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The association between physical activity, sedentary behaviour and body mass index in students

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**ABSTRACT:** Physical activity and sedentary behaviour play an important role in preventing the progression of obesity in adolescence to adulthood. This study was conducted to determine the association between physical activity, sitting time (sedentary behaviour) and Body Mass Index (BMI) in students at the Faculty of Medicine, University of Sumatera Utara. One hundred and thirty students were respondents in this study, selected based on inclusion and exclusion criteria and completion of the International Physical Activity Questionnaire (IPAQ). BMI was determined using a digital weighing scales and microtoise. All data were analysed using SPSS. Based on one-way ANOVA test analysis revealed that there was a significant association ($p = 0.007$) of physical activity toward the mean of BMI but no relationship the sedentary behaviour with BMI ($p = 0.546$). The results suggest that BMI is related to physical activity but not to sedentary behaviour.

1 INTRODUCTION

Technological developments and advancements in this modern age have positive and negative impacts on (human) life. Many activities can be done easily and quickly if they are viewed from their positive impact; however, from their negative impact, they tend to make people reluctant to move. For example, the use of an escalator can make people reluctant to climb the stairs (Booth et al., 2012).

Physical activity constitutes every movement produced by the skeletal muscles which requires energy above the acceptable resting threshold. Physical activity in daily life can be categorised as involving sport, cycling, walking, recreational activities, housework, gardening and other activities (Booth et al., 2012).

Physical inactivity occurs when body movements are minimal and can also be referred to as sedentary behaviour (behaviour that is bound to one place). Included in sedentary behaviour is watching television, reading, working in front of a computer or talking to friends on the phone or learning. Physical inactivity is counted as sitting time. Lack of physical activity and the duration of time spent in sedentary behaviour can be a risk factor for obesity (Heinonen et al., 2013; Brodersen et al., 2007). According to research Jayamani et al. (2013) comparison of women with moderate physical activity who are overweight/obese as much as 3.87 times than women with high physical activity. Previous research has shown that sedentary behaviours such as watching television and videos, using computers and playing video games are linked to obesity (Stamatakis et al., 2008).
In 2014, 11% of men and 15% of women worldwide were obese. Thus, over half a billion adults worldwide are classified as obese. This data also showed that about 3.4 million people die each year as a result of being overweight or obese. According to the Centers for Disease Control and Prevention (CDC), in 2012 the incidence of obesity reached more than 72 million people and included 20.5% of the adolescent population (World Health Organization, 2014). Adolescence is a period that is susceptible to the development of obesity as it is characterised by slowing growth and a decline in the value of physical activity. There is a risk a teenager with obesity or being overweight would be an obese or overweight adult compared to a person of normal weight (Ogden et al., 2012).

Obesity can be determined by anthropometric measurements. Anthropometric measurements exist in many forms, with one of the most widely used in nutrition surveys being the measurement of body mass index (BMI). BMI is the ratio of body weight (in kilograms) to squares of height (in metres). BMI is associated with body fat (Alaska Division of Public Health, 2011).

One group that demonstrate low physical activity are medical students (Resende et al., 2010). The age range of students can be classified as adolescence. Based on the above description, this study aimed to determine the association between physical activity, sitting time (sedentary behaviour) and BMI among students in the Faculty of Medicine, University of Sumatera Utara.

2 MATERIALS AND METHODS

This study was conducted after getting permission from the ethical committee of the Faculty of Medicine of the University of Sumatera Utara. The subjects who agreed to participate in the study were asked to fill out and sign informed consent after being given an explanation about the purpose and benefits of the research. This research involved an analytical study with a cross sectional design which searched for the relationship between the independent variables (physical activity and sedentary behaviour) and the dependent variable (BMI). It was conducted at the Faculty of Medicine, University of Sumatera Utara from March until November, 2016.

Inclusion criteria for this research included being students of the Faculty of Medicine, University of Sumatera Utara, aged between 16 to 23 years old. Exclusion criteria for this research included being students who smoked and suffered from chronic disease. An unpaired categorical analytical formula was used to determine the assumption of the number of samples. Primary data were gathered directly from the research subjects (questionnaires and BMI). Body height and weight were measured using a digital scale with a maximum capacity of 150 kg, a microtoise with a maximum length of 200 cm and an accuracy of 0.1 cm. The BMI was calculated by dividing weight and square of height. The data for physical activity and sedentary behaviour were obtained from the International Physical Activity Questionnaire (IPAQ) which had been completed by the respondents (Hagstromer et al., 2005).

Respondents’ data were included and analysed using SPSS (Statistical Product and Service Solution). A one-way ANOVA was used to determine the mean value of BMI in groups categories physical activities and sedentary behaviour (sitting time).

3 RESULTS

There were 130 students who participated in this research. Table 1 shows the characteristics of the participants. The mean value for age was 20.21 ± 1.65. It was found that there were more female respondents (74 respondents or 56.9%), while there were 56 male respondents (43.1%). The mean value of body height, body weight, BMI, physical activity and sedentary behaviour were: 162.20 ± 9.10; 68.93 ± 18.90; 26.25 ± 5.83; 2.020 ± 1.665.3 and 6.6 ± 3.03, respectively.
The categories of physical activity of subjects is shown in Table 2. The respondents were divided into three physical activity categories: low activity, moderate activity and high activity. Based on MET-minute/week, the mean value of low physical activity was 423 MET-minute/week, the mean value of moderate physical activity was 1546 MET-minute/week and the mean value of high physical activity was 6.468 MET-minute/week. There were 45 respondents (34%) involved in low activity, 34 respondents (30%) involved in moderate activity and 48 respondents (36%) involved in high activity. It was found that the mean BMI for low activity was 27.69 kg/m², for moderate activity was 26.47 kg/m² and for high activity was 24.05 kg/m².

The result of the one-way ANOVA test showed that there was a significant difference \((p = 0.007)\) in physical activity with BMI. As Table 3 shows, after multiple comparative analysis using the post hoc Bonferroni test, it was found that there was a significant difference \((p = 0.006)\) in the mean BMI between respondents involved in low activity and respondents involved in high activity, but a significant difference was not found \((p = 0.99)\) in the respondents involved in low activity and in the respondents involved in high activity. There was also no significant difference \((p = 0.127)\) in the mean BMI between the respondents involved in moderate activity and the respondents involved in high activity.

It was also found that for the sitting time (sedentary behaviour) divided in three categories (shown in Table 4). The mean value of the sedentary behaviour in less than four hours was 2.7 hours/day, the sedentary behaviour four to eight hours was 5.5 hours/day, and sedentary behaviour more than eight hours was 10.3 hours/day. The mean value of BMI in sedentary

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<th>Table 1. Characteristics of study population.</th>
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<td>Variables</td>
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<td>Age (year)</td>
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<tr>
<td>Sex</td>
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<td>Male n (%)</td>
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<td>Female n (%)</td>
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<td>Anthropometry</td>
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<td>Body height (cm)</td>
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<td>Body weight (kg)</td>
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<td>BMI (kg/m²)</td>
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<td>Physical activity (MET-minute/week)</td>
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<td>Sedentary behaviour (hours/day)</td>
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<th>Table 2. Physical activity categories in relation to BMI.</th>
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<td>Low activity</td>
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<td>((N = 45))</td>
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<tr>
<td>MET (MET-minute/week)</td>
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<td>BMI±SD (kg/m²)</td>
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*One-way ANOVA test.

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<th>Table 3. Multiple comparison analysis of physical activity and BMI.</th>
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<td>Variable</td>
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<td>BMI</td>
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*Post hoc Bonferroni test.
behaviour less than four hours was 25.12 kg/m²; the mean value of BMI in sedentary behaviour four to eight hours was 25.50 kg/m²; and the mean value of BMI in sedentary behaviour more than eight hours was 26.18 kg/m².

4 DISCUSSION

In this research, the mean value of the respondents' BMI was 26.25 kg/m². This high mean value of BMI was caused by the large number of obese students who participated in this research. The rate of one of the respondents’ weight even reached 133 kg. Students tend to lack a healthy lifestyle, such as not sleeping until late at night and a lack of exercise. Students do not have time to exercise or undertake recommended physical activity. This was because their study schedule was from 8.00 a.m. to 5.00 p.m. The curriculum and examination pattern of the students at the Faculty of Medicine was tight so that they had less time to concentrate on extracurricular activities. They only had spare time in the evening (Wattanapisit et al., 2016). These are risk factors for obesity (World Health Organization, 2014).

In this research categories physical activity of the students: the mean value of low physical activity was 423 MET-minute/week, the mean value of moderate physical activity was 1546 MET-minute/week and the mean value of high physical activity was 6.468 MET-minute/week. The result of a one-way ANOVA test showed that there was a significant difference (p = 0.007) in the mean BMI of the respondents involved in low activity (27.68 ± 6.1), moderate activity (26.47 ± 5.5) and high activity (24.05 ± 5.3), respectively.

Research conducted by Labban (2014) revealed that there was a correlation between physical activity and weight, height and obesity status. This indicates that physical activity plays an important role in body metabolism through fatty acid oxidation, gluconeogenesis processes and burning calories to hamper fatty adiposity (Sugondo, 2014). A previous study in the Faculty of Medicine, University of Sumatera Utara shows the effect of nutrients cause obesity (Sari & Sari, 2017).

Based on the research conducted by Kaplan, it was found that a person with higher IMT group was inclined to have a risk of being affected by diabetes, hypertension and cardiovascular disease. A high mortality rate occurred in IMT ≥ 25 kg/m² and ≥ 30 kg/m² (Kaplan et al., 2014).

Adolescents with good physical activity will mostly not be affected by obesity, compared with inactive adolescents. An adolescent with obesity or who is overweight will be an obese adult, compared with an adolescent of normal weight (Rauner et al., 2013).

Physical inactivity occurs when body movements are minimal and can also be referred to as sedentary behaviour (behaviour that is bound to one place). Sedentary behaviour is assessed by measuring sitting time using the IPAQ (Resende et al., 2010). Most of the respondents tended to engage in sedentary behaviour from four to eight hours with the mean value being 6.6 hours/day. This may happen because most of the students of the Faculty of Medicine had to follow the curriculum of the Faculty of Medicine such as courses of lectures, practical work, laboratory skills and tutorials, which enabled them to sit down in the same position for a prolonged period of time.
The research conducted by Krishnakumar et al. (2013) found similar results to those of the present study. In that research, it was found that the average sitting time for students of the Faculty of Medicine in Bangalore, India, reached six to seven hours per day. Students of the Faculty of Medicine in Casablanca, Morocco, also had a similar average sitting time of six hours per day (Otmani, 2016).

The results of this research showed that there was no difference in the mean value of sedentary behaviour between BMI. Different results from Labban, (2014) suggest that longer sitting times will result in higher BMI values. The existence of a trend that refers to the decrease in physical activity due to work activities that cause more sitting and transportation activities.

5 CONCLUSION

There was a significant difference in the mean value of BMI between low, moderate and high physical activity levels in students at the Faculty of Medicine, University of Sumatera Utara, but no difference in the mean value of BMI between sedentary behaviour. These findings indicate that physical activity modulates obesity in students at the Faculty of Medicine, University of Sumatera Utara because most of the students had to follow the curriculum including courses of lectures, practical work, laboratory skills and tutorials which involved prolonged periods of sitting.

ACKNOWLEDGEMENTS

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