Physical Activities, Nutrition Status, Food Intake and Mineral Density of Aerobic Calisthenics Participantsin Lubuk Pakam

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Abstract: *Prevalent data shows that osteoporosis is rising as a world emerging health problem. Its increasing prevalent will increase the direct cost of curing effort and losses of patient productivity. There are two controllable factors related to bone mineral density: life style and food. The uncontrollable are genetics, sex, and age. This research is to reveal the relation of physical activities. nutrition status and nutrition intake with BMD of aerobic calisthenics. This research was done on 2016 in observational base with cross sectional design. All fifty one subjects were chosen according to inclusion criteria. Collected data including name, age, education, occupations, the duration of aerobic exercise, physical activities, BMI, percentage of body fat, nutrition intake (protein, C and D vitamins)and BMD. Hypothesis was tested statically by Pearson correlation, Spearman ranks, and a double linier regression analysis. Result shows a significant relation between physical activities, percentage of body fat, protein and calcium sufficiency with bone mineral density. The most significant factors are physical activities and calcium sufficiency. The ongoing exercise intensity of once a week should be increased to three or four times. Calcium intake should be increased to prevent osteoporosis.*

Keywords: BMD, physical activities, BMI, nutrition intake

1. Indroduction

Osteoporosis affets millions of individuals across the word and its prevalence is increasing steadily proportional to the increase in the the aging population in both men and woen (1). Osteoporosis is a silent (asymptomatic) disease before the fracture is occurred (2). Data released by WHO shows that osteoporosis suffered by 25 million American and by 200 million people of other countries (3).Indonesian Health Department released its data resulting from its research during 2004 conducted in 14 provinces, says that osteoporosis is occurred among 19,7 percent of Indonesian. Five provinces severed by 22.8 percent (4). Recent research of International Osteoporosis Foundation (IOF) reveal that one of four Indonesian female of 50-80 years of age were risk to have osteoporosis, and the risk is four times greater than on males.

The national wealth betterment and the growing number of the old peopletend to increase the osteoporosis prevalent. This increasing will spend more direct cost of health cares, and increase the losses of patient productivity.

Bone behaves as a dynamic structure. A health bone performs a modeling-remodeling process continuously. This involves cells that balances the resorption of wear bones (*osteoclast*) and formation of new strong bones (*osteoblast*) at local condition, in a coordinate and sequence manner as a *coupling process* (2).

On 2013 a North Sumatera Province health institution (Riskesdas) reported that 5.1% of all accidents in the province were contributed by bone fractures. LabuhanBatu Utara has 14.5% prevalent, Karo 13.9%, LabuhanBatu 12.0%, and DeliSerdang 5.3% (5).

Low density of bone mineral caused by deficit of calcium, vitamin D, andphosphor. This density is related also to unbalance of estrogen on female, mal absorption of alcohol and carbonated beverages, heredity aspect, long use of corticosteroid, addiction of cigarettes, low density of *hypogonadism*on male, and less of physical activities (6).A normal bone metabolism maintained by protein, zinc, iron, magnesium, vitamins A, C and K. A study in East Jakarta reveal a significant relation between BMI with osteoporosis, that is, lean subjects were ten times tend to have osteoporosis compare to person with normal BMI (7).

Old people could maintain their activities as long as they manage their good health and bone structure (7). Regular exercises, preferably *weight-bearing sports* such as walks, jogging, calisthenics, and dances, increases muscle mass that increases bone's burden and subsequently increases bone density. Calisthenics is a good choice base on its easy, simple, effective, and its low cost that enable elder to prevent osteoporosis (8).

Protein (calogen) is responsible to build the cartilage structure and to transport minerals. Lesser protein, lesser cartilage and bone mineral density (9).Year 2014 "Survei Diet Total" reveal that adult (age 19-55 years) female average protein content was 107.2% nationally, and 111.4% in North Sumatera Province particularly (10).

Osteomalasia is a deficiency of calcium within the bone matrixes, that softening the bones. Unfortunately, over intake of calcium will give no advantage. *Food and Drug Administration* (FDA) suggests a sufficient calcium intake to maintain good health, but more than 2000 mg daily is fruitless (11).

Repeating and rhythmic movements of aerobic calisthenics employs most large muscles. The exerciser often uses audio and video music to support motivation. The intensity, i.e.

speed, of movements could be adjust by the music tempo as well. Generally, the aerobic calisthenicsis opened by a warming, and closed by a cooling step less than one hour.

In a Sunday morning of 2012 the government of Lubuk Pakam city performs an aerobic calisthenics in an open public court called Alun-alun. In 2014 it moved to other open public court called Lapangan Segitiga. Until now, they performed it weekly, join by 200s people according the attendance list. Ninety five percent were woman of 20-60 years age.

We have searched the relation between intakes of energy, protein,calcium, and bone mineral density of those calisthenics participants.

2. Method

This research was performed in Lubuk Pakamon January 2016. This research is an *observation* with *cross sectional research design*. Subject were choose base on inclusion criteria, adult female, between 41 and 59 years of age. Subjects have been joining the exercise continuously not less than three months. They must not use any drugs that changing bone density. They must free from alcohols and cigarettes. There are 51 woman from 200 participants who fulfill those criteria.

The independent variables are physical activities, BMI, percentage of body fat, intakes of protein, calcium, C and D vitamins. Dependent variable is bone mineral density.

The subject data are age, education, occupation, duration of aerobic exercise, which taken by interview using identity form. Physical activities data were collected by interview method using quiz once every 24 hours within two days intermittently. The total produced calories were calculated during subject's physical activities within two days intermittently base on table of *physical activity ratio* (PAR) to find the *physical activity level*. BMI data obtained by measuring of the body weight and length. BMI calculated by squaring the result of divided the kilogram of body weight by meter of body length. Percentage of body fat measured by *bioelectrical impedance analysis* (BIA). Nutrition intake includes protein, calcium, C and D vitamins with 24 hours food consumption recall within 2 days intermittently. The data were analyzed using *nutri survey* software to get the nutrition intake. The data were tested by Kolmogor of Smirnov tools. Pearson test is used to analyze the relation between physical activities, percentage of body fat, intake of vitamin C with bone mineral density. *Spearman rank* is used to analyze relation between BMI, intakes of protein, calcium, vitamin D with bone mineral density.

3. Result

3.1. Subject Characteristics

All subjects were female, between 41 and 50 years of age, 66.7% high school and graduated, 52.9% occupied as house maid, 70.6% have been exercising more than 1 year (Table 1).

Table 1: Characteristic data of aerobic calisthenics participants in LubukPakam

Variable		Frequency	
		n	*%*
Age	41-50 years	34	66.7
	51-59 years	17	33.3
	Sum.	51	100
Education	Low School	12	23.5
	Junior School	9	17.6
	High School	19	37.3
	University	11	21.6
	Sum.	51	100
Occupation	House host	27	52.9
	Particular businesses	6	11.8
	Trader	6	11.8
	Civil Servants	6	11.8
	Others	6	11.8
	Sum.	51	100
Duration of aerobic exercise	3Months to 1year	15	29.4
	More than 1 year	36	70.6
	Sum.	51	100

The densities of subject bone mineral were ranged between -2.70 to 0.90. Average of physical activities is 1.63 which is a low level, BMIis ranged between 21.17 to 39.95, and percentage of body fats were ranged between28.90 and48.20.(Table 2).

Table 2: Minimum, maximum, average, standard deviation, variable of bone mineral density, physical activities, BMI and percentage of body fat.

Variable	Minimum	Maximum	Average	Standard Deviation
Bone mineral density	-2.70	0.90	-1.01	0.94
Physical activities	1.37	2.01	1.63	0.14
BMI	21.17	39.95	28.12	3.74
Percent of body fat	28.90	48.20	36.50	5.05

Base on calculation of individual nutrition sufficiency, the subject's average of protein sufficiency and vitamin C sufficiency were higher than normal. Sufficiency of calcium were low, and sufficiency of vitamin D were normal. (Table 3)

Table 3: Averaged sufficiency of nutrition intake and bone mineral density.

Variable	Average (%)	Standard Deviation
Level of Protein Sufficiency	122.14	22.33
Level of Vit. C Sufficiency	123.21	38.07
Level of Vit. D Sufficiency	84.15	48.95
Calcium sufficiency	54.14	20.44

Osteopenia were found more than the normal, i.e. 58.8%.(Table 4).

Table 4: Frequency distribution of bone mineral density category.

Bone mineral density category	Frequency	
	n	%
Normal	21	41.2
Osteopenia	30	58.8
Total	51	100

3.2. Relation of Physical Activities, BMI, Percentage of Body Fat, Protein Sufficiency, Vitamins C, D, and Calcium with Bone Mineral Density.

Table 5: Relation of physical activities, nutrition status, and nutrition intake with bone mineral density

Variable	Bone mineral density	
	r	p
Physical activities (a)	0.427	0.002
BMI (b)	0.254	0.072
Percentage of body fat (a)	0.293	0.037
Protein sufficiency (b)	-0.302	0.031
Sufficiency level of vit. C (a)	0.248	0.080
Sufficiency level of vit. D (b)	0.152	0.289
Calcium sufficiency (b)	0.504	0.000

a. Pearson test
b. Spearman rank test

The result of correlation test shows a significant relation between physical activities ($p = 0.002$), percentage of body fat ($p = 0.037$), protein sufficiency ($p = 0.031$), and calcium sufficiency ($p = 0.000$) with bone mineral density. Physical activities and calcium sufficiency were correlated strongly. Negative correlation between protein sufficiency with BMD meaning higher protein sufficiency, lower mineral density. There is no significant relation between BMI, sufficiency level of vitamin C and sufficiency level of vitamin D with bone mineral density ($P > 0.05$).

Those variables were tested further using double linear regression analysis ($p < 0.25$). The result shows that the most influent variable to bone mineral density are physical activities and calcium sufficiency($P < 0.05$), which is very significant.(Table 6).

Table 6: Double linear regression, the result

Variable	Bone mineral density	
	B (Standardized Coefficient)	p
Physical activities	2,261	0.03
BMI	0.048	0.259
Percentage of body fat	-0.006	0.842
Protein sufficiency	-0.009	0.059
Sufficiency level of vit. C	0.005	0.085
Calcium sufficiency	0.019	0.000

4. Analysis

The result of study on 51 female aerobic calisthenics participants, of 41-59 years age, shows that 30 subjects (58.8%) were categorized likely to having osteopenia and none to osteoporosis. According to Wirakusumah, 2008, the optimal bone density achieved at the age of 25 years. This density will sustain until the age of 40 years, since than decreases slowly along with its mass decreasing. With other word, osteoporosis on the elders is caused by decreasing of bone mass (12).

This result of this research is higher than the previous research done in three provinces in Indonesia at year 2010, with osteopenia of 32,7% (13). Semarang research resulting 36,% female of 30-50 years of age were categorized to be osteopenia (14). Almost same with the result of Siahaan

research in Medan, 52,2% of participants were categorized to have osteopenia (15).

4.1. Relation of Physical Activities with Bone Mineral Density

Physical activities of research subject mostly categorized to be in light level. This is true in the consideration of occupation subjects that is half of the subjects were house hosts. Result of this research shows a positive relation between physical activities with bone mineral density on female of 41-59 years age. This is saying that increasing of physical activities could prevent the decreasing of bone mineral density. Wirakusumah state that lesser physical activities will inflate the risks of osteoporosis. Physical activities will build bones and strengthen muscles, and balancing the metabolism. Physical activities will maintain the bone mass along the lifetime (1). Bogor research on elders that were active on physical activities found eight times less to have osteoporosis compare to subjects with moderate physical activities (16).

4.2. Relation Nutrition Status with Bone Mineral Density
This result shows that BMI is not related with BMD, with average BMI of 28.12, average subjects were categorized to be obese. Prihantini research found that proportion of osteoporosis risk is higher on sample with BMI less than 18.5 (13).

Result of this research shows a significant positive relation among percentage of body fats. This says that a higher percentage of body fat will have a higher bone mineral density. Parallel with this research, female teens in Semarang found a positive relation between percentage of body fat with bone density (r=0.402) (17).

4.3. Relation Nutrition Intake with Bone Mineral Density
Result of this research shows a negative relation between protein sufficiency intake with BMD, which says that increases of protein sufficiency intake could decrease BMD. Meanwhile there is as positive relation between calcium sufficiency intake with BMD, says that higher calcium sufficiency could increase bone density. The high amount of average protein sufficiency intake (122.14%) and the low level of calcium sufficiency intake(54.14%)perhaps could explain the high proportion of subject's osteopenia. Parallel with this research, Bogor research on elders found that 37 subjects of having low calcium sufficiency will have nine times bigger probability to have osteoporosis compare to subjects with normal calcium sufficiency (OR=9,4) (16).Semarang research on female of 30-50 years age shows that calcium intake will build positive relations with bone density on average calcium sufficiency even from 50.6% (14).

Almatsier said that too much protein consumption will decrease bone mass via excretion of calcium and acid-alkali metabolism. Animal protein contains amino acid that contains sulfur which contributes to form acid condition in the body. Calcium emitted from bones to neutralize acid condition of body. Aging process decreases the efficiency of calcium absorption (18).Prentice & co research on 1991 reveal that not much osteoporosis to be found on Gambia

population with low daily calcium diet. This founding strengthen believes that a low calcium intake in some parts of world were not increase the osteoporosis prevalent. This phenomenon urging a relation between intakes of calcium and protein, that is, animal protein intake is able to increase the secretion of calciumvia urine (2).

This research could not proof a significant relation between sufficiency intake of vitamins C and D with BMD. This is parallel with Jakarta research on female which revealed that vitamin Chas an indirect relation with BMD, meanwhile vitamin C is not a single significant player to increases or to decrease BMD. This is also valid for vitamin D, because it could be supplied by non-food intake. The body itself produces vitamin D with help of sun radiation (19).According Almatsier, main role of vitamin D is to help the formation and maintaining the bones along with vitamins A and C, parathyroid and calcitonin, hormones, collagen protein, and minerals of calcium, phosphor, magnesium and flour. Particular role of vitamin D in this concern is to help the hardening of bones by providing sufficient calcium and phosphorin the blood to be deposited within the bones during the hardening process (18).

5. Result

Result of this research shows a significant relation between physical activities, percentage of body fat, protein sufficiency andcalcium sufficiency with bone mineral density. The most significant relation is physical activities and calcium sufficiency.

6. Suggestion

The intensity of aerobic calisthenics should be increased from once a week to three or four times a week. Calcium intake to be increased for preventing osteoporosis.

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