Mal J Nutr 28(3): 395-408, 2022

Relationship of self-regulation and lifestyle behaviour with overweight among male and female adolescents in Selangor

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ABSTRACT

Introduction: The ability of a person to self-regulate and practise healthy lifestyle behaviours determine one's weight status. The objective of this study was to determine the relationship of self-regulation, dietary practices, and physical activity with overweight status among male and female adolescents. **Methods:** This cross-sectional study used multistage cluster sampling involving government secondary school students aged between 13 and 14 years old in Hulu Langat, Selangor. Students answered a validated self-administered questionnaire comprising socio-demography, dietary practices, physical activity, and self-regulation items. Their body mass index (BMI) was calculated, and weight status was determined using the Centers for Disease Control and Prevention (CDC) BMI chart. **Results:** Among 636 students, 27.0% were "overweight", affecting more male than female students (p=0.032). Majority of them (96.7%) were motivated to maintain healthy body weight, but only a third of the students took vegetables, fruits and grains (32.4%), and performed vigorous physical activity (31.1%) regularly. Regardless of the "overweight" status, there were no significant differences in dietary practices, physical activity, and autonomous regulation for both genders. Female students showed a higher level of controlled regulation than male students in non-overweight (p=0.005) and overweight (p<0.001) groups. Higher controlled regulation increased the odds of being overweight among female students (AOR=1.04, 95% CI=1.04-1.08, p=0.010). **Conclusion:** Thus, health authorities need to develop programmes to assist, particularly female students, in practising higher autonomous regulation to combat overweight and obesity, as this group exhibits a high level of controlled regulation, which increases the likelihood of being overweight.

Keywords: school, self-regulation, students, weight status

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doi: https://doi.org/10.31246/mjn-2020-0095

INTRODUCTION

Having higher than expected healthy weight is known as overweight or obesity and this affects people of all ages, including adolescents. A national survey conducted in 2019 reported that 29.8% of children aged 5 to 17 years were overweight or obese (IPH, 2020). This is alarming as evidence has shown that 8 in 10 obese adolescents will become obese adults (Simmonds *et al.*, 2016). Furthermore, if overweight or obesity is untreated, adolescents are at risk of having chronic medical conditions, such as diabetes, hypertension, and coronary heart disease, at a later age (Pell *et al.,* 2016; Bibiloni, Pons & Tur, 2015). Thus, it is crucial to curb overweight early to prevent significant morbidity and mortality in adulthood. However, overweight has no instant cure as it is strongly related to human behaviours and lifestyles.

In parallel with the rise in modernisation and industrialisation, Malaysians are experiencing lifestyle changes, including dietary practices and physical activity. Fast-food restaurants are in abundance, and new technology has made foods easily available at our fingertips. People are using online food delivery services that are available in many parts of the country because of convenience and time saving (Hooi, Leong & Yee, 2021). The advances in public transportation have eased people to move from one point to another, thus becoming less active. Understandably, inactive lifestyles and unhealthy eating behaviours have led to an increased prevalence of obesity in the population, including adolescents (Pell *et al.,* 2016). Therefore, students need to self-regulate their lifestyle to achieve ideal body weight.

Self-regulation means the ability of an individual to learn and perform goal-directed behaviours, be in control of one's emotions and behaviours, and have a good relationship with others (Pandey *et al.*, 2018). Self-regulation is an essential component for maintaining health and well-being (Pandey *et al.*, 2018). It is a continuous spectrum of self-determination, from the least to most self-determined or from amotivation to controlled (external) regulation, and subsequently autonomous (internal) regulation (Deci & Ryan, 2002). In the context of weight status, amotivation is when a person has no intention to engage in weight control practices, while controlled regulation is when a person is experiencing pressures from others in the form of guilt, praise, rewards, and punishment to maintain a normal body weight. As it does not arise from one's interest, self-determination of those with controlled regulation may be lacking, increasing the chance for failure (Deci & Ryan, 2000). On the other hand, autonomous regulation is the most self-determined state as one actively engages in activity and lifestyle to reach a normal body weight. This high level of self-determination is likely to successfully meet the goals (Deci & Ryan, 2002).

The relationship between self-regulation and weight status has been shown in cross-sectional studies among adolescents. A higher level of autonomous regulation was associated with a higher level of physical activity and hence, lower body weight (Verloigne *et al.,* 2011; Power *et al.*, 2011). On the other hand, longitudinal studies involving students with amotivation and controlled regulation showed a lower level of physical activity and the occurrence of "overweight" or "obesity" (Gropper *et al.,* 2014; Verloigne *et al.,* 2011). Thus, this self-regulation concept is an essential principle in the care of adolescents. Those who are self-motivated would engage in physical activity and hence, reach or maintain a normal weight status.

Previous local studies have highlighted that socio-demographic profiles do influence the weight status of adolescents. Being younger, male, and Malay or Indian generally have a higher prevalence of "overweight" or "obesity" (Alagappan *et al.*, 2019; IPH, 2018; IPH, 2020; Mazidi, Banach & Kengne, 2018; Pell *et al.*, 2016). Higher prevalence of "overweight" or "obesity" among male adolescents was also observed in studies conducted in European countries, such as Germany, Italy, Denmark, Hungary, as well as East Asian countries such as China and Taiwan (Wang *et al.*, 2018; Bibiloni, Pons & Tur, 2013). Healthy lifestyle behaviours are different between male and female adolescents (Mollborn, Lawrence & Hummer, 2020). In addition, female adolescents were found to be more concerned with their body weight. They showed the tendency to take a more active role in self-regulation of weight through diet and exercise compared to male adolescents (Pich *et al.*, 2015).

However, there is still a paucity of research on the relationship between lifestyle behaviours and self-regulation with body weight status. Furthermore, it is unknown whether there are any gender differences between male and female adolescents regarding lifestyle behaviours and self-regulation that would influence the "overweight" or "obesity" problem. Thus, the first aim of this study was to determine self-regulation, dietary practices, and physical activity according to body weight status among secondary school students in Hulu Langat, Selangor. Secondly, this study aimed to explore the relationship between the variables and "overweight" or "obesity" status by gender.

It is hypothesised that there could be a different level of self-regulation and lifestyle behaviours according to gender that influences "overweight" or "obesity" problem among male and female adolescents. Therefore, the findings of the present study could inform the stakeholders about the importance of empowering self-regulation of health behaviours among Malaysian adolescents to combat overweight.

MATERIALS AND METHODS

Study population

A cross-sectional study was conducted from January to March 2019 among secondary school students in Hulu Langat, Selangor. Selangor is the most developed and populated state with the highest economic growth in Malaysia. In total, there are 40 government secondary schools in six zones of the Hulu Langat district. Using the multistage cluster sampling technique, one school was randomly selected from each zone and subsequently, three to four classes of Form 1 and Form 2 were randomly selected from each school. The total number of students selected from each school was proportionate to the total number of students of the respective school. The minimum sample size required for this study was 622, with an expected 28% prevalence of overweight (Woon *et al.,* 2015), 95% confidence interval, and design effect of 2. However, considering a non-response rate of 15%, this study aimed to approach at least 715 students. All Malaysian students aged 13 to 14 years who attended the selected classrooms were invited to participate in this study. They were briefed on the study protocol, and if they agreed to participate, they were requested to get parental consent. Students without parental consent, absent or with medical illness were excluded from the study.

Study instrument

The selected students were asked to answer a Malay version self-administered questionnaire containing four sections. Section one consisted of socio-demographic questions, including

students' age, gender, ethnicity, parents' level of education, and monthly household income. The second section was the Treatment Self-Regulation Questionnaire (TSRQ) to assess the level of self-regulation (Hartmann, Dohle & Streight, 2015). The TSRQ began with a screening question, "Would you like to maintain a healthy body weight?"; those who answered 'no' or 'it does not matter to me' were grouped as not motivated or 'amotivated' and were not required to answer the remaining 14 items of TSRQ. The 14 items measured two domains of self-regulation: autonomous regulation (six items) and controlled regulation (eight items) using seven-point Likert scale responses, from 'do not agree at all' (1) to 'totally agree' (7). The expected total score for autonomous regulation ranged from 6 to 42 and 8 to 56 for controlled regulation. A higher total score indicated greater self-regulation of the assessed type. The internal consistency was excellent for the autonomous regulation domain (Cronbach's alpha=0.90) and good for the controlled regulation domain (Cronbach's alpha=0.80) (Hartmann *et al.*, 2015).

The third section was the Simple Lifestyle Indicator Questionnaire (SLIQ), which assessed the adolescents' weight-related behaviours: healthy dietary practices (three items) and physical activity level (three items). The test-retest reliability of the SLIQ was 0.63 and 0.97 (Godwinn *et al.,* 2008). In the healthy dietary practices domain, the students' frequency of eating vegetables, fruits, and grains was assessed. In contrast, the frequency of performing three types of activities (light, moderate, and vigorous) was measured in the physical activity domain. The total score of healthy dietary practices domain ranged from 0 to 15, which were then categorised into poor practice (score of 5 and less), moderate practice (score between 6 and 10), and good practice (score between 11 and 15). For the physical activity domain, the total score ranged from 0 to 9, and they were categorised into light physical activity (score of 3 and less), moderate physical activity (score between 4 and 6), and vigorous physical activity (score between 7 and 9).

Both the TSRQ (Hartmann *et al.*, 2015) and SLIQ (Godwinn *et al.,* 2008) were adapted with permission from the original authors. They were translated from English to the Malay language and *vice versa* by professional translators. These questionnaires underwent content validation by local experts and were reviewed by ten adolescents for face validity. In addition, a pilot test was conducted among 100 students from a school different from the actual study sites to determine the feasibility and reliability of the translated questionnaires**.** The internal consistency was acceptable for both TSRQ (Cronbach's alpha=0.79) and SLIQ (Cronbach's alpha=0.74).

The fourth section was on anthropometric measurements. Weight and height of the students were measured without shoes and with light clothing using a Seca 786 weighing scale with an attached stadiometer (seca GmbH, Germany), which was calibrated for each use. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2). BMI was interpreted using the BMI charts by the Centers for Disease Control and Prevention (CDC) and was categorised into: underweight (BMI of <5th percentile), normal weight (BMI of between 5th to 85th percentile), overweight (BMI of between 85th to 95th percentile), and obese (BMI of >95th percentile).

This study obtained approval from the University Kebangsaan Malaysia (UKM) Ethics Committee (FF-2018-311), the Ministry of Education, the respective school principals, followed by written informed consent from

parents of students. Data were analysed using the IBM SPSS Statistics version 25.0 software (IBM Corp, Armonk, NY, USA). Descriptive analysis was presented in frequency and percentage, mean±standard deviation (*SD*), and median (interquartile range) where appropriate. Socio-demographic profiles were dichotomised into two groups. Parents were categorised as having a high level of education if they had tertiary education and low if they had secondary education or lower. Household monthly income was classified based on the Malaysian Household Income report in 2016. Parents with incomes of less than RM4000 were classified as having low income and high income if otherwise (Department of Statistics Malaysia, 2016). For overweight status, those with a BMI at or below 85th percentile were categorised as 'non-overweight', while those with a BMI of over 85th percentile were categorised as 'overweight'. Chi-square test and student *t*-test were used to determine the differences in demographic variables, lifestyle behaviours, and self-regulation according to overweight status. From these analyses, gender was the only variable associated with overweight status; therefore, subsequent analyses were stratified by gender. Multiple logistic regression (MLR) analysis with the enter method was used to identify factors associated with overweight status according to gender. The level of significance was set at $p<0.05$.

RESULTS

Out of 730 students, 636 completed the study, while 94 students were excluded due to lack of parental consent (40 students) and incomplete questionnaire (54 students), giving a response rate of 87.1%. From Table 1, among the 636 students included in the analysis, mean age of the students was 13.5±0.5 years. More than half of the students were female (53.5%), Malay (62.7%), had parents who attained secondary education (52.5%), and lived in low-income families (53.3%).

More than two-thirds of the students were non-overweight (*n*=464, 73.0%), while about one-third were overweight (*n*=172, 27.0%). Only a third of them had good dietary practices (*n*=206, 32.4%). The majority of the students reported an active lifestyle, with half of them practising moderate physical activity (326, 51.3%) and a third practising vigorous physical activity (198, 31.1%). As shown in Table 1, gender was the only significant variable associated with overweight. There were more male students in the overweight group compared to female students ($p=0.032$). Ethnicity, parental education level, family monthly income, dietary practices, physical activity, and self-regulation level were not associated with overweight.

Table 2 shows lifestyle behaviours and self-regulation by gender among non-overweight and overweight students. Female students were found to have significantly higher mean scores on controlled regulation compared to male students across both non-overweight ($p=0.005$) and overweight ($p<0.001$) groups. However, there was no difference in dietary practices, physical activity, and autonomous regulation of male and female students according to overweight status ($p>0.05$).

For questions on self-regulation, only a small proportion responded 'No' or 'It does not matter to me' to the question: 'Would you like to maintain a healthy body weight?'; thus, they were categorised as amotivated to have an ideal weight (*n*=21, 3.3%). For autonomous regulation, the expected total score ranged from 8 to 56, and the mean±*SD* total score of the students was 36.33±4.38. From Table 3, descriptive

Table 1. Socio-demographic profiles, lifestyle behaviours, and self-regulation of the students according to weight status (*N*=636)

Variables	*All*	*Non-overweight*	*Overweight*	χ^2/ *t-test*	*p-value*
Socio-demographic profiles, *n* (%)					
Gender					
Male	296 (46.5)	204 (68.9)	92 (31.1)	4.57	0.032
Female	340 (53.5)	260 (76.5)	80 (23.5)		
Ethnicity					
Malay	399 (62.7)	298 (74.7)	101 (25.3)	1.63	0.202
Non-Malay	237 (37.3)	166 (70.0)	71 (30.0)		
Father's education level					
Secondary & below	372 (58.5)	269 (72.3)	103 (27.7)	0.19	0.664
Tertiary	264 (41.5)	195 (73.9)	69 (26.1)		
Mother's education level					
Secondary & below	361 (56.8)	267 (74.0)	94 (26.0)	0.43	0.513
Tertiary	275 (43.2)	197 (71.6)	78 (28.4)		
Family monthly income					
<RM4000	339 (53.3)	253 (74.6)	86 (25.4)	1.03	0.310
>RM4000	297 (46.7)	211 (71.0)	86 (29.0)		
Lifestyle behaviours, *n* (%)					
Dietary practices					
Poor	81 (12.7)	59 (72.8)	22 (27.2)	4.171	0.124
Moderate	349 (54.9)	265 (75.9)	84 (24.1)		
Good	206 (32.4)	140 (68.0)	66 (32.0)		
Physical activity					
Light	112 (17.6)	84 (75.0)	28 (25.0)	4.75	0.093
Moderate	326 (51.3)	226 (69.3)	100 (30.7)		
Vigorous	198 (31.1)	154 (77.8)	44 (22.2)		
Self-regulation status, mean±*SD*					
Autonomous	36.33±4.38	36.47±4.21	35.96±4.82	0.70	0.202
Controlled	36.39±9.22	36.30±8.88	36.63±10.10	0.01	0.696

analysis of all the six autonomous regulation items showed no significant gender difference in terms of students' responses to each item (p>0.05), except for the item on making decision. In general, both male and female students agreed it was essential to be healthy. Moreover, they were responsible for owning health, indicating they had inner self-motivation to maintain body weight.

Table 2. Differences in lifestyle behaviours and self-regulation by gender among non-overweight and overweight adolescents (*N*=636)

Variables	*Non-overweight*		*p-value*	*Overweight*		*p-value*
	Male	*Female*		*Male*	*Female*	
Dietary practices, *n* (%)						
Poor	26 (44.1)	33 (55.9)	0.949	9 (40.9)	13 (59.1)	0.398
Moderate	118 (44.5)	147 (55.5)		45 (53.6)	39 (46.4)	
Good	60 (42.9)	80 (57.1)		38 (57.6)	28 (42.4)	
Physical activity, *n* (%)						
Light	37 (44.0)	47 (56.0)	0.998	16 (57.1)	12 (42.9)	0.550
Moderate	99 (43.8)	127 (56.2)		50 (50.0)	50 (50.0)	
Vigorous	68 (44.2)	86 (55.8)		26 (59.1)	18 (40.9)	
Self-regulation, mean±*SD*						
Autonomous	36.30±3.89	36.60±4.43	0.443	35.39±5.43	36.62±3.95	0.102
Controlled	34.96±8.76	37.32±8.85	0.005	33.53±9.33	40.17±9.83	<0.001

*Chi-square test and student *t*-test
* *p<0.05* is significant

However, more female students agreed that it was an important decision to maintain a healthy weight compared to male students (p=0.046).

For controlled regulation, the expected total score ranged from 10 to 42, and the mean±*SD* total score of the students was 36.39±9.22. From Table 4, descriptive analysis of all the eight items of controlled regulation showed more female students would be embarrassed (p<0.001), felt bad about themselves (p=0.002), felt guilty (p=0.001), and felt indiscipline (p<0.001) if they did not have a healthy body, compared with male students.

Table 5 shows the multivariate regression analysis on factors associated with overweight status according to gender. The only significant variable was female students, and higher controlled regulation was associated with overweight problem (AOR =1.04, 95% CI= 1.01,1.08, p=0.010). Other variables were not significant (p>0.05).

DISCUSSION

The prevalence of the "overweight" group among secondary school students was about a quarter (27.0%). This combined prevalence was nearly identical to that observed in a national survey conducted by the Institute for Public Health (IPH), which indicated that 29.8% of Malaysian students were overweight (IPH, 2020). However, this combined prevalence of overweight was higher than a prevalence involving overweight students from other Asian countries (23.2%). This overweight problem is alarming and calls for immediate intervention. Furthermore, the proportion of overweight or obesity was significantly higher in male students compared to female students. This finding was also evident among students in European and other Asian countries (Wang *et al.*, 2018, Mazidi *et al.*, 2018; Pell *et al.*, 2016, Bibiloni *et al.*, 2015). The possible explanation for this difference could be due to female students desiring a slimmer body. Hence, they may adopt unhealthy eating behaviours such as dieting to lose weight (Senín-calderón *et al.*, 2017, Pich *et al.,* 2015).

There was no significant relationship between ethnicity, parental education level, and family monthly income among overweight male and female students. In

Table 3. Detailed analysis of the self-regulation items by overweight status: Autonomous self-regulation (*N*=636)

Autonomous self-regulation	*Disagree*		*Neutral*		*Agree*		*p-value*
	Male n (%)	*Female n (%)*	*Male n (%)*	*Female n (%)*	*Male n (%)*	*Female n (%)*	
It is very important to be as healthy as possible	6 (75.0)	2 (25.0)	5 (33.3)	10 (66.7)	285 (46.5)	328 (53.5)	0.161
I personally believe that it is best for my health	6 (66.7)	3 (33.3)	6 (40.0)	9 (60.0)	284 (46.4)	328 (53.6)	0.422
I would like to take responsibility of my own health	3 (60.0)	2 (40.0)	16 (47.1)	18 (52.9)	277 (46.4)	320 (53.6)	0.830
It is an important decision I really want to take	7 (46.7)	8 (53.3)	46 (59.7)	31 (40.3)	243 (44.7)	301 (55.3)	0.046
I have thought about it carefully and think that this is important for many aspects of my life	7 (58.3)	5 41.7)	29 (48.3)	31 (51.7)	260 (46.1)	304 (53.9)	0.673
It fits my life goals	12 (46.2)	14 (53.8)	49 (48.0)	53 (52.0)	235 (46.3)	273 (53.7)	0.947

*Chi-square and student *t*-test
**p* value <0.05 is significant

Table 4. Detailed analysis of the self-regulation items by gender: Controlled self-regulation (*N*=636)

Controlled self- regulation	*Disagree*		*Neutral*		*Agree*		*p-value*
	Male n (%)	*Female n (%)*	*Male n (%)*	*Female n (%)*	*Male n (%)*	*Female n (%)*	
I would be embarrassed if I did not have a healthy body	80 (64.0)	45 (36.0)	47 (49.0)	49 (51.0)	169 (40.7)	246 (59.3)	<0.001
I would feel bad about myself if I do not have a healthy body	104 (57.5)	77 (42.5)	54 (44.6)	67 (55.4)	138 (41.3)	196 (58.7)	0.002
I would have a guilty conscience if I do not have a healthy body	92 (59.7)	62 (40.3)	53 (43.1)	70 (56.9)	151 (42.1)	208 (57.9)	0.001
I feel indiscipline when I do not have a healthy body	118 (58.4)	84 (41.6)	66 (46.5)	76 (53.5)	112 (38.4)	180 (61.6)	<0.001
I permanently feel pressured by others to have a healthy body weight	113 (49.1)	117 (50.9)	74 (49.0)	77 (51.0)	109 (42.7)	146 (57.3)	0.291
Others would be upset with me if I do not have healthy body weight	161 (48.2)	173 (51.8)	74 (44.8)	91 (55.2)	61 (44.5)	76 (55.5)	0.675
I want others to see that I can do it	31 (51.7)	39 (48.3)	41 (51.9)	38 (48.1)	224 (45.1)	263 (54.9)	0.372
I want others to accept me	28 (44.4)	35 (55.6)	43 (44.8)	53 (55.2)	225 (47.2)	252 (52.8)	0.858

*Chi square test
**p* value <0.05 is significant

Table 5. Logistic regression of socio-demographic profiles, lifestyle behaviours, and self-regulation with overweight among male and female students (*N*=636)

Variable	*Male (n=296)*					*Female (n=340)*				
	B	*SE*	*Wald*	*AOR*	*95% CI*	*B*	*SE*	*Wald*	*AOR*	*95% CI*
Age	-0.22	0.26	0.7	0.81	0.48-1.33	-0.18	0.27	0.44	0.84	0.50-1.41
Ethnicity: Malay [non-Malay]	-0.12	0.30	0.16	0.89	0.49-1.58	-0.38	0.29	1.65	0.69	0.39-1.22
Father's education level: High education [low education]	0.11	0.36	0.85	1.11	0.55-2.24	-0.31	0.35	0.76	0.74	0.37-1.47
Mother's education level: High education [low education]	0.22	0.35	0.39	1.24	0.63-2.45	0.46	0.35	1.73	1.58	0.80-3.11
Family monthly income: High income [low income]	0.49	0.36	0.19	1.05	0.52-2.10	-0.49	0.43	1.29	0.61	0.26 -1.43
Dietary practices: Moderate diet [poor diet]	0.15	0.44	0.12	1.16	0.49-2.73	-0.34	0.40	0.75	0.71	0.33-1.54
Good diet [poor diet]	0.72	0.47	2.34	2.26	0.82-5.18	0.36	0.43	0.01	1.04	0.44-2.42
Exercise level Moderate [light exercise]	0.15	0.44	0.12	1.16	0.49-2.73	0.47	0.38	1.49	1.59	0.75-3.36
Vigorous [light exercise]	-0.35	0.40	0.73	0.71	0.32-1.56	-0.14	0.44	0.10	0.87	0.37-2.07
Autonomous regulation	0.003	0.19	0.19	1.003	0.97-1.04	-0.05	0.03	3.23	0.96	0.91-1.00
Controlled regulation	-0.005	0.15	0.12	1.00	0.97-1.04	0.04	0.02	6.72	1.04	1.04-1.08*

*p=0.010

contrast, earlier studies have reported that overweight and obesity problems were more common among students from higher socioeconomic status, having parents with higher education levels, and a higher monthly income, as well as living in urban areas (Mistry & Puthussery, 2015, Okour *et al.*, 2019). However, this is inconsistent as recent national data showed that overweight was also prevalent in adolescents from low-income families (B40). At the same time, obesity was prevalent in adolescents from high-income families (T20) (IPH, 2020). This means that overweight and obesity affect both rich and poor Malaysian students. Thus, prevention strategies should target adolescents of all socioeconomic statuses to reduce the prevalence of overweight and obesity.

For lifestyle behaviours, only a third of the students practised a well-balanced diet containing vegetables, fruits, and grains four to six times per week. A similar finding was also observed in the National Health and Morbidity Survey 2019 that reported low daily consumption of fruits and vegetables among the Malaysian population (IPH, 2020). It is quite common for Malaysian students to have snacks and high carbohydrate fatty meals (Mohammadi *et al.*, 2019). Only a third of the students read the food label, with half of them, especially obese students, skipping breakfast and a third had carbonated soft drinks daily (IPH, 2018). This is further concerning because our current study found no difference in dietary practices between male and female students in the overweight and non-overweight groups.

In contrast to this, a systematic review showed Malaysian male students tend to have poorer diet quality and consumed foods greater in energy density and macronutrients than female students (Mohammadi *et al.*, 2019). The inconsistent findings may be due to the different age groups of adolescents focused upon in previous studies, which makes comparison of findings equivocal. Another possible explanation could be younger male and female students of 13 to 14 years old not having very much freedom to choose their foods as parents exert a strong protective influence on food choices. Therefore, they just eat anything prepared for them (Gunther *et al.*, 2019).

As for physical activity, only a third of the students performed vigorous activities, such as running, sports, and weight-lifting, more than four to seven times a week. This is far from the recommended level of at least 60 minutes of moderate to vigorous physical activity daily by the World Health Organization (WHO) (Guthold *et al.*, 2020). This low level of physical activity is a known phenomenon affecting adolescents worldwide. It was reported in a pooled analysis involving 141 countries that more than 80% of adolescents were not physically active daily (Guthold *et al.*, 2020). This study also showed no difference in the physical activity of overweight and non-overweight adolescents of both genders. The potential explanation for this includes other confounding factors that influence the weight status of adolescents and self-reporting of physical activity that may have led to various biases.

Irrespective of their weight status, majority (96.9 %) of the students were motivated to have a normal body weight. This could be attributed to their adolescence stage, where body image is essential to growing adolescents (Senín-Calderón *et al.*, 2017). The students showed a high total mean score for both autonomous and controlled regulations. However, based on the self-regulation theory, for ideal body weight, one's autonomous regulation should be higher than controlled regulation (Deci & Ryan, 2002). Looking into the detailed analysis of the autonomous regulation items,

both male and female students agreed it was vital to be healthy and take charge of their lives. Their motivation to maintain a healthy body weight was from inner-self, the students wanting to do it for their own good. However, there was no difference in the autonomous regulation of overweight and non-overweight adolescents of both genders.

Looking into the controlled regulation domain in this study, female students showed significantly higher scores on controlled regulation compared to male students in both overweight and non-overweight groups; and this higher level of controlled (external) regulation increased the odds for risk of overweight problem. This study was unique as it revealed that non-overweight females were also in danger of becoming obese. A higher number of female students would feel embarrassed, bad, guilty, or indisciplined if they did not have a healthy body weight. However, this external pressure was insufficient to make them lose weight, and they gained weight instead. This is consistent with a study among the United States adolescents that showed overweight adolescents, especially females, were associated with higher controlled regulation than normal-weight adolescents (Gropper *et al.,* 2014). The possible explanation is that female students are more concerned with their body image and self-appearance (Senin-Calderón *et al.*, 2017). As a result, people's perception and expectations (controlled regulation) can greatly affect their motivation to have an ideal weight, as opposed to male adolescents. However, the over-dependency on others' perceptions and expectations is less likely to make female adolescents sustain the motivation to achieve an ideal weight. Their impulse to change due to external pressure is temporary and requires many sacrifices. When perceiving behavioural change, females tend to break their dietary regimes and efforts to dietary practices, which is ineffective for the long term and thus, makes them prone to be overweight (Poraj-Weder, Wąsowicz & Pasternak, 2021).

An important inference that one can make from the above findings is that overweight students from both genders need intervention to increase autonomous regulation for long term weight control management. Theoretically, it is crucial for students to have high internal regulation and autonomous motivation to reduce and sustain normal weight. The greater the self-motivation, the higher the level of effort, such as engaging in physical activity, that will be given to reduce their weight (Aleksovska-Velickovska, Gontarev & Ruzdija, 2019); while failure to self-regulate may lead to obesity (Stoeckel *et al.*, 2017). Therefore, it is high time for the country to correct this, conducting more motivational programmes, and thus, making adolescents, especially those with overweight problems, have their own desire and self-motivation, and not be dependent on others to have a healthy body weight. Personal skills intervention using modelling behaviour, play therapy, and attention training may be considered as evidence has shown its efficacy in improving adolescents' self-regulation (Pandey *et al.*, 2018). Promoting self-motivation or autonomous (internal) regulation is likely to give a long-lasting commitment to weight control behaviours that include healthy dietary practices and physical activity (Hartmann *et al.*, 2015).

There are a few limitations in this study. The main limitation of a cross-sectional study is its inability to determine causal relationships between the variables. A longitudinal study would be beneficial to further understand the relationships between weight status, self-regulation, and weight-related behaviours. In addition, the use of self-

administered questionnaires could lead to socially desirable biases (Woon *et al.,* 2015), not reflecting their true motivation to maintain an ideal body weight or true dietary practices. A qualitative approach may be beneficial to explore further, especially on their internal or autonomous regulation in relation to external or controlled regulation, as well as a more detailed description of their dietary intakes. Findings from the present study should not be generalised to the whole adolescent population as this study was conducted among secondary school adolescents in the Hulu Langat district. Despite these limitations, the study also had its own strengths. The sample recruited for this study was robust using the multistage cluster sampling technique with a good response rate. The BMI and weight status of the students were based on the measurements done by the researcher and not self-reported, ensuring the reliability of the values reported. This study used well-validated questionnaires with good internal consistencies. Therefore, conclusive and reliable results were obtained, and several definite conclusions could be made.

CONCLUSION

In conclusion, the problem of overweight and obesity were highly prevalent among adolescents aged 13-14 years in Hulu Langat, Selangor, affecting more males compared to females. This study confirmed that gender influences weight status and self-regulation of one's weight status. Female students were found to have higher external (controlled) regulation compared to male students in both overweight and non-overweight groups. The feeling of embarrassment, bad, guilty, and indiscipline due to not having a healthy body had significantly influenced their weight status. The high level of controlled regulation increased the likelihood of overweight problem in female students, but not male students.

Based on these findings, intervention programmes involving both male and female students will be required to combat overweight and obesity. In addition, behavioural intervention is needed to improve self-regulation in female adolescents, particularly through motivational programmes aimed at increasing internal (autonomous) regulation over external (controlled) regulation.

Acknowledgements

The authors would like to acknowledge the Ministry of Education for the approval given to conduct the study. A special thanks to the institution for approving a short-term grant for this study (FF -2018-311). The authors would also like to express their appreciation to all the six schools, teachers, students, and parents of Hulu Langat District for their full cooperation throughout the data collection.

Authors' contributions

AG, site investigator, conducted the study, conceptualised and designed the study, prepared the draft of the manuscript, and reviewed the manuscript; NAM, principal investigator, conceptualised and designed the study, supervised the data collection, advised on data analysis and interpretation, and reviewed the manuscript; GR, led the data collection in schools and reviewed the manuscript; HT, advised on data analysis and interpretation, assisted in drafting of the manuscript, and reviewed the manuscript; MSH, advised on data analysis and interpretation, assisted in drafting of the manuscript, and reviewed the manuscript; KO, advised on data analysis and interpretation, assisted in drafting of the manuscript, and reviewed the manuscript.

Conflict interest

The authors declare no conflict of interest.

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