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The Influence of over Dieting on Bone Density in Japanese Female University Students

Fumihiro Omasu[1, *], Kana Murakami[2], Mami Fukuda[2], Tomomi Gotoh[2]

[1]Department of Health and Nutrition, Faculty of Health and Nutrition, Yamagata Prefectural Yonezawa University of Nutrition Sciences, Yamagata, Japan
[2]Department of School Health, Faculty of Education, Kumamoto University, Kumamoto, Japan

Email address

omasu@yone.ac.jp (F. Omasu)
[*]Corresponding author

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Abstract: In recent years, the increased proportion of those with a propensity to become slim in young women and the spreading of this propensity to become slim among even lower aged women have become big problems in contemporary Japanese society. Excessive dieting and incorrect dieting lead to increased risk of menstrual disorders including amenorrhea along with osteoporosis. The purpose of this study was particularly to clarify how dieting affects bone density in university students. The study was conducted among 111 female students. Calcaneal ultrasound bone densitometry as well as a questionnaire on awareness regarding the desire for thinness/dieting were conducted. As a result, the majority of the "underweight group" with a BMI of less than 18.5 and the "normal group" with a BMI of 18.5 to less than 25 were found to have a desire for thinness, with many of those who do not need to lose weight found to have desire for thinness. Moreover, elementary school students are dieting as early as possible, revealing the occurrence of the spreading of dieting among lower aged children. The results of bone density measurements demonstrated that low body weight was not significantly relevant to low bone density values. That said, regarding all those in the lower bone density group having a desire for thinness, there is a concern for future "osteoporosis" due to dieting.

Keywords: Desire for Thinness, Dieting, Bone Density, University Student

1. Introduction

Although various factors appear to be involved in the increasing tendency of girls to have a propensity to become slim, one factor is believed to be mass media including the Internet and SNS. In recent years, many mass media outlets have frequently put together feature stories on dieting, giving young people the wrong impression that those with thin figures such as celebrities and models are nice women and that losing weight is a good thing, thereby encouraging dieting. Consequently, the erroneous body image that thin women are more attractive and beautiful has developed among young people [1].

The issue of young women's thinness is a big problem of contemporary Japanese society and is an issue which will affect the next generation as well. Moreover, it is said that pubertal emaciation and unhealthy thinness have spread among those of lower age [2-3].

Entering university is the time when students start living alone apart from their families or when changes in their life patterns can be seen even living with their families, in addition to significant changes in their the food behavior/food environment. During this time, they are also greatly influenced by their interaction with society and are at the stage when the tendency to care about their visible image becomes stronger, possibly causing the propensity to become slim to strengthen [4].

Impossible restrictions on diet increase the risk of osteoporosis due to deficiency of calcium and vitamins [5]. Moreover, extreme weight loss and excessive stress reduce the release of growth hormone-releasing hormones, causing a decrease in both LH and FSH from the anterior pituitary lobe,

further resulting in a decrease in the release of estrogen and progesterone [6]. As a result, amenorrhea occurs, and furthermore, the prolonged persistence of this low estrogen state reduces the suppression of osteoclasts, causing the progression of bone resorption and resulting in reduced bone density combined with the effect of low nutrition. More specifically, the influence of incorrect dieting on bone density is enormous.

This time, we conducted a paper questionnaire survey regarding desire for thinness, dieting experience and the content thereof, etc. among female university students in addition to taking bone density measurements in order to examine how dieting affected their bodies, particularly bone density.

2. Methods

2.1. Subjects

The subjects included a total of 111 Japanese female students. The study was approved by the Ethics Committee of Epidemiological Studies at Yamagata Prefectural Yonezawa University of Nutrition Sciences. All data in the present study were collected in October 2016.

2.2. Measurements

The ultrasonic propagation velocity SOS (m/sec) (Speed of Sound) in calcaneal bone was measured using an ultrasound bone density measuring device (CM-200 from Canon). This SOS value is a parameter highly correlated with bone density or bone mass. Simultaneously, the YAM (Young Adult Mean) value was also calculated. YAM is a numerical value comparing the percentage of their current bone density, with the bone density of healthy women aged 20 to 44 as 100%. Height, weight, and BMI (bone mass index) were also measured. Their awareness regarding dieting was investigated by selective/descriptive questionnaire. The survey items included and consisted of their awareness regarding a desire for thinness, questions regarding awareness/experiences of dieting, and their current diet. The questionnaire was conducted anonymously, taking privacy into consideration.

2.3. Statistical Analysis

For the analysis, simple tabulation, chi-square test, and correlation coefficient were used. All the tests were conducted with a level of significance of 5%.

3. Results

The survey was conducted among a total of 111 Japanese female students. The average age was 21.2±1.7 years (range: 18–26 years). The average height was 1.58±0.05 m (range: 1.48–1.70 m) and the average weight was 51.1±6.7 kg (range: 30.3–68.3 kg). The average BMI was 20.5±2.3 kg/m^2 (range: 16.3–30.2 kg/m^2). The height, weight and BMI of subjects in this study were within the normal range based on the national average in Japanese adult females.

As the assessment of BMI, subjects were classified as follows: an underweight group with a BMI of less than 18.5; a normal group with a BMI of 18.5 to less than 25; and an obese group with a BMI of 25 to less than 40. Among the subjects, the results were as follows: an average value of 20.5; 20.7% for the underweight group; 76.6% for the normal group; and 2.7% for the obese group.

Table 1 shows the results of the survey regarding the relationship between BMI and desire for thinness. Over 90% of the normal group were revealed to have a desire for thinness. Moreover, in the underweight group, more than 40% of those who were thin still had a desire to become thinner. Based on this, it was revealed that many of those who do not need to become thinner have a desire for thinness.

Table 1. *Distributions by BMI group and desire for thinness group.*

	With a desire for thinness (n=93)	With no desire for thinness (n=18)
Obese group (n=3)	100%	0%
Normal group (n=85)	94.1%	5.9%
Underweight group (n=23)	43.5%	56.5%

$p<0.01$

The average SOS was 1544.2±30.2 m/sec (range: 1472–1646 m/sec). The average YAM was 103.5±16.5 (range: 67–160). As the assessment of bone density, subjects were classified in accordance with the YAM value as follows: a lower group with a bone density of less than 80; an intermediate group with a bone density of 80 to less than 100; and an upper group with a bone density of greater than 100. The subjects included 5.4% in the lower group, 34.2% in the intermediate group, and 60.4% in the upper group.

The results of a survey conducted regarding the difference in the proportion of each bone density group depending on whether or not they had a desire for thinness were as shown in Table 2. Although there was no lower bone density group in the group with no desire for thinness, there was a lower bone density group in the group with a desire for thinness.

Table 2. *Distributions by bone density group depending on whether or not there was a desire for thinness.*

	Upper group	Intermediate group	Lower group
With a desire for thinness (n=93)	60.6%	33.0%	6.4%
With no desire for thinness (n=18)	58.8%	41.2%	0%

N.S.

A survey conducted regarding the relationship between each group of BMI and bone density indicated that all of those in the obese group were in the upper bone density group (Table 3). Even in the normal group and the underweight group, the upper group and the intermediate group accounted for 90% or more; however, the lower bone density group was observed to be in the normal group and the underweight group.

Table 3. *Distributions by BMI group and bone density group.*

	Upper group	Intermediate group	Lower group
Obese group (n=3)	100%	0%	0%
Normal group (n=85)	60.0%	34.1%	5.9%
Underweight group (n=23)	56.5%	39.1%	4.4%

N.S.

Regarding the presence of dieting experience, while 68 students had dieting experience, 43 students had no dieting experience, resulting in approximately 60% having experienced dieting to date (Table 4). Regarding the relationship between the presence of dieting experience and BMI, more than 60% of those who had experienced dieting existed in the normal group which does not currently need to lose weight. Moreover, approximately 40% of those who had experienced dieting existed in the underweight group.

Table 4. *Distributions by BMI group and presence of dieting experience.*

	With dieting experience (n=68)	With no dieting experience (n=43)
Obese group (n=3)	100%	0%
Normal group (n=85)	67.0%	33.0%
Underweight group (n=23)	39.0%	61.0%

$p<0.01$

Moreover, a survey conducted regarding the correlation between BMI and bone density according to presence of dieting experience indicated that the correlation coefficient between BMI and bone density in those with dieting experience was -0.03 while the correlation coefficient in those with no dieting experience was 0.34 ($p<0.05$) (Table 5). In other words, the results showed that a low BMI was related to low bone density in those with no dieting experience.

Table 5. *Correlation coefficient of bone density values according to the presence of dieting experience.*

	Bone density value with dieting experience (n=68)	Bone density value with no dieting experience (n=43)
BMI	-0.03	0.34*

* $p<0.05$

Table 6 showed the survey results regarding the time when those with dieting experience started dieting for the first time. Those replying as high school students was most at 25 students (36.8%), followed by as university students for 21 students, as junior high school students for 15 students, and as elementary school students for 6 students. Elementary school students and junior high school students made up 21 of the 68 students, accounting for nearly 30% of the total and revealing the spreading of dieting among lower aged children.

Table 6. *The time when starting dieting for the first time.*

	Elementary school students	Junior high school students	High school students	University students	No response
Number of subjects	6	15	25	21	1

Regarding the physical changes due to dieting, a survey was conducted among subjects with dieting experience (Table 7). Many subjects experienced good aspects of dieting such as "my body became lighter" and "I got my waist back." In contrast, many subjects suffered from physical disorder/problems due to dieting, such as "constipation," "menstrual disorders," and "anorexia."

Table 7. *Physical changes due to dieting (multiple answers allowed).*

Physical changes due to dieting (multiple answers allowed)	Number of subjects
My body became lighter	27
I got my waist back	25
Constipation	13
Menstrual disorders	12
Anorexia	10
I got tired more easily	9
Rough skin	9
Getting up in the morning became painful	6
Anemia	2
Coldness of the body	1

4. Discussion

Factors influencing dieting behavior and body image include socio-cultural factors consisting of family, friends, and media supported by the tripartite theory by Van den Berg et al. [7] Lopez-Guimera et al. [8] mentioned, as a mechanism of influence on body image and dieting behavior by the media, "internalization of the thin ideal" in which the social criteria of "being thin is a good thing" was adopted as as their own criteria occurred due to media exposure, inducing dieting behavior because of dissatisfaction with their own body by social comparison. Junior high school students who do not have sufficient judgment of information are said to be vulnerable to the influence of the rapid development of the media [9]. Adolescent young people are more likely to fluctuate in terms of their own way of thinking and emotions towards their body shape for physical/mental reasons, with dieting behavior caused by a desire for thinness believed to increase especially in girls.

Moreover, along with the lack of knowledge regarding thinness, they are believed to go on a diet even though it is not necessary for them to lose weight. Also regarding the subjects at this time, even though students were classified as those with a BMI of less than 25 who do not need to lose weight, more than 90% of them have a desire for thinness and many are still on a diet even now. Self-esteem is said to be required for the establishment of identity and it has been revealed that a desire for thinness appears strongly due to low self-esteem [10]. Based thereon, it is believed necessary to provide health guidance so as to have a correct perception regarding the body shape of the growth period and build high self-esteem.

In this survey, some students replied that they began to desire thinness as an elementary school student. In a previous

study conducted among 5th and 6th grade elementary school students [1], the more they valued thinness, the higher their degree of obesity was. Particularly, the perception of body shape was related to desire for thinness in girls in the higher grades of elementary school. There is a concern that they are starting to diet without sufficient knowledge. Because of this fact, it is necessary to start nutrition education from elementary school.

Regarding changes in physical and mental conditions due to dieting, positive aspects were observed such as "the body became lighter," "I got my waist back," "I was pleased to be praised from those around me," and "I gained confidence in myself." However, negative aspects such as "constipation," "menstrual disorders," "I lost my appetite," "I got tired more easily," "rough skin," "anemia," "I came to feel stress," "I became afraid of eating," and "I lost my motivation" were also observed in 79.4% of those who felt physical and mental changes. Among these, "menstrual disorders" is one symptom which should not be overlooked because it leads to infertility and reduced bone density in the future. In this survey, 12 students (22.2%) experienced "menstrual disorders." According to a previous study [11], it was reported that weight loss of 5 kg or more or 10% or more will result in amenorrhea. Three students experienced amenorrhea among the subjects this time (data not shown), including one student who lost 12.8% of her weight in 6 months, another student who lost 8.6% of her weight in 1 month with a BMI of 14.6, and another student who lost 5 kg in 9 months. Regarding meals, some students reduced their meals to just one, eliminated carbohydrates, or had an unbalanced diet (data not shown). There were also some students who reduced their weight by excessive exercise even though they took in a balanced three meals to a certain extent, resulting in menstrual disorders. Based on the results of this survey, excessive dieting among women was found to be a major cause of menstrual disorders. If amenorrhea continues, the risk of osteoporosis is increased due to increased bone resorption which is normally suppressed by estrogen.

Regarding the underweight group with dieting experience, there is a concern that many people become underweight due to the effort they put into dieting. In previous studies [12], it has been reported that there is a correlation between BMI and bone density. A slight positive correlation was observed between BMI and bone density among those with no dieting experience. On the other hand, no correlation was observed between BMI and bone density among those with dieting experience, which is consistent with the results of other previous studies [13]. This is because, in the subjects of this study, the degree and period of dieting and the subsequent rebound circumstances varied, resulting in the belief that the degree of low body weight and the period thereof were not significantly relevant to reduced bone density. After women's menopause, bone density will inevitably decrease due to the decrease in estrogen secretion, so if the bone density is low from the young age of university students, osteoporosis episodes are of concern in the future.

5. Conclusion

The purpose of this study was to investigate the desire for thinness and presence of dieting among female university students in addition to focusing on how dieting affects their bodies, particularly bone density.

In this survey, all of those who were classified into the lower bone density group had a desire for thinness, making osteoporosis a future concern if excessive dieting is conducted going forward. Although a variety of dieting was experienced, as a result of dieting, the existence of those experiencing menstrual disorders including amenorrhea was also revealed.

Moreover, elementary school students are engaging in dieting as early as possible, revealing the occurrence of the spreading of dieting among lower aged children.

Because many people start dieting from elementary and junior high school, it was found that there is a need to provide health guidance in which correct knowledge regarding body shape/dieting can be acquired by elementary school students, provide nutrition education in collaboration with nutrition teachers, and build self-esteem.

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