	R^2	B	SEB	T	P
Constant			1.2463	0.19222	6.484	0.0002
Age (year)	0.80	0.65	-0.0102	0.00265	-3.824	0.0051
Weight(kg)		removed from the equation				0.1942

Notes:
1. R: correlation value
   R^2: the square of R
   B: coefficient
   SEB: the standard error of B
   (the same in the below)
2. Weight does not affect Total BMD, so it was removed from the equation automatically.
3. Multiple regression is applied in SPSSPC+.

Table 4

THE RELATIONSHIP BETWEEN TOTAL BMD AND AGE,

TOTAL BMD AND WEIGHT IN CONTROLS

Independent variables	R	R^2	B	SEB	T	P
Constant			0.8953	0.18524	4.833	0.0001
Age (year)	0.74	0.54	-0.0084	-0.57464	-4.443	0.0002
Weight(kg)	0.83	0.69	0.0062	0.00195	3.207	0.0041

Note: Multiple regression is applied in SPSSPC+.

Table 5

THE RELATIONSHIP BETWEEN TOTAL BMD AND AGE,

TOTAL BMD AND WEIGHT IN ALL 35 SUBJECTS

Independent variables	R	R^2	B	SEB	T	P
Constant			1.130	0.143	7.895	0.0000
Age (year)	0.79	0.62	-0.0109	0.00153	-7.129	0.0000
Weight(Kg)	0.83	0.69	0.0043	0.00153	2.818	0.0082

Note: Multiple regression is applied in SPSSPC+.

Chart 1

THE RELATIONSHIP BETWEEN TOTAL BMD AND AGE IN CASES
(by using linear regression model)

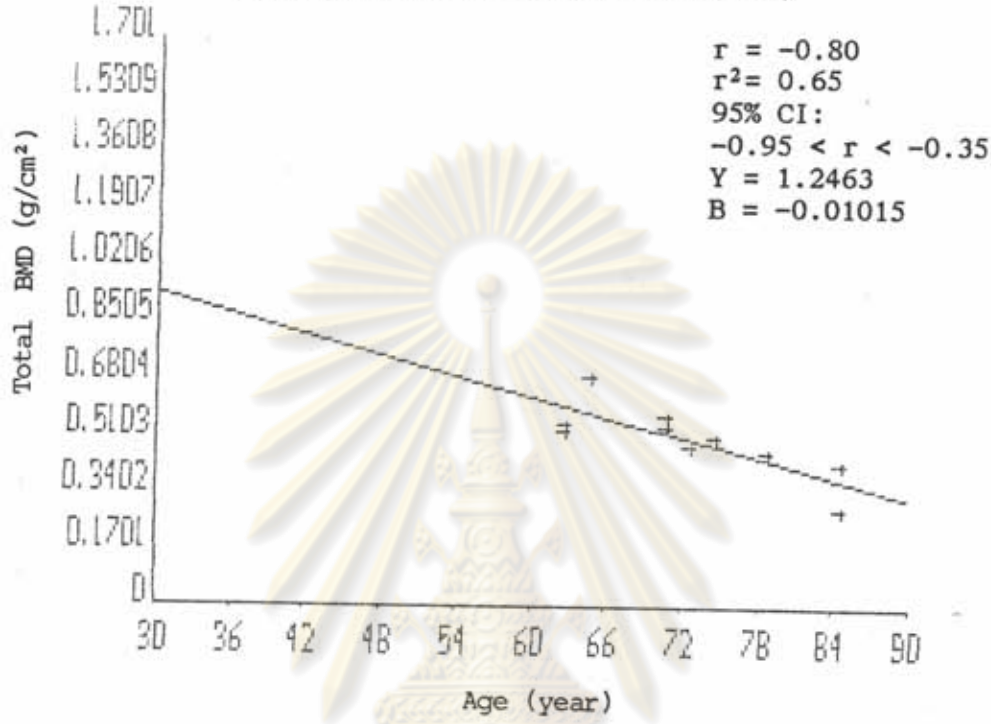

Chart 2

THE RELATIONSHIP BETWEEN TOTAL BMD AND WEIGHT IN CASES
(by using linear regression model)

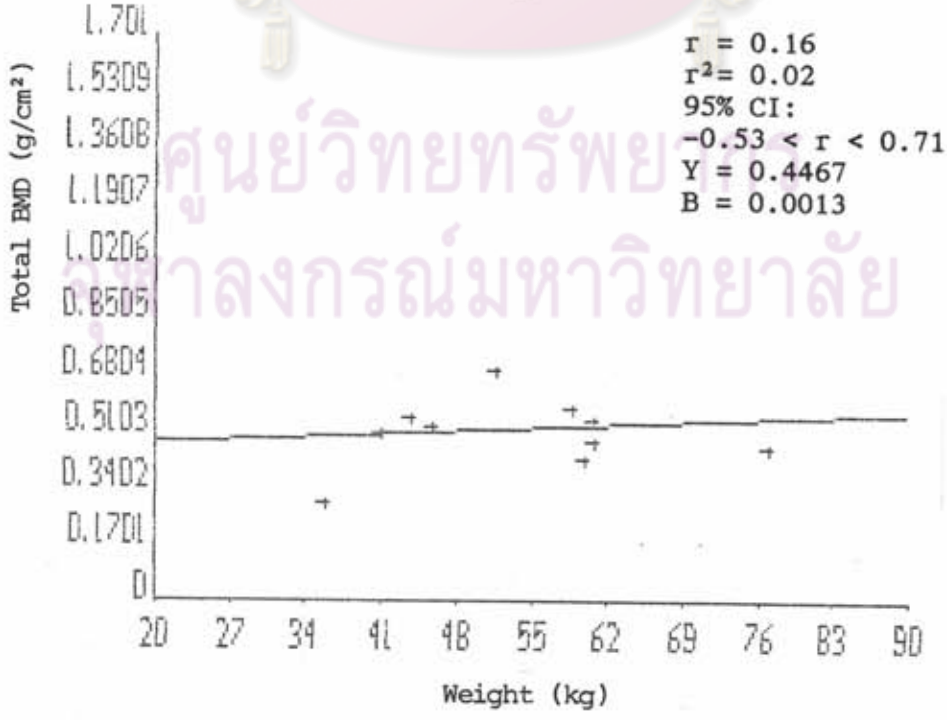

Chart 3

THE RELATIONSHIP BETWEEN TOTAL BMD AND AGE IN CONTROLS
(by using linear regression model)

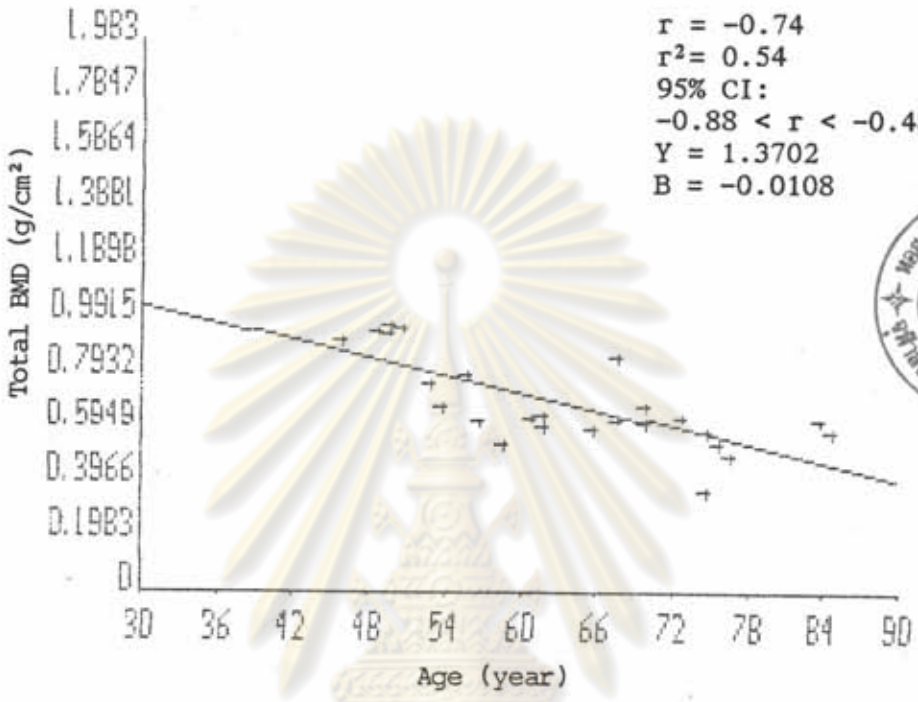

Chart 4

THE RELATIONSHIP BETWEEN TOTAL BMD AND WEIGHT IN CONTROLS
(by using linear regression model)

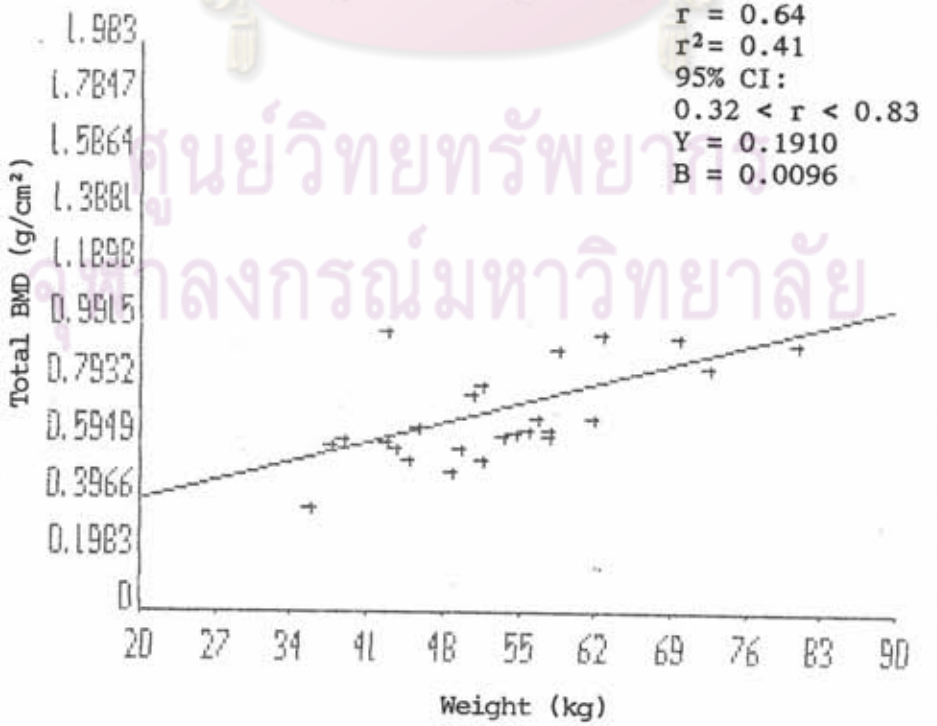

Chart 5

THE RELATIONSHIP BETWEEN TOTAL BMD AND AGE IN ALL SUBJECTS
(by using linear regression model)

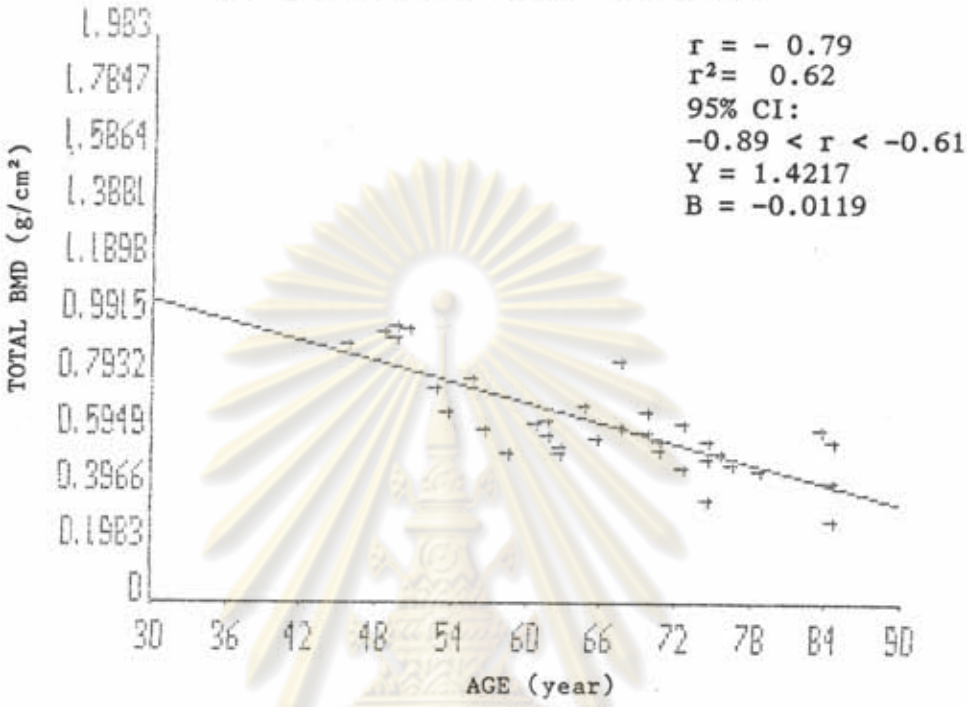

Chart 6

THE RELATIONSHIP BETWEEN TOTAL BMD AND WEIGHT IN ALL SUBJECTS
(by using linear regression model)

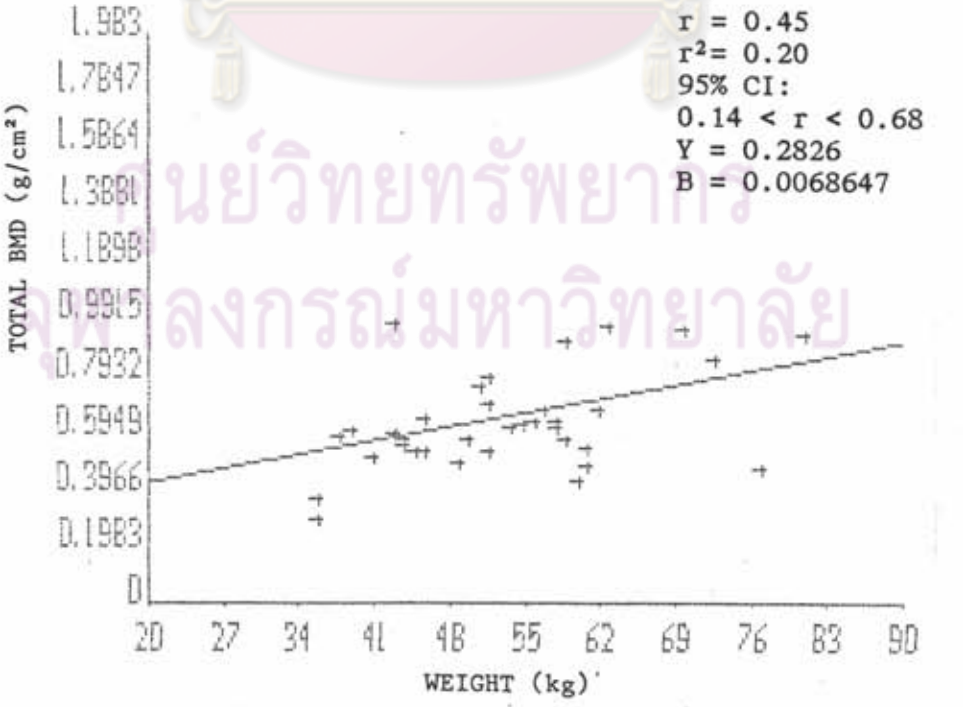

Table 6

SENSITIVITY AND SPECIFICITY FOR BMD THRESHOLD OF HIP FRACTURE

Cutoff point of total BMD in hip (g/cm^2)	Sensitivity a/(a + c) %	Specificity d/(b + d) %	False Positive Rate (1 - specificity) %
< or = 0.45	20	96	4
< or = 0.50	40	92	8
< or = 0.55	60	84	16
< or = 0.60	90	68	32
< or = 0.65	90	44	56

Chart 7 ROC CURVE FOR THE THRESHOLD OF HIP FRACTURE
By using all subjects' data in the model

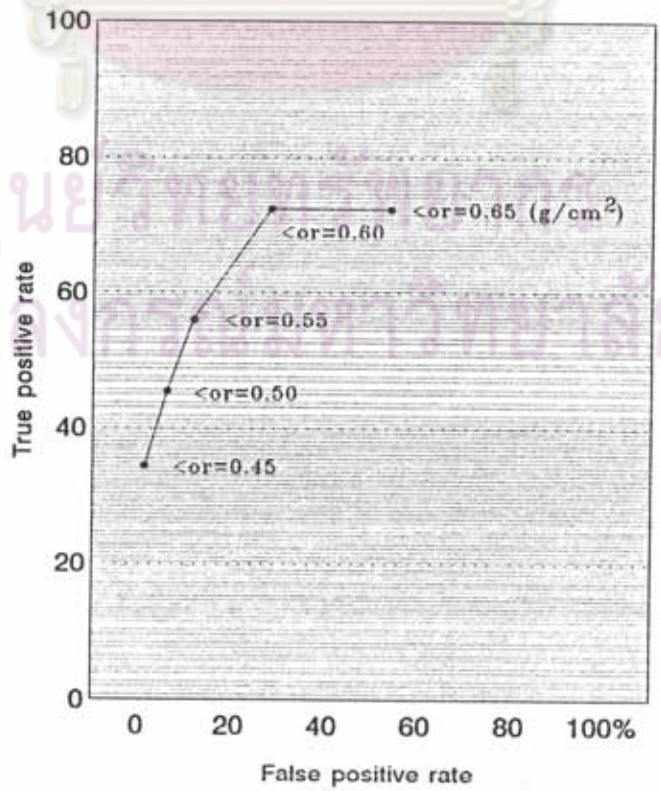

Table 7

ODDS RATIO FOR HIP FRACTURE IN ALL 35 SUBJECTS

Factors	B	SE	Odds Ratio	95%CI	P
Total BMD					
<or= 0.6 g/cm²	2.95	1.14	19.11	2 - 178	0.0095
> 0.6 g/cm²	-	-	-	-	-

Notes: 1. R = 0 in smoking, alcohol drinking, body mass index, physical activity and age, while R = 0.135 (P> 0.05) in milk drinking.
2. Logistic regression is applied in SPSSPC+.

Table 8

ODDS RATIO FOR LOW BMD (<or= 0.6/cm²) in all 35 subjects

Factor	B	SE	Odds Ratio	95%CI	P
Age (year)	0.1393	0.048	1.15	1.046 - 1.264	0.004

Notes: 1. R = 0 in smoking, alcohol drinking, milk drinking, and physical activity, while R = 0.128 (P> 0.05) in body mass index.
2. Logistic regression is applied in SPSSPC+.

Table 9

FREQUENCY OF OTHER POSSIBLE RISK FACTORS FOR FALLING, HIP FRACTURE OR LOW BONE MASS

Factors		All cases	All controls	All subjects Frequency	Percent
Food	all kinds	9	21	30	85.7
	except beef	1	4	5	14.3
Falls last year					
	no	5	19	24	68.8
	once or more	5	6	11	31.4
Fracture in the past					
	no	10	22	32	91.4
	once or more	0	3	3	8.6
Hypertension	no	5	21	26	74.3
	yes	5	4	9	25.7
Hypotension	no	10	21	31	88.6
	yes	0	4	4	11.4
Poor vision	no	9	20	29	82.9
	yes	1	5	6	17.1
Heart diseases	no	8	22	30	85.7
	yes	2	3	5	14.3
Knee arthritis	no	6	13	19	54.3
	yes	4	12	16	45.7
Digestive diseases					
	no	9	25	34	97.1
	yes	1	0	1	2.9
Diabetes	no	9	20	29	82.9
	yes	1	5	6	17.1
Falling during:					
Dizziness	no	7	16	23	65.7
	yes	3	9	12	34.3
Weakness	no	7	22	29	82.9
	yes	3	3	6	17.1
Not stable pace	no	8	23	31	88.6
	yes	2	2	4	11.4
Help for walk	no	10	24	34	97.1
	yes	0	1	1	2.9
Pain on legs	no	6	18	24	68.6
	yes	4	7	11	31.4
Unclear sight	no	9	22	31	88.6
	yes	1	3	4	11.4
nothing	yes	4	10	14	40
1 or more of above		6	15	21	60

Table 10 THE TYPES OF FALLING IN ALL 35 SUBJECTS

Type of falling	Case	Control	Total
While walking on the level	6(60%)	18(72%)	24(68.8%)
While walking on the slope	-	1(4%)	1(2.9%)
While standing up or sitting down	3(30%)	1(4%)	4(11.4%)
From a chair or a bed	1(10%)	-	1(2.9%)
While running on the level	-	-	-
While running on the slope	-	-	-
From one single step	-	5(20%)	5(14.3%)
	10(100%)	25(100%)	
Total			35 (100%)

Table 11 THE REASONS OF FALLING

Fell down	Cases	Controls	Percent
1.on a slippery surface	2	8	28.6
2.because of an obstacle or uneven road	3	8	31.4
3.because of dizziness, too weak or painful legs	3	6	25.8
4.1 and 3	-	-	
5.2 and 3	-	1	2.8
6.other	2	2	11.4
Total			100%

Table 12 DIAGNOSTIC TEST FOR SINGH INDEX

		DEXA		
		<or=0.60(g/cm²)	>0.60 (g/cm²)	
(<=grade 3) Singh Index	osteoporosis	6	1	7
(>grade 3)	non-osteoporosis	7	13	20
		13	14	27

Sensitivity = a/(a+c) = 46%
Specificity = d/(b+d) = 93%