Relationship between Gender, BMI, and Lifestyle with Bone Mineral Density of Adolescent in Urban Areas

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Abstract—The purpose of this study was to analyze relationship between gender, BMI, and lifestyle with bone mineral density (BMD) of adolescent in urban areas . The place of this study in Jakarta State University, Indonesia. The number of samples involved as many as 200 people, consisting of 100 men and 100 women. BMD was measured using Quantitative Ultrasound Bone Densitometry. While the questionnaire used to collect data on age, gender, and lifestyle (calcium intake, smoking habits, alcohol consumption, tea, coffee, sports, and sun exposure). Mean age of men and women, respectively as much as 20.7 ± 2.18 years and 21 ± 1.61 years. Mean BMD values of men was 1.084 g/cm ^{2} ± 0.11 while women was 0.976 g/cm $^2 \pm 0.10$. Men and women with normal BMD respectively as much as 46.7% and 16.7%. Men and women affected by osteopenia respectively as much as 50% and 80%. Men and women affected by osteoporosis respectively as much as 3.3% and 3.3%. Mean BMI of men and women, respectively as much as 21.4 ± 2.07 kg/m^2 and 20.9 ± 2.06 kg/m^2. Mean lifestyle score of men and women , respectively as much as 71.9 ± 5.84 and 70.1 ± 5.67 (maximum score 100). Based on Spearman and Pearson Correlation test, there were relationship significantly between gender and lifestyle with BMD.

Keywords—Adolescents, Body Mass Index (BMI), Bone Mineral Density (BMD), gender, and lifestyle.

I. INTRODUCTION

BONE is living tissue and continue to grow. Bones and their structure, growth, and unique functions, not only gives strength and create a stable framework, bone continues to change due to mechanical stress and continued to demolition, repair and cell turnover [6]. That means the bone is very important for the body and must be protected against the disease. One of the bone disease is osteoporosis.

Osteoporosis is a condition characterized by mass (weight) and low bone damage to the tissue inside the bones. In osteoporosis, a decrease in bone quality and quantity of bone density, but both are largely determine the strength of bone that eventually lead to osteoporosis and easy bone fragility fractures. Cases of premature bone loss or osteoporosis in Indonesia was higher than the world average, because two out of five people of Indonesia have a risk of the disease, while the prevalence of the world is just one of three people at risk of suffering from this case. In Indonesia, the number of osteoporosis is much greater rate 19.7%. Records in several

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big cities such as Jakarta, Surabaya, Bandung, and Medan even reaches 30% (Departemen Kesehatan RI, 2006). Osteoporosis generally attacks the bones are hollow like a spine, neck, femur, spine, hip, forearm bones.

According to WHO, the number of osteoporotic fractures is increasing rapidly. Worldwide in 1990 occurred 1.7 million cases of hip fracture. This figure is expected to reach 6.3 million by 2050, along with increasing life expectancy. Fracture risk increases with age. Records in 2003 in America, vertebral fractures each year to reach 1.2 million cases. It says: every 20 seconds causing osteoporosis fractures.

Bone loss is a condition that does not cause any symptoms for decades, because osteoporosis does not cause symptoms until a fracture or fractures occur. Then the symptoms will not be far from the site of fracture. An example of fracture of the spine will cause symptoms such as pain radiating from the back strapped to the side of the body. Complaining of pain in the spine, burning sensation in the bones, it turns out this is one sign of osteoporosis. Plus if the bent posture and decreased height of about 1-2 cm, it should be wary of and should be prevented so that the condition from getting worse again.

Osteoporosis is identical to the elderly's disease, but now can also attack the young people. Bone formation started from someone still in the womb, so that during pregnancy, a mother must increase the consumption of milk for the calcium content in the body of the mother and the baby's body can be increased. When starting a teenager, diet that meets the minimum standards vatamin D and calcium, phosphorus, potassium, and sodium and regular exercise will make the growth of bone formation reached its maximum.

Adequate intake of calcium is very important to achieve optimal peak bone mass and reduce the rate of bone loss due to aging. While the main function of vitamin D is to maintain serum calcium and phosphorus concentrations within the normal range by increasing the efficiency of the small intestine to absorb these minerals from food. The main source of vitamin D is mainly derived from milk and other dairy products [9].

In addition, exercise is very important factor. Regular exercise is useful blood circulation, reduce sugar and fat, stabilize blood pressure, and improve quality of life and our soul. Unhealthy behavior increases risk of osteoporosis such as smoking, alcoholic beverages, soft drinks, caffeine and drugs. The nicotine content in cigarettes will absorb the body's calcium reserves. Smoking also inhibits the activity of the

formation of new cells from the bone while alcohol can reduce the absorption of calcium due to interference with the small intestine. And usually the people who smoke and drink alcohol often forget to eat because the full effect of alcohol.

The most rapid bone formation occurs at puberty, when bones become larger, the longer, getting thicker and more dense, which would peak in about 25-30 years of age. Approximately 50-80 percent of peak bone mass is influenced by genetic factors so that these teens will become higher and higher when derived from the offspring or parents who have a high and great posture.

Early adulthood is a period of adjustment to new life patterns and new social expectations, including the change in appearance, interests, attitudes and behavior because of certain environmental pressures will cause problems in the cultural adjustment that must be faced. As emphasized by Gould, "the right age when the change occurred is a product of personality and lifestyle of total sub-culture of an individual". Often a person will develop patterns of behavior attitudes and values tend to be characteristic for the rest of his life [3].

Examination of Bone Mineral Density (BMD) or bone mineral density in early adulthood to determine the amount of bone tissue in a certain volume can be measured in the amount of material per square centimeter of bone. In early adulthood found the incidence of bone loss in a milder degree. Statistics show an increasing incidence [6]. Early adulthood to ignore the pattern of consumption and healthy lifestyle it is influenced by the urban lifestyle of urban people who tend to want things that are practical and easy. In order to prevent or reduce the risk of old age osteoporisis on the need for inspection in early adulthood, it is necessary to do the research to analyze the bone density in early adulthood and the factors that influence it.

II. METHOD

The research was carried out in the Home Economics Department, Faculty of Engineering, Jakarta State University. This study uses survey with correlational approach. The number of samples in this study was 100 men and 100 women. Simple random sampling technique was used as a sampling technique.

Instrument of research or study gauges are devices used to measure the research variables. Data collection tool used in this study are as follows:

1. The questionnaire study

This instrument to collect data on lifestyle includes consumption patterns and healthy living. Any opinion given by the respondent will then be given a score according to Likert scale, has provided an answer of each question item and the respondent can choose the one answer that fits every answer 1 to 4 correspond to the answer.

TABLE I
SCORE OF LIFESTYLE

Scale	Positive Score	Negative Score
Always	4	1
Sometimes	3	2
Seldom	2	3
Never	1	4

2. Quantitative Ultrasound Bone Densitometry

The result of technological tools to measure bone density, with some benefits such as high mobility, easy operation, short examination time, radiation-free, inexpensive, provides information on bone structure, and trustworthy. Data results from the examination can be expressed by T-score is assessed by looking at differences in BMD of the measurement results with an average value of peak BMD. T-score criteria are divided into three, namely T-score> -1 standard deviation (SD), which indicates that someone is still in the normal category. T-score <-1 to -2.5 as osteoponia and <-2.5 are included in the category of osteoporosis. From the results of the study and measurement of conversion values obtained with the T-score of bone mineral density (g/cm^2).

To find the relationship between gender, BMI and lifestyle with BMD used the Spearman and Pearson Correlation test.

III. RESULTS AND DISCUSSION

A. Consumption Pattern

Based on data from the consumption of animal milk such as milk cows, goats and other, 50% of men are sometimes consume animal milk, 33.3% of women rarely consume animal milk and 13.3% of women never consume animal milk.

TABLE II
DISTRIBUTION OF ANIMAL MILK CONSUMPTION AMONG WOMEN AND MEN

No	Frequency	Women	Men
1	Always	20%	20%
2	Sometimes	33,3 %	50%
3	Seldom	33,3%	26,7%
4	Never	13,3%	3,3%

Based on data from the consumption of vegetable milk such as soy milk, 30% of women are sometimes consume milk plant, 53.3% of men rarely consume plant-based milk and 26% of women never consume dairy plant.

TABLE III
DISTRIBUTION OF MILK VEGETABLE CONSUMPTION AMONG WOMEN AND MEN

No	Frequency	Women	Men
1	Always	3,3%	0%
2	Sometimes	30%	26,7%
3	Seldom	40%	53,3
4	Never	26%	20%

The data showed that consumption of dairy products like cheese, ice cream and yogurt ice, 43.3% of women are

sometimes consume dairy products, 40% of men rarely consume dairy products and 6.7% of women never consume dairy products.

TABLE IV
DISTRIBUTION OF DAIRY CONSUMPTION AMONG WOMEN AND MEN

No	Frequency	Women	Men
1	Always	13,3%	20%
2	Sometimes	43,3%	36,7%
3	Seldom	36,7%	40%
4	Never	6,7%	3,3%

The data showed that consumption of fish such as salmon, tilapia, sardines, pindang soft, snapper, eel, 50% of women eat fish sometimes, 43.3% of men and women rarely eat fish, 6.7% of men have never women consume fish.

TABLE V
DISTRIBUTION OF FISH CONSUMPTION AMONG WOMEN AND MEN

No	Frequency	Women	Men
1	Always	16,7%	6,7%
2	Sometimes	50%	43,3%
3	Seldom	30%	43,3%
4	Never	3,3%	6,7%

Data consumption of green vegetables such as spinach, green beans, broccoli, kale, mustard greens and beans, 50% of women always eat green vegetables, 40% of men are sometimes consume green vegetables and 3.3% of women never eat green vegetables.

TABLE VI
DISTRIBUTION OF GREEN VEGETABLE CONSUMPTION AMONG WOMEN AND MEN

No	Frequency	Women	Men
1	Always	16,7%	6,7%
2	Sometimes	50%	43,3%
3	Seldom	30%	43,3%
4	Never	3,3%	6,7%

Data consumption of fruits such as oranges, papayas and bananas, 40% of women always eat fruit, 46.7%, males sometimes eat fruit and no (0%) women and men who never consume fruit.

TABLE VII
DISTRIBUTION OF FRUIT CONSUMPTION AMONG WOMEN AND MEN

No	Frequency	Women	Men
1	Always	40%	33.3%
2	Sometimes	33,3%	46,7%
3	Seldom	26,7%	20%
4	Never	0%	0%

Based on the consumption of whole grains such as rice, wheat, brown rice and corn, 83.3% of men always consume grain, while 73.3% of women always consume whole grains and no (0%) of men the men never consume whole grains.

TABLE VIII
DISTRIBUTION OF GRAIN CONSUMPTION BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	73,3%	83,3%
2	Sometimes	10%	6,7%
3	Seldom	10%	10%
4	Never	6,7%	0%

Based on the consumption of nuts such as almonds, peanuts, soybeans, tofu and tempeh, 46.7% of women are sometimes consume nuts, 36.7% of men rarely consume nuts, and 0% male men had never consumed nuts.

TABLE IX
DISTRIBUTION OF NUTS CONSUMPTION OF WOMEN AND MEN

No	Frequency	Women	Men
1	Always	20%	33,3%
2	Sometimes	46,7%	30%
3	Seldom	30%	36,7%
4	Never	3,3%	0%

The data showed that consumption of high protein such as meat, eggs and other animal protein, 63.3% of women always consume a high protein, 50% of men are sometimes consume a high protein and 0%, 0% of women and men never eat high protein.

TABLE X
DISTRIBUTION OF HIGH PROTEIN INTAKE BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	63,3%	40%
2	Sometimes	30%	50%
3	Seldom	6,7%	10%
4	Never	0%	0%

Fast food consumption data as berger, fried chicken and others, 73.3% of women rarely eat fast food, 60% of men rarely eat fast food and 6.7% of men do not ever eat fast food. Fast food is fast food high in fat and can affect bone health.

TABLE XI
DISTRIBUTION OF FAST FOOD CONSUMPTION AMONG WOMEN AND MEN

No	Frequency	Women	Men
1	Always	6,7%	10%
2	Sometimes	16,7%	23,3%
3	Seldom	73,3%	60%
4	Never	3.3%	6,7%

Food consumption data such as instant noodles, 43.3% of women and men sometimes eat instant meals, 40.3% of women rarely consume instant meals and 3.3% of women and men never eat instant food. Instant food is often consumed as fast and practical, the calcium content is very little and do not meet daily calcium needs.

TABLE XII
DISTRIBUTION OF INSTANT FOOD CONSUMPTION BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	13,3%	16,7%
2	Sometimes	43,3%	43,3%
3	Seldom	40%	36,7%
4	Never	3.3%	3,3%

B. Healthy Living

Based on data from the morning sunlight, the most of men (66.7%) and women (53.3%) are always exposed to sunlight in the morning.

TABLE XIII
DISTRIBUTION OF THE SUN EXPOSURE BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	53,3%	66,7%
2	Sometimes	26,7%	20%
3	Seldom	20%	13,3%
4	Never	0%	0%

Based on data from light exercise such as cycling, jogging, aerobics and other, 36.7% of men are always do light exercise and women only 3.3%. The most of women (56.7%) seldom do light exercise.

TABLE XIV
DISTRIBUTION OF THE LIGHT EXERCISE BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	3,3%	36,7%
2	Sometimes	20%	33,3%
3	Seldom	56,7%	16,7%
4	Never	20%	13,3%

Base on data from heavy exercise such as soccer, basketball, tennis, badminton, fitness, etc., 33.3% of men are always do heavy exercise, 20% of men are sometimes heavy exercise, 36% of men rarely exercise and weight 50% of women never heavy exercise.

TABLE XV
DISTRIBUTION OF THE HEAVY EXERCISE BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	3,3%	33,3%
2	Sometimes	13,3%	20%
3	Seldom	33,3	36,7%
4	Never	50%	10%

Data sleep or take a rest per day 8 hours, 46.7% of women always do sleep or take a rest, 53% men sometimes do sleep or take a rest and 3.3% of women and men never do sleep or take a rest 8 hours per day.

TABLE XVI
DISTRIBUTION OF SLEEP / REST BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	53,3%	66,7%
2	Sometimes	26,7%	20%
3	Seldom	20%	13,3%
4	Never	0%	0%

Based on data from smokers, 20%, men always smoked, 13.3% men and 93.3% less smoking women had never smoked, while 56,% of men had never smoked.

TABLE XVII
DISTRIBUTION OF SMOKERS BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	53,3%	66,7%
2	Sometimes	26,7%	20%
3	Seldom	20%	13,3%
4	Never	0%	0%

Based on data from alcohol, 0% of women and men drink alcohol, 33.3% of men are rarely consumed alcohol and 93.3% of women never consume alcohol while 60% of men had never consumed alcoholic beverages.

TABLE XVIII
DISTRIBUTION OF ALCOHOLIC BEVERAGES BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	53,3%	66,7%
2	Sometimes	26,7%	20%
3	Seldom	20%	13,3%
4	Never	0%	0%

Data soft drinks, 20% of men are sometimes consume soft drinks, 73.3% of men rarely consume soft drinks, while 56% of women rarely consume fizzy drinks and 26.7% of women never consume soft drinks.

TABLE XIX
DISTRIBUTION OF SOFT DRINK BEVERAGES BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	3,3%	3,3%
2	Sometimes	13,3%	20%
3	Seldom	56%	73,3%
4	Never	26,7%	3,3%

Data caffeinated beverages, 40% of men are sometimes consume caffeinated beverages, 40% of women rarely consume caffeinated beverages while 36% of men rarely consuming caffeinated beverages and 40% of women never consume caffeinated beverages.

TABLE XX
DISTRIBUTION OF CAFFEINATED BEVERAGES BETWEEN WOMEN AND MEN

No	Frequency	Women	Men
1	Always	6,7%	3,3%
2	Sometimes	13,3%	40%
3	Seldom	40%	36%
4	Never	40%	20%

Data calcium supplements, 26.7% men sometimes take a calcium supplement, 26.7% of men rarely take supplements of calcium and 66.7% of women never take calcium supplements, while 46.7% of men have never taking calcium supplements.

TABLE XXI
DISTRIBUTION OF CALCIUM SUPPLEMENTS BEVERAGES BETWEEN WOMEN
AND MEN

No	Frequency	Women	Men
1	Always	0%	0%
2	Sometimes	10%	26,7%
3	Seldom	23%	26,7%
4	Never	66,7%	46,7%

C. Score of Lifestyle

The average consumption patterns score of women was 70.5 with a minimum and maximum value were 61.7 and 77.5. While the average score of the men was 69.2 with a minimum and maximum value were 62.5 and 74. The average score of the healthy living of women was 69.7 with a minimum and makasimal value were 55.8 and 85. While the average score of the men was 74.5 with a minimum and maximum value were 62.5 and 82.5. The average lifestyle score of men and women, respectively as much as 71.9 ± 5.84 and 70.1 ± 5.67 (maximum score 100).

D. Osteoporosis

The normal bone density for men was 46.7% and for women was 16.7%, osteopenia to the 50% of men and 80% for women, while osteoperosis for men 3.3% and also 3.3% for women.

E. Bone Mineral Density

The average value of T-score conversions into bone mineral density for men was -0.8 ($\pm$ 1.084) g/cm² with minimum and maximum values were 0.868 and 1.360 g/cm². The average value of T-score conversions into bone mineral density for women was -1.7 ($\pm$ 0.976) g/cm² with minimum and maximum values were 0.808 and 1.312 g/cm². In general, men's and women's bone mineral density were not normal, because the average value of BMD was only $\pm$ 1.084 g/cm² and $\pm$ 0.976 g/cm², while the limit of normal bone density was $\geq$ 1.18 g/cm².

F. Correlation Test

Base on Pearson Correlation test showed that r = 0.32 and r_{table} = 0.254, it was mean there was a positive relationship significantly between lifestyle with bone density. The results of the coefficient of determination was 10.24%, it indicated that BMD was influenced with lifestyle only 10.24% and 89.76 with the other factors.

IV. CONCLUSION

The consumption patterns of women are better than men, while men better than women for the healthy living. But, BMD of women and men were not normal or low, so that the most of them were osteopenia. The conclusions of this research were adolescent, especially in urban area must increase their lifestyle like consumption of calcium and vitamin D. Physical activity is also essential to achieve optimal peak bone mass and reduce the rate of bone loss.

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