

## **Association of Physical Activity and Body Mass Index among University Students: A Cross-Sectional Study**

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**Abstract:** Obesity is fast approaching cigarette smoking as the major preventable cause of mortality. The relationship between activity levels and body mass index is unclear, despite large number of studies. The purpose of this study was to analyze the association between physical activity and body mass index among university students. We chose a cross-sectional study design. The sample comprised 372 university students, 140 males and 232 females. The mean age for total population was 20.7±1.3 years. Body mass index was calculated from the data retrieved from self-reported questionnaire. Subject's participation in physical activity was assessed using International Physical Activity Questionnaire Short-Form (IPAQ). Data were analyzed using the Statistical Package for the Social Sciences. Categorical variables were described by frequency analysis. The chi-square test of significance was used to assess the association between physical activity and body mass index. Comparisons were considered to be statistically significant at  $P \leq 0.05$ . Out of 372 subjects, 255 (68.5%) of total study population had BMI in the normal weight category, 68 (18.3%) of total population were underweight and 49 (13.2%) were overweight or obese. High level of physical activity among the study population was 62 (16.7%) while 148 (39.8%) and 162 (43.5%) of them had a moderate and low level of physical activity respectively. No significant correlation was found between BMI and PA ( $p=0.153$ ). There was a statistically significant association between gender and body mass index among university students ( $p=0.001$ ). The results obtained in this study reinforce the controversy of the relation between PA and BMI among university students. Our findings suggested that the higher physical activity level could be found even among overweight and obese categories. However, the results indicate that those belonging to the moderate and high PA group are more likely to belong to normal BMI category.

**Keywords:** obesity, young adults, physical activity, underweight

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### **INTRODUCTION**

Obesity is one of the most pressing health threats facing children and young adults today. Obesity has more than doubled in children and quadrupled in adolescents in the past 30 years [1]. The pandemic of obesity has been restricted to developed, high-income countries until few decades ago, but recently, it has penetrated even the poorest of nations in the world. Asia has undergone considerable socio-economic transition in the last three decades which has resulted in increased availability of food, better transport facilities, and better health care facilities. The changing trend was seen first in the urban populations and in the recent years, with improving socioeconomic scenario in the rural areas, the changes were seen even among the urbanizing rural populations [2]. Malaysians have been found to be the most obese people in Asia. A study from British Medical Journal, The Lancet showed that an alarming 49% of Malaysian women and 44% of men were obese. The study published in May 2014 showed Malaysia was rated most heavy at 45.3% of its

population being overweight or obese, followed by South Korea (33.2%), Pakistan (30.7%) and China (28.3%) [3]. The prevalence of overweight and obesity are escalating in both developing and developed countries [4].

Physical activity should be an integral part of weight loss therapy and weight maintenance because it contributes to weight loss, decreases abdominal fat and increases cardio-respiratory fitness. It is important to note that in Asian adults, the health complications associated with overweight and obesity start at a lower BMI than seen in the U.S. and Europe. Therefore; many of the estimates of obesity prevalence in Asia are likely to underestimate the true public health burden of obesity in Asia [5]. In Malaysia, 33.3 % of adults aged 18 and above are pre-obese and 27.2% are obese as reported in the National Health and Morbidity Survey, 2011. The same survey reported that 64.8 % of adults aged 18 years and above were physically active based on International Physical Activity Questionnaire

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(IPAQ) definition [6]. A good body of research on obesity among Malaysian university students documented high burden of overweight and obese [7, 8]. A study conducted in University Putra Malaysia reported that 14.9% of undergraduate university students were physically inactive [9]. As Malaysia strives to achieve developed nation status by 2020, Malaysians are experiencing many of the diseases predominantly encountered in fully developed countries.

Under-weight is a commonly overlooked health problem of the adolescents, often due to the implicit assumption that under-nutrition is a rare occurrence in adolescence and overweight is an invariable consequence due to their physical inactivity and poor dietary habits. Surprisingly; adolescent malnutrition is more widespread than is commonly recognized. Discrepancy between actual weight and body weight perception can lead to dangerous weight loss that is not necessary as compared with those individuals who can estimate their body weight accurately[10]. Conversely, if the individuals are not aware that they are actually overweight, they would not engage themselves in weight loss program. Body weight perception and BMI is closely related to weight control behaviors. University Tunku Abdul Rahman (UTAR) is one among the competitive private universities in Malaysia. It has been reported that competitive universities foster eating disorder, especially among female students [11]. Female university students typically desire to lose weight and are more likely than male students to diet or try other weight loss practices. Underweight status has been associated with higher rates of morbidity and mortality, although to a lesser extent than obesity. Canadian and US studies have demonstrated higher rates of hospitalizations and mortality in underweight adults, compared to those with weights within normal ranges [12]. Abnormal menses and sub fertility has been demonstrated in underweight females[13]. Amenorrhea may also occur, as a result of low leptin levels, decreased body fat, emotional stress or anxiety [14]. Studies on the assessment of nutritional status of adolescents in Malaysia are limited in number and have great implication for intervention.

Excess body fat gained during childhood and adolescence persists into adulthood and there is an increased risk of developing chronic diseases in later life such as cardiovascular diseases, type-II diabetes, and certain cancers [15]. The identification and prevention of obesity during adolescence is an important strategy to reduce present and future health risks. However, the differential effects of physical activity (PA) on obesity levels in adolescents have yielded contradictory results. Similarly, a lifestyle intervention with behavior modification and movement skills practice showed a profound effect on weight and

body mass index (BMI) [16]. Some studies have also suggested that the relationship between PA, sedentary behavior (SB) and obesity appears to be gender-specific, possibly due to differences in body composition profiles during the pubertal growth spurt and differences in lifestyle practices [17]. It is not clear whether obese university students are less physically active than their non-obese peers [18]. For many of these reasons, it is widely thought that a greater understanding of PA in youth is necessary. A better understanding of the lifestyle practices of Asian young adults is particularly important based on reports of increasing inactivity in this age category [19, 20]. Similarly, more definitive information regarding the relationships between PA and obesity could assist in the development of effective and innovative lifestyle intervention programs during the growing years. The purpose of this study was to analyze the association between physical activity and body mass index among university students.

## METHODS

This cross-sectional study was conducted at Sungai Long campus of University Tunku Abdul Rahman (UTAR) between October and December 2014. We used a self-administered, structured questionnaire on demographic characteristics and International Physical Activity Questionnaire (IPAQ). The statements in the questionnaire were assessed by the panel to ensure that they covered the objectives of the study. The questionnaire was administered to students enrolled in Faculty of Medicine & Health Sciences (FMHS) and Faculty of Accountancy & Management (FAM) of UTAR, Malaysia. Students who were willing to complete the questionnaire were selected by the “convenience sampling” method. Our research study has received ethical approval from UTAR Scientific and Ethical Review Committee. Participation was voluntary, and informed consent was obtained from each participant. All the study participants were assured full confidentiality of the data collected.

### *Instruments*

A self-administered questionnaire was designed for data collection. There were two sections in the survey form; which includes a section on socio-demographic characteristics and the International Physical Activity Questionnaire (IPAQ). Socio-demographic characteristics such as faculty, program of study, year of study, age, sex, weight and height of the participants were included. Body Mass Index (BMI) is defined as the weight in kilograms divided by the square of the height in meters ( $\text{kg}/\text{m}^2$ ).

### **International Physical Activity Questionnaire (IPAQ):**

Participation in physical activity was assessed using self-reported International Physical Activity

Questionnaire Short-Form (IPAQ) which is available at <http://www.ipaq.ki.se/scoring.pdf>. The objective of IPAQ is to provide a set of well-developed instruments that can be used internationally to obtain comparable estimates of physical activity. It has been developed and tested for use in adults which ranging from 15-69 years old and until further development and testing is undertaken the use of IPAQ with older and younger age groups is not recommended. This questionnaire is the most feasible instrument for measuring physical activity in large groups or populations. Previous studies showed satisfactory reliability and validity of IPAQ [21]. IPAQ accesses 7-day recall of domain-specific PA which include i) vigorous intensity activity ii) moderate intensity activity iii) walking for at least 10 min at one time. iv) hour spent sitting and/or lying down (excluding sleeping) per day. According to the IPAQ analytic guidelines, the obtained data were presented as estimated energy expenditure in MET-hours/week in each domain. The short form is preferred by many researchers because it has equivalent psychometric properties to the long form despite being one-third the length.

#### Statistical Analyses

Data were analyzed using the Statistical Package for the Social Sciences (IBM SPSS Statistics version 20). Participants with disability were excluded from the analysis. Categorical variables were described by frequency analysis. The chi-square test of significance was used to assess the association between PA and BMI. Comparisons were considered to be statistically significant at  $P \leq 0.05$ . As we anticipated a

study sample involving a narrow range of ages, we did not sub-analyze our data with respect to age. From self-reported height and weight of participants, body mass index (BMI) of was calculated. The BMI category was initially divided into four categories: underweight normal weight children, overweight and obese. Overweight and obese were arranged in a single category and considered as unhealthy excess body weight.

#### RESULTS

Out of 372 participants, 140 (37.6%) participants were male and 232 (62.4%) were female. 162 (43.5%) students were from FMHS and 210 (56.5%) from FAM. The response rate was 93%. The mean age for total population was  $20.7 \pm 1.3$  years. The descriptive statistics of study participants are presented in Table No: 1. According to WHO International Classification of Body Weight, 255 (68.5%) of total study population had BMI in the normal weight category, 68 (18.3%) of total population were underweight and 49 (13.2%) were overweight or obese. Out of 255 of total normal weight participants, majority were males (70.7%) while 67.2% were females. Out of 68 of total underweight participants, 23.3% of females were underweight compared to only 10% of males. The prevalence of overweight and obese was higher among males than females. Out of 49 overweight and obese participants, 19.3% were males while only 9.5% were females. There was a significance association between gender and body mass index among university students ( $p=0.001$ ).

**Table No: 1 Distribution of socio-demographic characteristics.**

| Characteristics | Categories                           | No. of students(n=372) | Percentage (%) |
|-----------------|--------------------------------------|------------------------|----------------|
| Faculty         | Faculty of Medicine & Health Science | 162                    | 43.5           |
|                 | Faculty of Accountancy & Management  | 210                    | 56.5           |
| Gender          | Males                                | 140                    | 37.6           |
|                 | Females                              | 232                    | 62.4           |
| Age group       | 18-20                                | 178                    | 47.8           |
|                 | 21-23                                | 172                    | 46.2           |
|                 | 24-26                                | 22                     | 5.9            |

**Table No: 2 Percentages of students by gender based on Body Mass Index (BMI).**

| Classification       | BMI(kg/m <sup>2</sup> ) | Male |      | Female |      | Total |      |
|----------------------|-------------------------|------|------|--------|------|-------|------|
|                      |                         | n    | (%)  | n      | (%)  | n     | (%)  |
| Underweight          | < 18.5                  | 14   | 10.0 | 54     | 23.3 | 68    | 18.3 |
| Normal weight        | 18.5-24.9               | 99   | 70.7 | 156    | 67.2 | 255   | 68.5 |
| Overweight/<br>obese | 25.0-29.9               | 27   | 19.3 | 22     | 9.5  | 49    | 13.2 |

**Table 3: Physical activity level among university students.**

| Characteristics   | Category | No. of students(n=372) | Percentage (%) |
|-------------------|----------|------------------------|----------------|
| Physical Activity | Low      | 162                    | 43.5           |
|                   | Moderate | 148                    | 39.8           |
|                   | High     | 62                     | 16.7           |

**Table 4: Association between Physical Activity level and Body Mass Index among university students.**

| BMI      | Underweight |      | Normal weight |      | Overweight/<br>Obese |      | Total |     |
|----------|-------------|------|---------------|------|----------------------|------|-------|-----|
|          | n           | %    | n             | %    | n                    | %    | n     | %   |
| High     | 7           | 11.3 | 43            | 69.3 | 12                   | 19.4 | 62    | 100 |
| Moderate | 24          | 16.2 | 104           | 70.3 | 20                   | 13.5 | 148   | 100 |
| Low      | 37          | 22.8 | 108           | 66.7 | 17                   | 10.5 | 162   | 100 |

Subjects were categorized into subgroups; high, moderate and low according to their physical activity status. The prevalence of engaging in high level of physical activity among the study population were 62 (16.7%) while 148 (39.8%) and 162 (43.5%) of them had a moderate and low level of physical activity respectively. As shown in Table 3, a total of 210 participants had high and moderate physical activity level while 162 participants had low physical activity level. This means that majority of the students participated in physical activity. Out of 210 participants who had high and moderate physical activity level, 69.3% of normal weight participants and 11.3% were underweight participants. 19.4% were overweight and obese who engaged in high physical activity level. Correspondingly, 16.2% of underweight participants, 70.3% of normal weight participants and 13.5% of overweight and obese participants are categorized in moderate physical activity level.

Out of 162 participants who had low physical activity level, 22.8% of participants belonged to underweight group, 66.7% of participants belonged to normal weight groups followed by 10.5% of participants belonged to overweight and obese group (Table: 4). It was evident from the results that the prevalence of underweight was higher among participants with low physical activity level compared to participants who had high and moderate physical activity. However, the prevalence of normal weight and overweight and obese was higher among participants who had high and moderate physical activity level. There is no significant correlation between physical activity level and body mass index among university students ( $p=0.153$ ).

## DISCUSSION

This study examined the association of different PA intensity levels with weight status among university students. This is worthy to notice that our results indicate that the PA influenced the change in BMI. Despite that, no statistically significant correlation was found for levels of PA and weight status.

The results of this study show that the prevalence of overweight and obesity among university was 13.2%. The results concur with the studies conducted by Huda et al [22] and Gan et al [23] among

university students in Malaysia which showed that around 13.0% of the students were obese or overweight. Upon comparison, the results of this study were found to be in line with the national data, which showed that the prevalence of obesity ( $BMI \geq 30 \text{ kg/m}^2$ ) and overweight ( $BMI$  between 25 to 29.9  $\text{kg/m}^2$ ) was lower among the younger age group compared to the older group. In terms of gender difference, males (19.3%) were more overweight and obese than females (13.2%) in this study. This is in accord with the findings of Ghrayeb et al in which 23.4% of males and 13.7% of females were overweight and obese [24].

Data from a number of studies provide strong evidence that higher levels of BMI during childhood and adolescence can predict overweight later in life. This was recently summarized in a review [25]. Must et al presented data relating to the outcomes of overweight adolescents who were followed up to 50 years [26]. Both men and women who were overweight at adolescence had increased age-specific morbidity and mortality relating to cardiovascular and other chronic diseases. Increased risk was also present even if adolescents who were obese had lost the excess weight during the adult period, suggesting that obesity during adolescence may set triggers that are associated with adverse risk in the adult. Therefore, the increasing prevalence of obesity will have significant public health implication related to non-communicable diseases. Overweight adolescents should be encouraged to adopt appropriate weight control behaviours for their health needs.

Additionally, it was shown that the prevalence of underweight was 18.3%. This is comparable to the findings of other studies. Most of the participants in this study were Chinese students. A study conducted by Sakamaki et al stated that the prevalence of underweight among Chinese students was 16.6%; which is consistent with our results [27]. Another study conducted in Japan showed that majority of students having a desire to be thinner although the prevalence of overweight was very low in this study population. Proportion of underweight female was higher than male which is 23.3% and 10% respectively. A similar study conducted in another university in Malaysia vouch our findings which reported that 16.5% of students (22.0% females and 11.0% males) were categorized in



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underweight category [28]. According to our findings underweight or thinness as a form of malnutrition is more prevalent than obesity. This might be due the body perceptions and weight control behavior among female students. Female subjects were found to have higher dissatisfaction and desired to become thinner (48%) than male subjects (34%). A previous study by Khor et al showed that females who have a sense of dissatisfaction with body shape were higher than males and they want a slim figure [29]. The socio-cultural pressure is greater among women than men to achieve an ideal body shape [30]. Furthermore, another study by Harring et al also stated that female university students were more concerned with their weight and tried to lose weight [31]. Further researches should be conducted to identify socio-cultural factors that can influence the perception of body weight among university students. Female students have more desire to be thinner than male. According to Ministry of Health, Malaysia (2010), a low body weight was an unhealthy condition as it can increase the risk of clinical conditions such as anemia and lead to distortion of body image among young adults. The prevalence of normal weight was 68.5% which is similar to a study conducted in Malaysia by Khan et al at Universiti Teknologi MARA (UiTM), Puncak Alam Campus [32]. The trend in underweight statistics is especially alarming in adolescents since the high prevalence of chronic energy and micronutrient deficiencies of today's adolescent girls is directly linked to the quality of the next generation.

Our study reports that participation in PA among the university students was low. Only 16.6% of subjects participated in high level of PA whereas majority of them were categorized under low (43.5%) and moderate (39.8%) physical activity levels. Our results agree with previous investigations showing that PA level among Malaysians is generally low. The current results were consistent with the findings from National Health and Morbidity Survey 2011, in which 35.7% of adults aged above 16 were found physically inactive. The same instrument, IPAQ-Short Form was used in both studies. A rapid urbanization increased use of motorized transportation such as car, motorcycle and trains and this phenomenon causes decreased in walking among majority of young adults [33]. A breadth of research exists that has shown the participation in PA is declining dramatically among adolescents in Malaysia. The findings of our study underscore the necessity of focusing interventions on university students to promote physical activity. Therefore, encouraging vigorous or moderate PA along with the promotion of a healthy diet, are necessary steps aimed at preventing and controlling overweight/obesity among university students, thus decreasing the risk of chronic diseases in those population groups.

Personal, social, and environmental factors all play a role in determining PA levels among youth.

Physical activity researchers have identified some of the principal factors found to be positively associated with PA among youth which include parental education, male gender, participation in physical education classes and school sports, belief in ability to be active (self-efficacy), personal goals, enjoyment of physical activity, support of friends and family, and supportive environments [34]. A good body of research has investigated the association between physical activity and obesity [35]. A positive finding revealed from our study was that most of the participants who had normal BMI participated in physical activity. This finding underscores the importance of PA in maintaining a healthy body weight. Another study reported the characteristics among individuals who were successful in weight loss maintenance included engagement in regular physical activity [36]. In contrast, our results do not support the hypothesis that BMI is independently associated with PA in this sample of university students. The analysis indicated that the physical activity level was not significantly related to the variables of body mass index ( $p > 0.05$ ). Our findings show that both participants who had normal BMI and those with overweight and obese BMI had higher participation in physical activity. There was no difference in the likelihood of being categorized as normal BMI despite their participation in highly active and moderately active PA. The discrepancy in results is still a matter of debate. The putative reason for this discrepancy is that participants who are overweight and obese were more concerned about their health problem and therefore they had tried to stay physically active. However, several studies have shown contrasting results, in which the level of physical activity has no linear correlation with the variables of body mass index. It is possible that this unexpected finding is the result of obese students being more likely than non-obese students to perceive moderate-intensity PA such as brisk walking (perhaps done for weight control purposes) as vigorous-intensity PA. The Health Survey for England report had a special focus on physical activity showing self-reported activity levels by BMI category. They reported that 41% of overweight men and 32% obese men met the recommendations of physical activity [37].

Physical activity among the obese might have helped them to reduce central obesity. Researchers in Germany report that even among people who are normal weight, having excess fat around the abdomen can increase the risk of premature death. Current obesity guidelines rely on the body mass index (BMI), a ratio of height and weight. The problem, as many experts have noted, is that the weight component does not distinguish between fat and muscle mass nor does it account for how fat distributed. Recent research suggests that the fat that accumulates around the midsection and deep in the body around the organs is more likely to contribute to conditions such as heart

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disease and diabetes, since it is more metabolically active[38].

Our findings brought to light the concept of 'obesity paradox'. Many scientists now believe that fitness, not fatness, is what we should focus on. Being metabolically fit may be the game changer; and physical fitness; irrespective of weight is a strong predictor of whether or not the subject is going to be metabolically fit. In a new study by U.S. and European researchers in the European Heart Journal, overweight and obese people were found to be at no greater risk of developing or dying from heart disease or cancer, compared with normal weight people, as long as they were metabolically fit despite their excess weight[39]. BMI harbors intermixed positive and negative confounding effects on mortality of waist and hip circumference. Failing to control for the confounding effect of hip circumference may stymie unbiased hazard estimation and render conclusions paradoxical. A Canadian study of 60,000 people, published last year, showed that eight per cent of people with a healthy weight were actually very unhealthy because they were unfit [40]. Our findings indicate that majority of the participants who had low physical activity level, belonged to normal weight group. Therefore; the low intensity and short duration of the physical activity has also played a role in low BMI values. Strong scientific evidence shows that physical activity can help you maintain your weight over time. However, the exact amount of physical activity needed to do this is not clear since it varies greatly from person to person. The guidelines for physical activity for adults emphasize that there is not a minimal amount of physical activity for which all health benefits will accrue. Doing some physical activity is better than none.

The present study showed that the prevalence of underweight was higher among participants with low PA level compared to participants who had high and moderate PA. However, there was no association between level of PA and underweight. Similar study documented that lower levels of physical activity are associated with underweight[41]. One widely acceptable idea was due to body size and body mass influence the capability to perform physical activity. Low muscle mass markedly affects the ability to perform physical exercise. Association between PA and underweight was rarely a subject of any studies. Amongst sparse studies dealing with this problem, Elinder et al [42] and Kumar et al [43] observed that underweight co-exists with lower levels of PA in boys, which is consistent with the results of this study. Another study reported that there was no significant association between sedentary practices and body fat levels in both genders [44]. The precise mechanism for this discrepancy is unclear however could be attributed to differences in duration and intensity of PA.

The reported findings can serve as current reference on body mass index distribution and physical activity levels of Malaysian university students and a basis for future efforts in health and nutrition interventions for Malaysian youth. Novel approaches in the prevention and treatment of underweight and obesity are urgently required. In addition, recent data suggest that varying biological responses may differently contribute to malnutrition and its comorbidities. Although differences in gene-nutrient interactions may contribute, the role of varying cultural and socioeconomic variables still needs to be determined to understand these disparities.

#### **LIMITATIONS AND RECOMMENDATIONS**

This research study is cross-sectional in nature, and therefore the results are limited in predicting a causal relationship. Since the research involved only young adults, the findings cannot be used to draw conclusions for men or women of other ages. Moreover, the use of an objective method of physical activity assessment should be further explored in research involving different age and ethnic groups in Malaysia. The effects of physical activity on body composition, blood pressure and other health outcomes among different ethnic groups could also be further explored. A detailed future study exploring the reasons for gender differences in the body weight would equip health professionals in helping people to make strategic decisions in maintaining an ideal body weight.

#### **CONCLUSION**

Sedentary lifestyle with less physical activities as well as changing dietary habits occurs not only in affluent countries, but also in developing countries and in countries in economic transition. Lifestyle and disease patterns in Malaysia also have changed following rapid economic development. Motivational factors such as body weight perception should be included in the intervention programs to prevent and overcome obesity. The results showed that both the problems of under- and over-nutrition co-exist among the university students of Malaysia. The promotion of healthy eating and physical activities is required to address the problems of under- and over-nutrition in order to build up a strong and healthy nation in the future. The results obtained in this study reinforce the controversy of the relation between PA and BMI among university students. However, the results suggested that those belonging to the moderate and high PA group are more likely to belong to normal BMI category.

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