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Associations between body mass index and physical activity level with mindful eating behaviour among undergraduate medical students of Universiti Sains Malaysia

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ABSTRACT

Introduction: Mindful eating is being fully present in the moment of eating and it is critical in preventing poor eating habits. The main objective for this study was to determine the associations of body mass index (BMI) and physical activity level with mindful eating behaviour among undergraduate medical students of Universiti Sains Malaysia (USM), Health Campus, Kubang Kerian, Kelantan. **Methods:** A cross-sectional study was conducted among 158 students (Years 1-5; 69% females and 31% males) by using a self-administered online questionnaire consisting of socio-demographic data, anthropometric data, short version of the International Physical Activity Questionnaire (IPAQ), and Mindful Eating Questionnaire (MEQ). The associations between BMI and physical activity with MEQ were determined by Spearman's Correlation and One-Way ANOVA or Kruskal-Wallis Test, respectively. **Results:** Majority of the students had normal BMI (66.4%, n=105), and 39.9% (n=63) had low physical activity levels. The mean MEQ summary score of the students was considered high (2.82±0.26). There was a significant negative association between MEQ summary score (r=-0.191; p=0.016) and disinhibition subscale score (r=-0.340; p<0.001) with BMI, whereby MEQ summary and disinhibition subscale scores increased as BMI decreased. However, there was no significant association between physical activity level with MEQ score (p>0.05). **Conclusion:** A student with positive mindful eating behaviour has the potential to lower his/her BMI. However, further research is required to verify this finding.

Keywords: body mass index (BMI), medical students, mindful eating behaviour, physical activity

INTRODUCTION

Medical students are future doctors who are expected to be great role models in the community, especially in terms of health. However, previous studies found that medical students were predisposed to obesity as a result of their sedentary lifestyle (Nisar *et al.,* 2009; Thomas & Geethadevi, 2019) and disordered eating habits (Nor Afiah *et al.,* 2014). Furthermore, the prevalences of overweight (37.1%) and obesity (8.5%)

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were higher too among medical students in Malaysia (Ghazi *et al.,* 2018).

There are a few reasons that lead medical students to be at a higher risk of being overweight or obese. Diet quality usually is poor during college years (Ramón-Arbués *et al.,* 2021), which may play a key influence on weight increment (Miller & Hartman, 2020). Majority of medical students reportedly consume junk foods and soft drinks, which are linked to obesity (Nisar *et al.,* 2009). For many university students, poor nutrition quality is usually coupled with a decrease in physical activity (Allam *et al.,* 2012) and sedentary hours spent on studying, being in the classroom, watching television, and sitting at a computer (Castro *et al.,* 2018).

In respect of mindful eating, Kristeller & Wolever (2011) found that mindful-based eating behaviour was effective in treating uncontrollable eating patterns (Kristeller & Wolever, 2011). When an individual eats mindfully, he or she is aware of the present moment, paying close attention to how the food affects his or her senses, and recognising the physical and emotional sensations felt in response to eating (Warren, Smith & Ashwell, 2017). In other words, if people pay close attention to their eating, or eat consciously, they are more likely to not overeat. This new concept of intuitive eating in modulating eating habits may benefit medical students in controlling their dietary intake, therefore reducing the risk of obesity in the future.

In terms of physical activity, it was found that being physically active was linked to a longer life expectancy and a life free from diabetes (Jonker *et al.,* 2006). The level of physical activity has decreased in developing countries, where sedentary behaviours are on the rise, thus potentially contributing to an increase in chronic diseases (Musaiger, Al-Khalifa & Al-Mannai, 2016). In addition, lack of physical activity can have a negative impact on an individual's body weight status, thus increasing the risk of obesity.

Accordingly, the purpose of this study was to investigate the associations between BMI and physical activity level with mindful eating behaviour among medical students in Universiti Sains Malaysia, Health Campus, Kelantan, Malaysia.

MATERIAL AND METHODS

Study population

This research used a cross-sectional study design and was conducted from February 2021 to April 2021, using an online survey form. The study setting was at Universiti Sains Malaysia, a local university in Kelantan, situated in the North East region of Malaysia.

The inclusion criteria were subjects aged 18 years and above, Malaysian, and currently enrolled as an undergraduate medical student at the School of Medical Sciences in Universiti Sains Malaysia (Health Campus). The exclusion criteria were having underlying health concerns and chronic health diseases.

Sampling method

This study used convenience non-probability sampling and the sample size calculated for this study was based on the formula by Naing (2003), $n = \left[z \times \frac{\sigma}{\Delta}\right]^2$, whereby n=sample size, z=value representing the desired confidence level, σ=population standard deviation, and Δ=precision (true value). The population standard deviation was taken from a previous study done by Moor and colleagues (Moor, Scott & McIntosh, 2013), whereby the mean score for mindful eating had a standard deviation of 0.32. Meanwhile, the precision was estimated to be within 5% points of the true value. The study took into account a 10% drop-out rate. As a result, a total of 174 students were needed for this study.

Measuring tools

Each set of online survey had four sections – Sections A, B, C, and D, as follows:

Section A (demographic data)

Part A was on demographic data that included information regarding the student's personal information such as age, gender, ethnicity, years of study, household income, and sponsorship.

Section B (anthropometric data)

Self-reported weight and height were used in this study. After that, the researcher was responsible to calculate body mass index (BMI) from the data collected. The classification of BMI was based on the World Health Organization (WHO) cut-off points, which were <18.5 kg/m^2 (underweight), 18.5 – 24.9 kg/m^2 (normal), 25.0 – 29.9 kg/m^2 (overweight), and ≥30.0 kg/m^2 (obese) (WHO, 2000).

Section C (International Physical Activity Questionnaire, IPAQ)

In this study, the short version of IPAQ was used and it was an open-access tool, thus no permission was required to use it (Patterson, 2010). It had seven items and assessed three different forms of activities, which were walking, moderate-intensity activities, and vigorous-intensity activities. The classification of physical activity level were as follows:

i. High physical activity was represented by at least three days of vigorous-intensity activity which achieved at least 1500 metabolic equivalent of task (MET) (minutes/week) or seven or more days of any combination of walking, moderate-intensity, and vigorous-intensity activities which achieve at least 3000 MET (minutes/week);
ii. Moderate physical activity was represented by at least 20 minutes of vigorous-intensity activity in three or more days or at least 30 minutes of moderate-intensity activity and/or walking in five days or more or more days of any combination of walking, moderate-intensity, and vigorous-intensity activities which achieved at least 600 MET (minutes/week).
iii. Low physical activity was defined as not meeting any of the criteria for high and moderate physical activity categories.

Section D (Mindful Eating Questionnaire, MEQ)

Mindful eating behaviour was assessed using the MEQ. This questionnaire was developed by Framson and colleagues (Framson *et al.,* 2009). It comprised of 28 items and five different subscales (awareness, distraction, disinhibition, emotional response, and external cues). The subscales were defined as follows: awareness (noticing the effects of food on the senses and how food affects internal states); distraction (focusing on other activities while eating); disinhibition (the ability to stop eating when full); emotional response (eating in response to negative emotion); and external cues (eating in response to environmental triggers). Out of 28 items, eight items were categorised under disinhibition subscale, seven items under awareness subscale, six items under external cues subscale, four items under emotional response subscale, and three items under distraction subscale. For each item, students must select one out of four frequency categories, which were 'Never/Rarely', 'Sometimes', 'Often', and 'Usually/Always'. A summary score was calculated using the mean of the five subscale scores added together. A higher summary score indicated better mindful eating behaviour. Reports showed that

the reliability of the questionnaire ranged from 0.64 to 0.83, as measured by Cronbach's alpha. A permission to use the MEQ was granted by the institution who was in charge of the survey instrument.

Data collection method

The researchers began collecting data after gaining ethical approval from the Ethics Committee of Universiti Sains Malaysia (USM/JEPeM/21010070). Each batch representative was contacted and given a brief overview of the study. Following that, students were given a soft copy of a poster and message template describing the recruitment of study subjects, along with a link. Students who were interested to participate were directed to a Google Form that included a consent form, as well as a set of self-administered questionnaires. Those who matched the eligibility requirements and wanted to participate filled in the online permission form and questionnaire. The process of resubmission of the advertisement study link was repeated until researchers obtained a total of 174 valid responses.

The participants took about 20 minutes to complete the four-part questionnaire. Student's confidentiality was ensured, and they could withdraw from the study at any time with no repercussions. The study hypothesised that there were associations between BMI and physical activity with mindful eating behaviour among medical students at Universiti Sains Malaysia.

Data analysis

All survey data were analysed using the IBM Statistical Package for Social Science (SPSS) Version 26.0 (IBM Corp., Armonk, NY, USA). BMI was calculated as weight (in kilograms)/height (in meters)^2 using the respondents' self-reported weight and height. In terms of physical activity, total physical activity MET-minutes/week was calculated using the sum of the total IPAQ score and then classified as either low, moderate or high physical activity. The overall mindful eating score was calculated by averaging the mean scores, with higher scores indicating greater mindfulness. The Shapiro-Wilk Test was used to determine whether the distribution was normal. The socio-demographic characteristics of the participants were summarised using descriptive data. Numerical data were presented as mean±standard deviation (*SD*) or median (interquartile range, *IQR*) based on the normality distribution, while categorical data were presented as frequency and percentage. The association between BMI and MEQ score was examined and presented using Spearman's Correlation Test, and the association between physical activity level and MEQ score was examined and presented using one-way analysis of variance (ANOVA) or Kruskal-Wallis Test. Statistical significance was determined at $p<0.05$.

RESULTS

Demographic characteristics

A total of 174 students responded to the survey; nevertheless, 16 were excluded from the analysis because their responses were incomplete. As a result, there were 158 complete responses used for further analysis. There were 49 males (31%) and 109 females (69%) among the 158 students who responded. Students were between the ages of 19 to 27 years old and most of the students (60.8%) were between the ages of 22 and 25 years old. Majority of the students were Malays (62.7%), in year 4 (25.9%), from M40 families (45.6%), and received a scholarship (62.7%). Table 1 represents the demographic characteristics of medical students in this study.

Table 1. Demographic characteristics of medical students (*n*=158)

Characteristics	*n (%)*
Gender	
Male	49 (31.0)
Female	109 (69.0)
Age	
18 – 21 years	61 (38.6)
22 – 25 years	96 (60.8)
> 25 years	1 (0.6)
Ethnicity	
Malay	99 (62.7)
Chinese	46 (29.1)
Indian	10 (6.3)
Others	3 (1.9)
Year of study	
Year 1	28 (17.7)
Year 2	34 (21.6)
Year 3	27 (17.1)
Year 4	41 (25.9)
Year 5	28 (17.7)
Household income	
Not stated/Not sure	8 (5.1)
B40 (RM 0 – RM 4, 849)	61 (38.6)
M40 (RM 4, 850 – RM 10, 959)	72 (45.6)
T20 (≥ RM 10, 960)	17 (10.8)
Sponsorship	
Parents	19 (12.0)
Scholarship	99 (62.7)
Loan	39 (24.7)
Others	1 (0.6)

B40: Bottom 40%, M40: Middle 40%, T20: Top 20% (Malaysian household income classification)

Anthropometric data

The average weight, height, and BMI of the students were 56.0 (16.0) kg, 1.62±0.09 m, and 21.5 (4.4) kg/m^2, respectively. According to WHO (2000), majority of the students had normal BMI (*n*=105, 66.4%), 15.2% were overweight (*n*=24), 14.6% were underweight (*n*=23), and 3.8% were obese (*n*=6).

Physical activity

According to the survey, 63 students (39.9%) had a low level of physical activity, 42 of them (26.6%) had a moderate level of physical activity, and 53 students (33.5%) had a high level of physical activity. The median total MET-min/week for this study was 904.5 (2042.2). Table 2 illustrates the anthropometric data and physical activity of medical students.

MEQ score

The MEQ score of students is shown in Table 3. The MEQ mean summary score of the student was 2.82±0.26. In addition, the mean mindful eating subscale scores ranged from 2.41 to 3.08, with the highest score in the distraction subscale (3.08±0.62) and the lowest score in external cues (2.41±0.60).

Table 2. Anthropometric data and physical activity level of medical students (*n*=158)

Anthropometric Data	*n (%)*	*Mean±SD*	*Median (IQR) [Q1, Q3]*
Weight (kg)			56.0 (16.0) [49.0, 65.0]
Height (m)		1.62±0.09	
Body mass index (kg/m^2)			21.5 (4.4) [19.5, 23.9]
Body mass index category			
Underweight (<18.5 kg/m^2)	23 (14.6)		
Normal (18.5 – 24.9 g/m^2)	105 (66.4)		
Overweight (25.0 – 29.9 kg/m^2)	24 (15.2)		
Obese (≥30.0 kg/m^2)	6 (3.8)		
Physical activity level			904.5 (2042.2) [237.8, 2280.0]
Low	63 (39.9)		
Moderate	42 (26.6)		
High	53 (33.5)		

Association between MEQ score and BMI

Table 4 proves the associations between mindful eating scores with BMI. According to Chan (2005), the correlation coefficient value (*r*-value) is used to interpret the strength of a linear relationship, with a value of <0.3 denoting a poor relationship, 0.3 to 0.5 denoting a fair relationship, 0.6 to 0.8 denoting a moderately strong relationship, and >0.8 denoting a very strong relationship. The MEQ summary score had a significant, negative poor relationship with BMI (*r*=-0.191; *p*=0.016). This meant that as MEQ summary score increased, BMI decreased. Students with lower MEQ summary scores therefore had higher BMI values. BMI and disinhibition subscale score had a fairly negative relationship (*r*=-0.340; *p*<0.001). BMI decreased as disinhibition subscale score increased, similar to the MEQ summary score. Meanwhile, there was no significant associations between BMI and awareness subscale score (*r*=-0.152; *p*=0.056), distraction subscale score (*r*=-0.075; *p*=0.351), emotional response subscale score (*r*=-0.011; *p*=0.895), or external cues subscale score (*r*=0.142; *p*=0.075).

Association between MEQ score and physical activity level

Physical activity level had no significant association with MEQ summary score (*p*=0.931). Likewise, physical activity level had no significant associations with awareness subscale score (*p*=0.172), distraction subscale score (*p*=0.805),

Table 3. Mindful Eating Questionnaire (MEQ) scores of medical students (*n*=158)

Variables	*Subscale score (Mean±SD)*
MEQ Awareness	2.79±0.62
MEQ Distraction	3.08±0.62
MEQ Disinhibition	2.81±0.62
MEQ Emotional Response	3.04±0.70
MEQ External Cues	2.41±0.60
Mean of Summary Score	2.82±0.26

Table 4. Associations between Mindful Eating Questionnaire (MEQ) scores and BMI among medical students (*n*=158)

Variables	*Correlation coefficient value (r)*	*p-value*†
MEQ Awareness	- 0.152	0.056
MEQ Distraction	- 0.075	0.351
MEQ Disinhibition	- 0.340	<0.001*
MEQ Emotional Response	- 0.011	0.895
MEQ External Cues	0.142	0.075
MEQ Summary Score	- 0.191	0.016

†Spearman's Rank-Order Correlation Test, *significant at the 0.001 level (2-tailed)

disinhibition subscale score (*p*=0.626), emotional response subscale score (*p*=0.103), or external cues subscale score (*p*=0.685). The associations between mindful eating score and physical activity among medical students are represented in Table 5.

DISCUSSION

Female students frequently outnumber male students in medical school (Wattanapisit *et al.,* 2016). In terms of ethnic diversity, the majority of participants were Malays, and this was an expected outcome, given that Malays make up the largest ethnic group in Malaysia (69.1%) (*Jabatan Perangkaan Malaysia*, 2018).

In terms of the prevalence for overweight and obesity, the current

Table 5. Associations between Mindful Eating Questionnaire (MEQ) scores and physical activity among medical students (*n*=158)

Variables	*Physical activity*	*n*	*Median (IQR) [Q1, Q3]*	*Chi-Square statistic (df)*	*p-value*†
MEQ Awareness	Low	63	2.7 (0.6) [2.43, 3.00]	3.520 (2)	0.172
	Moderate	42	3.0 (1.0) [2.40, 3.43]		
	High	53	2.9 (0.9) [2.43, 3.29]		
MEQ Distraction	Low	63	3.0 (0.7) [2.67, 3.33]	0.434 (2)	0.805
	Moderate	42	3.2 (1.4) [2.59, 4.00]		
	High	53	3.3 (0.7) [2.67, 3.33]		
MEQ Emotional Response	Low	63	3.3 (1.0) [2.67, 3.67]	4.542 (2)	0.103
	Moderate	42	3.0 (0.8) [2.50, 3.25]		
	High	53	3.0 (0.8) [2.75, 3.50]		
			Mean±SD	*F (df)*	
MEQ Disinhibition	Low	63	2.85±0.59	0.469 (2)	0.626
	Moderate	42	2.73±0.68		
	High	53	2.81±0.61		
MEQ External Cues	Low	63	2.40±0.58	0.379 (2)	0.685
	Moderate	42	2.47±0.64		
	High	53	2.37±0.58		
MEQ Summary Score	Low	63	2.83±0.23	0.071 (2)	0.931
	Moderate	42	2.81±0.27		
	High	53	2.83±0.30		

†Tested using One-Way ANOVA or Kruskal-Wallis Test

study had a higher prevalence as compared to previous studies conducted in Ipoh, Malaysia (Sugathan & Bagh, 2014) and India (Anupama *et al.,* 2017). However, the prevalence was lower when compared to a study that was conducted among medical students in Bangladesh (Akhter *et al.,* 2017). The differences in results could be attributed to different methods of assessing anthropometry, as other studies used measured weight and height, whereas the current study used self-reported weight and height of medical students. However, majority of the studies categorised body weight using the same WHO classification.

For physical activity, the findings showed that most of the medical students had low physical activity. This is in line with the findings of a previous study conducted by Wattanapisit and colleagues among medical students in Southern Thailand, in which they discovered that only half of the students were physically active (Wattanapisit *et al.,* 2016). Time constraints, lack of money, the absence of safe sports venues, lack of interest in sports, and a body that cannot tolerate physical activity were all significant barriers to physical activity among physically inactive medical students (Abdel-Salam & Abdel-Khalek, 2016). Another possible reason for the low physical activity level of most participants could be the shift from clinical rotations to online classes due to the COVID-19 pandemic, which included a period of lockdown in Malaysia when data for this study were collected. This was supported too by a study conducted among Italian medical students who discovered that during the lockdown, universities shifted physical classes to online, allowing students to skip clinical rotations and thus reducing their physical activity (Luciano *et al.,* 2021).

Meanwhile, the MEQ score demonstrated that the distraction and emotional response subscales had the highest scores among the students. These indicated an individual's ability to focus on their food while eating without being affected by disturbances and the ability to resist emotional triggers for overeating (Giannopoulou *et al.,* 2020). The external cues subscale received the lowest score from the students. This revealed that students tend to eat in response to inappropriate external cues such as simply the presence of food nearby, which may lead to overconsumption of calorie-dense foods and long-term weight gain (Taylor, Daiss & Krietsch, 2015).

For the association between BMI and mindful eating behaviour, mindful eating was found to be negatively related to BMI, implying that medical students with lower BMI were more mindful eaters. Köse & Tayfur (2021) found a significant relationship between BMI and MEQ subscales (r=-0.208, p<0.01). This is consistent with the results from previous studies (Moor, Scott & McIntosh, 2013; Taylor *et al.*, 2015; Pintado-Cucarella & Rodríguez-Salgado, 2016). However, only the disinhibition subscale score had a fair negative relationship with BMI, while other subscales were not significant. Overall, the association between BMI and mindful eating behaviour evidenced that as mindful eating was applied, students were less likely to develop poor eating habits and thus have a lower BMI. Therefore, mindfulness may help those with overweight or obesity to develop more adaptive responses to emotional distress, which may lead to healthier eating habits (Gouveia, Canavarra & Moreira, 2019).

There were only a few studies that evaluated the association of physical activity with mindful eating. The current finding reported that there was no association between BMI and physical activity among medical students. Mindful eating is not merely a characteristic

of people who engage in other healthy behaviours, since those who exercise more are not more likely to be mindful eaters. According to a study conducted by Topan and colleagues, mindful eating increases as physical activity increases (Topan *et al.,* 2021). However, a previous study by Moor and colleagues reported that there was no significant relationship between mindful eating behaviour and physical activity level. They suggested that more research needs to be performed on this concept because the relationship between mindful eating behaviour and physical activity is not straightforward. Therefore, a better understanding of these complexities could be very useful in addressing the risk of overweight and obesity in university populations (Moor, Scott & McIntosh, 2013). The disparities in the results of the studies could be attributed to the different tools used to measure mindful eating behaviour (MEQ) score and physical activity component. Concerning mindful eating behaviour (MEQ) score, the present study used 28 items or 28 questions (MEQ-28) from the original source in comparison to a previous study that used an adapted and modified version of the original source that consisted of 30 items or 30 questions (MEQ-30) (Topan *et al.,* 2021). In the meantime, for the physical activity component, the tool used in this study was IPAQ as compared to a previous study that used questions enquiring whether students were exercising regularly or not (Topan *et al.,* 2021).

There are a few limitations to this study. Firstly, due to the COVID-19 pandemic, data collection was conducted online and self-reported weight and height were used, which increased the chance of error. Secondly, due to the COVID-19 pandemic, there were restricted movements that could affect mindful eating behaviour among the medical students since the current study used the original version of MEQ questionnaire without modification. In the future, a modified MEQ questionnaire can be created accordingly based on situations of restricted movement. Besides that, the long version of the IPAQ can be used instead of the short version because it contains a more comprehensive set of questionnaires to accurately assess the subject's physical activity. Thirdly, because convenience sampling was one of the study's limitations, the findings may not be completely generalisable and further raises the possibility of bias in the results due to subject selection. Finally, the current study was a cross-sectional study in which the associations between exposures and outcomes of interest were measured concurrently at a single point in time, which is ineffective for determining the cause-and-effect relationship.

CONCLUSION

In conclusion, being mindful when eating is one of the key factors that could contribute to undergraduate medical students having a lower BMI. Lower BMI was also linked to the ability to quit eating when satisfied. As a result, mindful eating may be a useful intervention for reducing the prevalence of overweight and obesity among undergraduate medical students, but more comprehensive research, with a larger sample size and probability sampling, is essential to confirm the results and the benefits of physical activity in achieving the same goal.

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Authors' contributions

Nurul Zulaikha T and Ang SQ, conducted the study, data analysis, and interpretation of the data with support from Juliana S; Juliana S, helped supervise the study, prepared the draft of the manuscript, and reviewed the manuscript; Zafirah MN, assisted in drafting of the manuscript, reviewed and proofread the manuscript. All authors approved the final manuscript.

Conflict of interest

The authors declare that they have no conflicting financial or non-financial interests in this study.

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