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A Survey on the Influencing Factors of Body Mass Index Among Middle School Students

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Abstract: ***In this article, the study will identify the related factors that influence the BMI value in teenagers aged 16-17 years old who study in high school located in Chiang Mai, Thailand. The processes focus on collecting the BMI data from all 1,528 students and clarifying them into 5 categories, i.e., very thin, thin, slim, chubby, and fat, to analyze the factors, which are selected from reliable sources. The study revealed that 77% of participants are classified as slim and thin BMI categories. This means that general students have a healthy lifestyle. Furthermore, the BMI factors questionnaire demonstrates that the primary impact factors appear to be stress level and frequency of alcohol consumption.***

Keywords: Body Mass Index, BMI factors, Chiang Mai high school, Adolescents

1. Introduction

The Body Mass Index (BMI) is the standard measurement for testing body weight and body height to identify the health level of each person [1]. Furthermore, it also estimates various types of risk diseases. For instance, a high rate of BMI could cause obesity leading to high blood pressure and diabetes [2]-[3]. Conversely, participants who are clarified in the group below BMI standard are also the reason for malnutrition.

According to the World Health Organization (WHO), BMI values of people around the world are usually classified in the slim category [4]. Similar to Thailand, the Department of Health reports also show that the Thai population is generally classified in the normal, which is around 18.50-22.90. However, people with higher or lower BMI standards are excluded from this slim category leading to poor long-term performance such as the obstacles of physical movement.

In this article, the authors intend to study the factors influencing BMI value from respondents, who are students aged between 16-17 years old studying in a high school located in Chiang Mai, Thailand. The overall processes consist of the collection of BMI data from high school students and the factors that affect BMI values, such as the frequency of exercise and nutritious consumption. In addition, the processes also carry out the analysis of factors affecting BMI to categorize the groups of people with disease risk based on BMI values.

2. Method

2.1 The process of collecting data

To receive the information, the authors collect BMI data of 1,528 high school students aged between 16 and 17 years old from physical education teachers in Chiang Mai province to do a further study on the relative proportion of body weight and body height. To determine the standard level of BMI, the formula is derived from the value of body weight in kilograms divided by the height in square meters (kg/m^2), given by Equation (1). Consequently, the BMI value can be classified into various categories varying from very thin to fat.

$$BMI\ Value\ (\frac{kg}{m^2}) = \frac{weight\ (kg)}{height^2(m^2)} \quad (1)$$

2.2 Searching for the factors which affect the BMI value

The factors affecting the BMI value are searched from various databases on the internet and reliable papers with the keywords "body mass index factors in adolescence". It was found that there were 12,498 articles during the recent 10 years period, 2014-2023 related to this keyword [1], [5]-[7]. Following that, the researchers select the information that is suitable for this research based on both the article type and the publication title. The analysis revealed that there were merely 16 articles related to this research contributing to the required factors that affect the BMI value.

2.3 Design of the questionnaire for BMI factor evaluation

The following appropriate factors are used to construct a BMI factors questionnaire. After that this questionnaire will be distributed to 20 random high school students to do this survey. This questionnaire includes information in concern with sex, age, type of exercise, frequency of exercise, period of doing exercise, intensity of exercise, nutrition per week, alcohol consumption, stress level, and congenital disorder, which are shown in Table 1. All the mentioned factors are used to analyze the BMI results.

Table 1: Type of selected factors in the questionnaire

Factors	*Details*
Sex	Male, Female
Age	16, 17
Type of exercise	Walk, Run, Bicycling, Swim, Aerobic, Weightlifting, Sit up, Yoga, Push up, Cardio, etc.
	• Less than one time per week

Frequencies of exercise	• One time per week • Two times per week • Three times per week • Four times per week • More than four times per week
Nutrition consumption	• Protein • Carbohydrates • Mineral • Vitamin • Fat
Alcohol consumption frequency	• Every day • Every week • Every month • Every 2-3 month • Every 6 month • Once a year • Never drink alcohol • The frequency of drinking depends on festival
Stress level	• Severe stress • Moderate stress • Mind stress
Congenital disorder	Depending on each person answer

2.4 Comparing the BMI data with selected factors

After the data were collected and the factors were selected, BMI data from all 1,528 high school students were compared with the questionnaire answer in order to analyze the BMI value whether it is consistent with related factors or not.

3. Results

3.1 Data collecting process

Total of 1,528 high school students were subjected to this study. A total of 525, 522, and 481 high school students are studying in grades 10, 11 and 12, respectively. The Department of Health, Ministry of Public Health of Thailand defines BMI values into five categories as described in Table 2. According to the data collected from students, the numbers of surveyed students with respect to BMI categories for students in grade 10 to 12 are illustrated in Figures 1 to 3, respectively.

Table 2: Details of BMI values

BMI value	*Category details*
Less than 18.5	Very thin
18.5-22.90	Thin
23-24.90	Slim
25-29.90	Chubby
More than 30	Fat

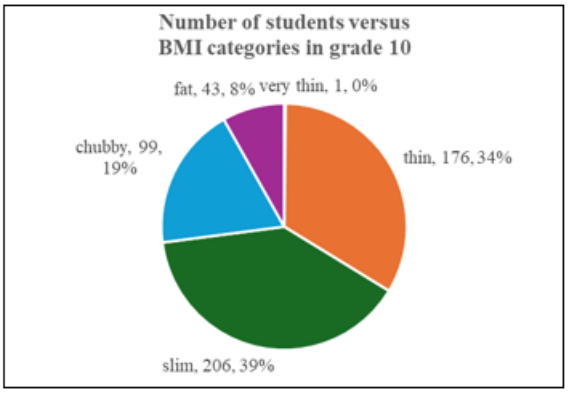

Figure 1: Numbers of students with respect to BMI categories in grade 10

According to Figure 1, the graph shows the numbers of 525 students in grade 10 with respect to BMI categories. The majority portion of students appear to be slim and thin, which both are around 70% (382 students) of all students. The least category is very thin, which is merely 0.19% (1 student). The other approximately 30% (142 students) are chubby and fat.

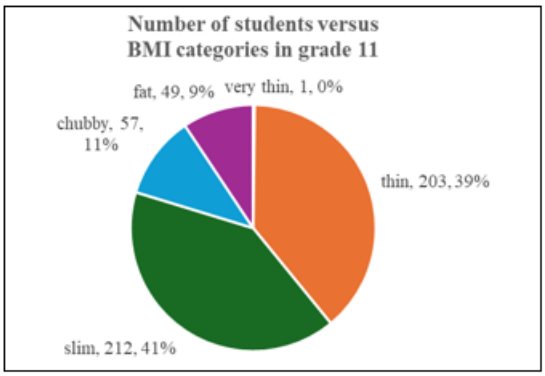

Figure 2: Numbers of students with respect to BMI categories in grade 11

From Figure 2, there were 522 participants who conducted this BMI test. Students who clarified in slim and thin categories are the most portions, which accounted for 212 and 203 participants, respectively. Chubby and fat come third and fourth with 57 and 49 students, respectively. Surprisingly, the smallest BMI group is very thin similarly to those in Figure 1.

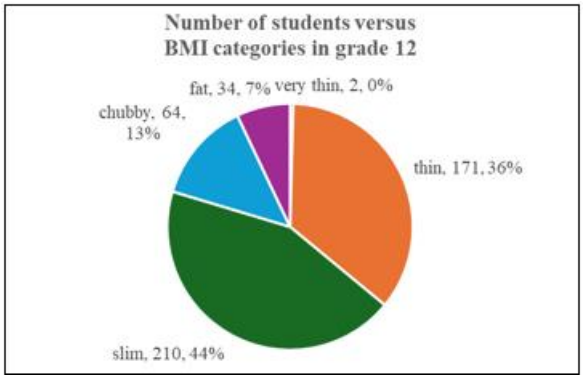

Figure 3: Numbers of students with respect to BMI categories in grade 12

Figure 3 shows that 481 participants performed BMI test. 210 participants are in the slim category, followed by 171 students in the thin category. Likewise, 64 and 34 students clarified in

chubby and fat, respectively. Category very thin consists of 2 students that is the smallest portion of all BMI categories.

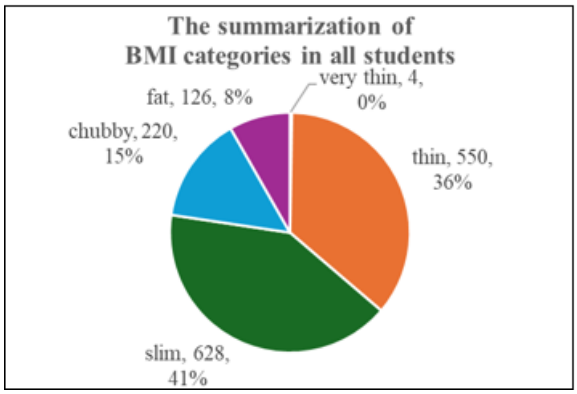

Figure 4: BMI categories summarization

The summarization of all high school students who carried out the BMI test is shown in Figure 4. It was found that both slim and thin categories have high numbers of students in this BMI test, with numbers of 628 and 550 students, respectively. Nearly one-fourth of portions are chubby and fat categories. The insignificant smallest group in this test is very thin category, which included only 4 students clarifying in this group.

3.2 Factors associated with BMI

To conclude, Gene-environment interaction study for BMI reveals interactions between genetic factors and physical activity, alcohol consumption and socio-economic status. Six primary factors, which are 1) Sex and age, 2) Types of exercise activity, 3) Frequencies of exercise, 4) Frequencies of nutrition consuming, 5) Chronic disease, and 6) Stress level of participants, have been discussed in the given study. The most significant of them were physical activity, alcohol consumption and socio-economic status. Among other noticeable factors, the impacts of genetic attributes, life-style choices and demographic factors, such as sex and age, are worth mentioned. In addition, psychological and behavioral patterns, cultural and ethnic backgrounds and environmental factors create social determinants for BMI results.

3.3 Statistical data obtained from a survey

To obtain information regarding lifestyle factors from participants, the authors utilized sections of the lifestyle assessment form provided by the American College of Lifestyle Medicine at Loma Linda University [12]-[14]. To streamline data collection and enhance participant accessibility, they developed an online form using Google Forms and generated QR codes for easier access.

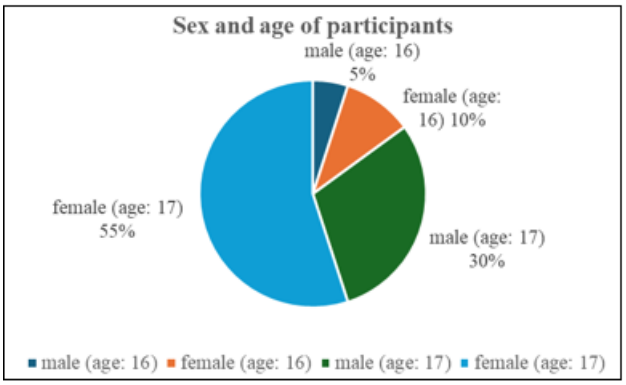

Figure 5: Sex and age of participants

Figure 5 shows the portion of participants by sex and age. It is notable that female accounts are more than half of the total participants. Interestingly, among seventeen-year-olds, females are a lot larger than males; however, among sixteen-year-olds, males are lower than females with merely 5% difference. This suggests that while females dominate overall, there are some variations in the distribution across different age groups, with some slight differences between males and females at the age of sixteen.

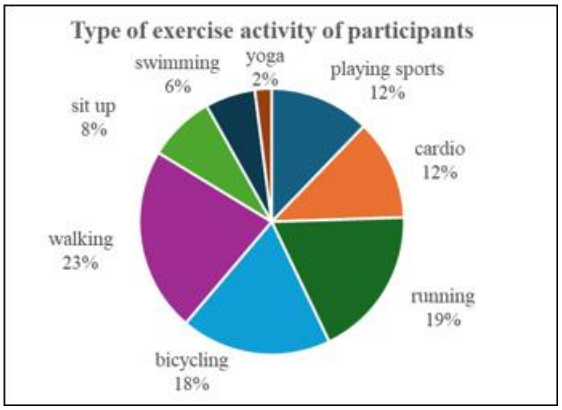

Figure 6: Types of exercise activity of participants

In Figure 6, the chart represents the varieties of exercise activities chosen by participants. In general, walking is the most favored activity, accounting for 22.4%, followed by running and bicycling, each at 18.4%, and playing sports and cardio, both at 12.2%. Furthermore, there is a preference for sit-ups over swimming and yoga, with a difference of 2% and 4%, respectively. This implies that most people prefer basic and common exercise that can be done daily [15]-[16].

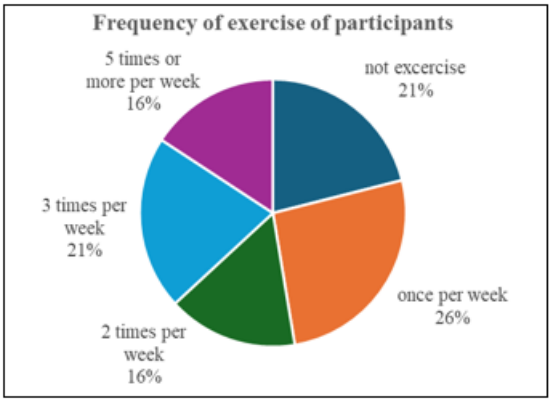

Figure 7: Frequencies of exercise of participants

Figure 7 illustrates how often people work out. More than one-fourth of participants exercise on a weekly basis, followed by those who exercise three times a week, representing 21.1%. Surprisingly, a high percentage of people do not exercise accounting for 21.1%. Additionally, 15.8% of participants exercise both daily and twice a week. In conclusion, not only is the number of people who exercise regularly high, but also those who do not exercise.

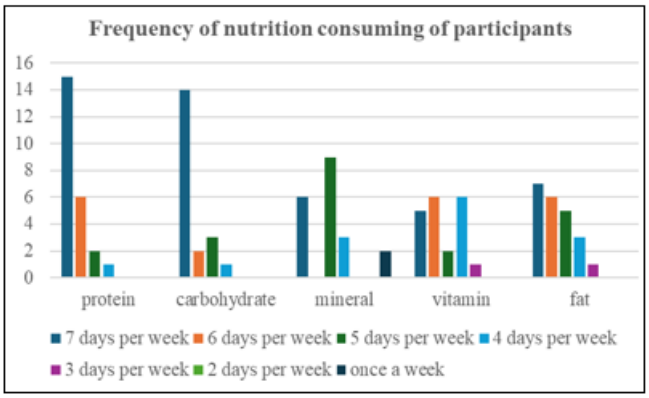

Figure 8: Frequencies of nutrition consuming of participant

Figure 8 illustrated the frequencies of five nutrients consumed by the participants. In overall, the data shows that the participants consume protein and carbohydrates daily, while minerals, vitamins, and fat are consumed less frequently. It can be inferred that the participants have a balanced diet, even though some of them do not consume all the nutrients in a single day.

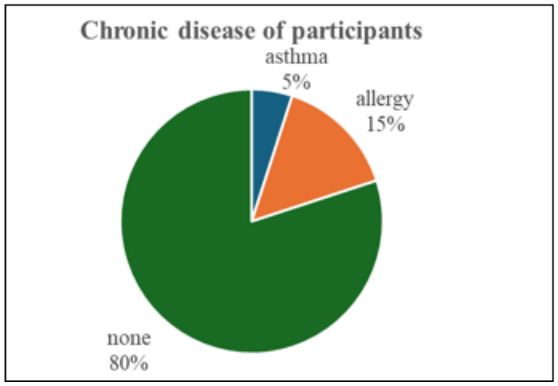

Figure 9: Chronic disease of participants

Figure 9 represented the medical condition among the participants. It is noticeable that 80% of the participants do not have any chronic disease. However, there is 10% difference between some people who have allergy and some who have asthma.

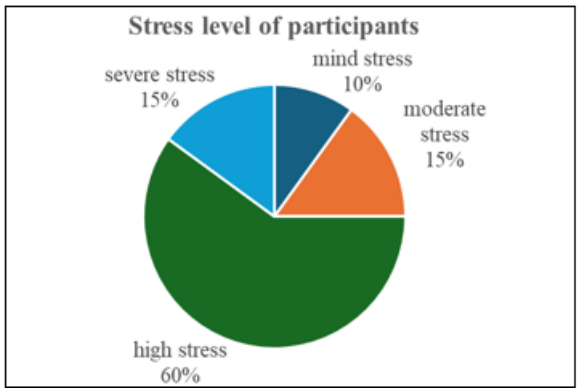

Figure 10: Stress level of participants

Figure 10 illustrates the stress levels among the participants. Surprisingly, more than half of the people have high level of stress, while some individuals are at moderate and severe levels, each at 15%. Moreover, only 10% of the participants experience mild stress. According to this data, there should be concern over the number of high and severe stress levels in the participants.

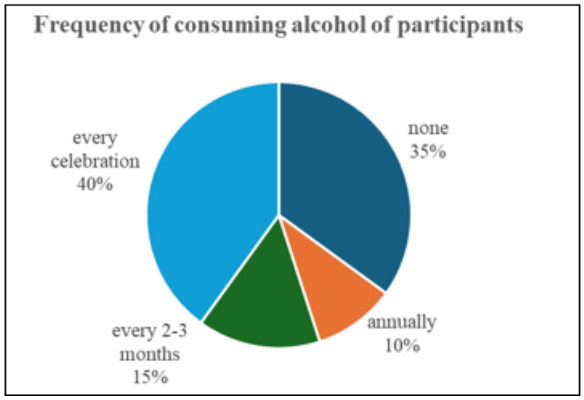

Figure 11: Frequencies of consuming alcohol of participants

Figure 11 reveals the frequencies of drinking alcohol in participants. Generally, approximately one-third of the participants do not drink alcohol while the others drink but in various frequencies. Among the drinkers, only 10% consume alcohol annually while 40% of participants have some drink every celebration, and 15% of participants drink every two or three months which are quite often.

4. Discussion

4.1 BMI value discussion

According to BMI value of 1,528 students, there were 525 high school students are studying in grade 10, 522 students are studying in grade 11, and 481 of them are studying in grade 12. The majority portion of BMI value of students in grade 10 appear to be slim and thin, with 206 and 176 students, respectively. This portion is almost similar to student who study in grade 11. The portion of students who are clarified in thin and slim are 80% of all grade 11 students accounting for 212 and 203 students, respectively. Likewise, the numbers of 210 students are in slim category and 171 students are in thin category. These figures show that most of high school students are able to maintain physically health. However, the rest of participants seems to be out of general trends in which just

only 4 students of all participants are clarified in very thin category. The others concerning categories are chubby and fat. It was found that 15% of all students are chubby, which is approximately twice as high as the students in fat category (8%). To suggest this, physical education teachers in high school should intently address effective methods to reduce the overweight students particularly by doing exercise in the morning.

4.2 Related factors discussion

The related factors in this study are searched from various database on internet and reliable researches, leading us to summarizations of factors which affected on BMI value of high school students. Starting with sex and age, the pie chart shows that there were females at the age of 17 playing a big part in this BMI factors questionnaire; however, the figures seem to have some slightly difference between males and females at the age of 16. Furthermore, type of exercise activities for each participants seem to be varied. Most students like to do a common exercise in daily life, according to almost equal portions of walking (22.4%), bicycling (18.4%) and running (18.4%). The rest portions prefer playing sport by using specific equipment, consist of swimming, yoga, and sit up. Looking into a frequency of doing exercise, working out portion are likely to be divided equally as well. To conclude this, some high school students doing exercise regularly; however, some students are not. This impact could contribute to some small percentage of overweight BMI result. Consequently, participants consume protein and carbohydrates daily, in the contrary to the frequencies of minerals, vitamins, and fat consumption. In overall, most participants have balance nutrition. Only some of them have not had a all types of nutrition in single day. Although 80% of participants in general are recorded without chronic disease, there are still some 20% who were born with a congenital disorder such as asthma and allergy. Surprisingly, the stress chart appears to be worrisome because significant percentage of people are labelled with severe and high stress level. According to high school students, the high stress level may come from the stressful studying and preparing to the national examination for entering university [17]. In suggestion, high school teachers should encourage students thoroughly and provide the effective recommendation for students in general. The last pie chart is frequency of alcohol consumption. The figure reveals that 65% of participants drink alcohol that may lead to poor health in a long-term.

5. Conclusions

The collected BMI data show that 77% of participants are clarified in the slim and thin categories related to the data in the questionnaire. Furthermore, participants in general do not have any chronic diseases. The primary influencer for the BMI value appears to be stress levels and frequency of alcohol consumption. According to a high stress level in high school students, the main reason comes from stressful preparing of the national examination to entrance into university. Additionally, the record showed that there are also significant portions of consuming alcohol, which lead to poor health affected on unhealthy BMI result. On the other hand, the study revealed that there were some factors that did not cause any impact to the BMI outcomes, consisting of type of exercise activities, the frequency of doing exercise, and the unregularly nutrient consumption. Nevertheless, the better BMI result depends on life style and individual activities in each day.

6. Acknowledgements

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