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Eating self-regulatory skill, diet quantity, and diet quality of Malaysian healthcare university students: A cross-sectional study

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ABSTRACT

Introduction: The ability to self-regulate eating can improve health. This study aimed to determine the relationship between eating self-regulatory skills, diet quantity, and diet quality among Malaysian university students. **Methods:** This cross-sectional study involved 132 university students. Eating self-regulatory skill was assessed using the Self-Regulation of Eating Behaviour Questionnaire (SREBQ). Dietary intakes from two 24-hour dietary recalls were used to assess diet quantity and quality. Diet quantity was measured as energy and macronutrient intakes, analysed using NutritionistPro. Diet quality was measured using the Malaysian Healthy Eating Index (M-HEI). The relationship between eating self-regulatory skills, diet quantity, and diet quality were evaluated using tests for differences between means and multiple linear regression. **Results:** Male participants (n=47) consumed more energy than female participants (n=85) (Male: 1850±570 kcal/day, Female: 1596±567 kcal/day, p=0.015). Participants from the Nutrition and Dietetics (N&D) course (n=49) had better M-HEI scores than participants from other health courses (n=83) (N&D course: 52.7±10.5, non-N&D course: 47.2±10.7, p=0.005). The predictors of energy intake were gender (β=-0.193, p=0.023) and SREBQ score (β=-0.223, p=0.009). Being female and having higher eating self-regulatory skills were associated with lower energy intake. The predictors of diet quality were university course (β=0.240, p=0.005) and SREBQ score (β=0.181, p=0.033). Studying N&D and having higher eating self-regulatory skills were associated with higher M-HEI scores. **Conclusion:** Higher self-regulation of eating behaviour score is a factor that contributes to lower daily energy intake and higher diet quality score.

Keywords: diet quality, diet quantity, self-regulation, university students

INTRODUCTION

Obesity and non-communicable diseases (NCDs) are health problems (IPH, 2020). A high prevalence and co-occurrence of behavioural risk factors of NCDs were discovered among university students, among which 80.5% had inadequate fruit and vegetable intakes (Pengpid & Peltzer, 2020). Adherence to a healthy diet throughout life helps prevent NCDs. Within this perspective, a healthy diet provides an optimal quantity of nutrients and a variety of food groups for good diet quality (Echouffo-Tcheugui & Ahima, 2019).

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The increase in the prevalence of obesity and NCDs matches with the quantitative (larger portion sizes, increase in energy and fat intakes, and decrease in dietary fibre intake) and qualitative (increase in animal fat intake and decrease in wholegrain, fruit, and vegetable intakes) dietary changes seen in eating patterns (Popkin, 2006). Summaries of research on nutrition, body weight, and NCDs showed that modifications to both diet quantity and diet quality reduce these health problems (Popkin, 2006; Brandhorst & Longo, 2019). Diet quantity can be expressed as energy, carbohydrate, protein, fat, sugar, salt, and fibre intakes (Popkin 2006; Brandhorst & Longo, 2019). In terms of diet quality, the focus is on dietary patterns, which include intakes of fruits, nuts and seeds, vegetables, fish, legumes, cereals, meat, sugary beverages, high salt, and processed foods (Popkin, 2006; Brandhorst & Longo, 2019).

The ability to successfully self-regulate eating is postulated to prevent weight gain, produce weight loss, and reduce risk factors associated with NCDs (Reed *et al.*, 2016). Self-regulation is defined as the extent to which people influence, modify, or control their behaviour, including thoughts and feelings according to goals or standards (Freund & Hennecke, 2015). A systematic review showed that self-regulatory skills mediate long-term weight and physical activity outcomes, and short-term dietary intake outcomes (Teixeira *et al.*, 2015). Antecedents of eating self-regulation include cognitive restraint, moderation, mindfulness, disinhibition, delayed gratification, emotions and mood, self-efficacy, social support, environment, and physical activity (Reed *et al.*, 2016). These antecedents can vary by setting, including different age groups and environments. University students are emerging adults who must rely more on their own resources in a less supervised environment. This provides a unique setting to study how eating self-regulatory skills affect dietary intake (Wood *et al.*, 2017). Cross-sectional and intervention studies in this area showed that eating self-regulatory skills are associated with the dietary intake of university students, but the context of these studies is limited to Western countries (Ling & Zahry, 2021; Deliens *et al.*, 2016). Hence, this study aimed to determine the relationships between eating self-regulatory skills, diet quantity, and diet quality among Malaysian university students.

MATERIALS AND METHODS

Participants and sampling

This cross-sectional study was conducted among healthcare students in the International Medical University (IMU) Malaysia, from March to June 2021. A minimal sample size of 134 participants was determined with a power of 0.90, an alpha value of 0.05, and a correlation coefficient of 0.30. Using convenience sampling, Malaysian students aged between 18 to 25 years, were invited to participate in this study on a voluntary basis. After the provision of informed consent, the participants were assessed for eligibility. This study excluded students who were pregnant, lactating, trying to lose weight, or diagnosed with medical conditions. The IMU Joint Committee on Research and Ethics provided ethical approval (BDN I/2020(03)) for the study.

Data collection

Data were collected using a self-administered online questionnaire. Following completion of the questionnaire, participants attended two interview sessions via Microsoft Teams lasting approximately 30 minutes each.

Eating self-regulatory skills

The Self-Regulation of Eating Behaviour Questionnaire (SREBQ) was used to assess eating self-regulatory skills (Kliemann *et al.*, 2016). The SREBQ consisted of five items that were rated using a five-point Likert scale: (1) never, (2) rarely, (3) sometimes, (4) often, and (5) always. A higher score indicated higher eating self-regulatory skills. The sum of scores from the SREBQ was then converted into mean scores to group the participants into low self-regulation (mean scores below 2.8), medium self-regulation (mean scores between 2.8 and 3.6), and high self-regulation (mean scores above 3.6) categories.

Diet quantity

During the interview sessions, a two-day (one weekday and one weekend) 24-hour dietary recall was used to assess daily total energy, carbohydrate, protein, and fat intakes. The multiple pass method, photographs of food portions, and household measurements were used to improve recall and estimation of portion size. Energy, carbohydrate, protein, and fat intakes were calculated using the NutritionistPro computer software (Axxya Systems LLC, Redmond USA) to analyse the nutritional composition of foods based on the Malaysian and Singaporean food composition databases.

Diet quality

The Malaysian Healthy Eating Index (M-HEI) was used to measure diet quality (Goh & Norimah, 2012). This tool consisted of nine components, encompassing seven food groups and two nutrient groups, namely grains, cereals and tubers, vegetables, fruits, milk and dairy products, legumes, meat, poultry and eggs, fish and seafood, energy from fat, and sodium intake. The recommended serving sizes for each food group were in accordance with the Malaysian Dietary Guidelines 2020, based on an energy intake (EI) of 1800 kcal/day for females and 2000 kcal/day for males. The total M-HEI score was obtained by summing the scores of all components. The composite M-HEI score was calculated with the formula: [(Total score obtained from 9 components/Maximum score of 90) x 100%]. The possible composite M-HEI score ranged from 0 to 100%, and a higher score indicated better diet quality. The composite M-HEI scores were used to group the participants into poor diet quality (M-HEI % scores <51), moderate diet quality (M-HEI % scores between 51 to 80%), and good diet quality (M-HEI % scores >80%) categories.

Statistical analysis

Statistical analysis was performed using the IBM Statistical Package for the Social Sciences version 28 for Windows (IBM Corp., Armonk, NY, USA). Independent *t*-test was used to determine the differences in mean energy and macronutrient intakes, M-HEI scores, and self-regulation of eating behaviour scores by gender and university course. The one-way analysis of variance (ANOVA) test, followed by Tukey post-hoc tests for multiple comparison were used to determine the differences in mean energy and macronutrient intakes, M-HEI scores, and self-regulation of eating behaviour scores by ethnicity. Multiple linear regression analysis was performed to determine the relationship between the independent variables (age, gender, ethnicity, university course, and self-regulation of eating behaviour score) and the dependent variables (diet quantity – EI and macronutrient intake, and diet quality – M-HEI score). Non-significant independent variables were removed using the backward stepwise method. At each step, the independent variable that had the lowest correlation with the dependent variables was

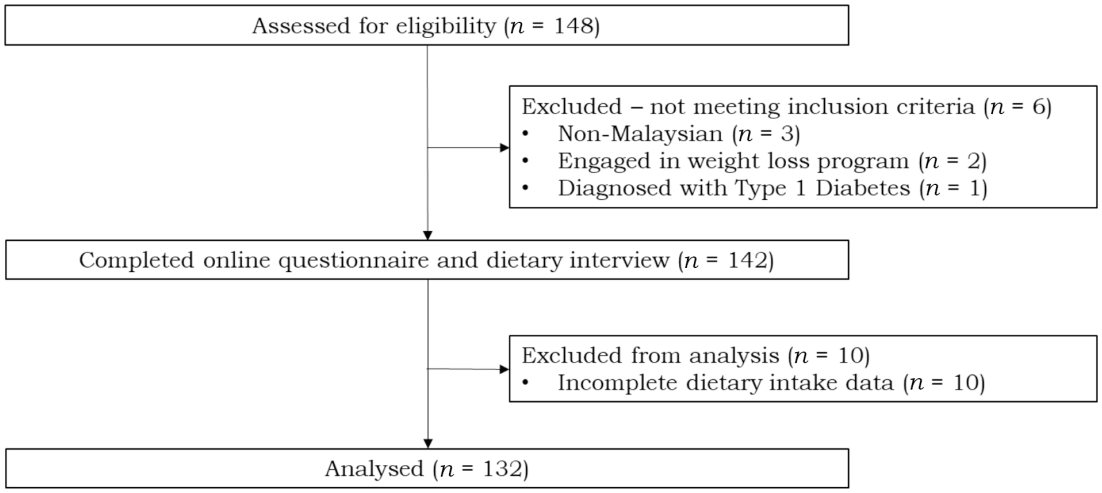

Figure 1. Flow chart on recruitment of study participants

removed from the model (*p* for removal >0.10). Variables remaining in the model were those that were independently predictive of diet quantity and diet quality. Statistical significance was set at <0.05.

RESULTS

A total of ten participants were excluded from the analysis due to incomplete dietary intake data (Figure 1). The study participants had a mean±standard deviation (*SD)* age of 21.2±1.4 years, were predominantly females (64.4%, *n*=85), and of the Chinese ethnic background (94.7%, *n*=125). When segregated by university course, students from non-Nutrition and Dietetics courses (Medicine, Dentistry, and Pharmacy) accounted for 62.9% of the participant pool (Table 1).

Eating self-regulatory skills

The mean±*SD* SREBQ score for all participants was 2.59±0.56, with no significant difference seen between either gender (*p*=0.369) or university course (*p*=0.828) when assessed by

Table 1. Sociodemographic characteristics of participants (*N*=132)

Sociodemographic variables	*Mean±SD*	*Frequency (n)*	*Percentage (%)*
Age (years)	21.2±1.4		
Gender			
Male		47	35.6
Female		85	64.4
Ethnicity			
Malay		4	3.0
Chinese		125	94.7
Indian		3	2.3
University course			
Non-Nutrition and Dietetics		83	62.9
Nutrition and Dietetics		49	37.1

independent *t*-test (Table 2). There was also no significant difference in mean±*SD* SREBQ score between ethnic groups (p=0.414) when assessed by one-way ANOVA test. Half of the participants (55.6%, n=73) were categorised with low self-regulation, while 39.1% (n=52) with medium self-regulation, and 5.3% (n=7) with high self-regulation of eating behaviour.

Diet quantity and quality

Table 2 shows the diet quantity and quality by gender, ethnicity, and course of study. In terms of diet quantity, the participants consumed a mean±*SD* EI of 1690±578 kcal/day with carbohydrate, protein, and fat contributing to 45.3%, 17.1%, and 37.6% of EI, respectively. Independent *t*-test showed that male participants had a higher daily EI than female participants, with a mean±*SE* difference of 254±103 kcal/day (95% *CI*: 50, 458; p=0.015). EI did not differ by ethnicity (p=0.853) or university course (p=0.337). There was no difference in macronutrient composition of the diet between either gender (% EI from carbohydrate, p=0.647; % EI from protein, p=0.096; % EI from fat, p=0.806) or university course (% EI from carbohydrate, p=0.112; % EI from protein, p=0.848; % EI from fat, p=0.117). There was, however, a difference in the % EI from protein between ethnic groups, with Chinese participants consuming more energy from protein than their Indian counterparts (p=0.041).

As for diet quality, the participants had a mean±*SD* M-HEI % score of 49.2±10.1, with 59.8% (n=79) and 40.2% (n=53) of the participants categorised as having poor and moderate diet quality, respectively. Independent *t*-test showed that participants from the Nutrition and Dietetics course had better diet quality scores than participants from the non-Nutrition and Dietetics courses, with a mean±*SE* difference of 5.5±1.9 %

Table 2. Comparisons of SREBQ score, diet quantity and diet quality according to gender, ethnicity, and university course (N=132)[a]

Variables	*Gender*		*Ethnicity*			*University course*	
	Male (*n=47*)	*Female* (*n=85*)	*Malay* (*n=4*)	*Chinese* (*n=125*)	*Indian* (*n=3*)	*Non-Nutrition and Dietetics* (*n=83*)	*Nutrition and Dietetics* (*n=49*)
SREBQ score (mean score)	2.53±0.58	2.62±0.54	2.30±0.50	2.60±0.55	2.33±0.76	2.58±0.60	2.60±0.48
Diet quantity							
Energy intake (kcal/day)	1850±570*	1596±567*	1782±295	1680±585	1835±729	1724±660	1624±376
Carbohydrate intake (% EI)	44.7±8.3	45.5±8.9	43.9±4.5	45.0±8.7	55.5±7.7	44.2±8.7	46.8±8.5
Protein intake (% EI)	18.0±4.9	16.7±4.0	16.0±2.7	17.3±4.4*	11.2±0.9*	17.2±4.7	17.1±3.7
Fat intake (% EI)	37.5±7.0	37.8±7.7	40.0±4.1	37.7±7.5	33.1±7.5	38.5±7.4	36.4±7.4
Diet quality							
M-HEI % score	47.2±2.1	50.3±10.1	43.2±1.7	49.4±11.1	49.4±12.2	47.2±10.7*	52.7±10.5*

SREBQ=Self-Regulation of Eating Behaviour Questionnaire; EI=Energy intake; M-HEI= Malaysian Healthy Eating Index
[a]Data are displayed in mean±*SD*
*Significant difference between means at p<0.05

score (95% *CI*: 1.7, 9.3; *p*=0.005). Diet quality score did not differ by gender (*p*=0.112) or ethnicity (*p*=0.541). None of the participants were categorised as having good diet quality, as less than a quarter of the participants met their daily recommendations from vegetables (4.5%, *n*=6), fruits (9.1%, *n*=12), milk and dairy products (3.8%, *n*=5), and fish (24.2%, *n*=32). Only 16.7% (*n*=22) of the participants kept their EI from fat to ≤30% and 43.9% (*n*=58) consumed ≤2000 mg of sodium/day (Figure 2).

Eating self-regulatory skills, diet quantity, and diet quality

Table 3 depicts the results of the multiple linear regression showing predictors of diet quantity and diet quality. Starting with five independent variables that may predict EI, the backward stepwise linear regression reduced these variables to gender and SREBQ score. Gender and SREBQ score explained 9.4% of the variation in daily EI [*F*(2,129)=6.698, *p*=0.002]. Participants who were female and had higher SREBQ scores had lower daily EI. Starting with five independent variables that may predict carbohydrate and protein intakes, the backward stepwise linear regression reduced these variables to ethnicity. Ethnicity explained 5.9% and 4.4% of the variation in % EI from carbohydrate [*F*(2,129)=4.076, *p*=0.019] and protein [*F*(1,130)=5.948, *p*=0.016], respectively. Participants who were Indian had a higher % EI from carbohydrate, but a lower % EI from protein. The backward stepwise linear regression showed that none of the independent variables were significant predictors of % EI from fat. Starting with five independent variables that may predict M-HEI scores, the backward stepwise linear regression reduced these variables to university course and SREBQ score. University course and SREBQ score explained 9.2% of the variation in M-HEI scores [*F*(2, 129)=6.526, *p*=0.02). Participants who were from the Nutrition and Dietetics course and had higher SREBQ scores had higher M-HEI scores.

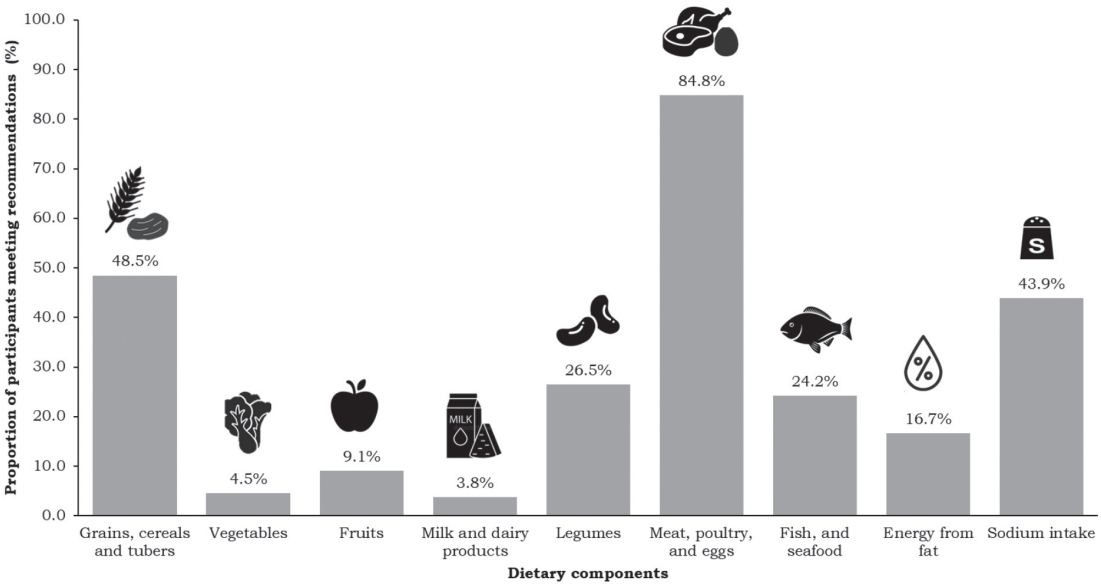

Figure 2. Proportion of participants meeting the dietary recommendations for food groups, energy intake from fat and sodium intake (*N*=132)

DISCUSSION

The results on diet quantity from this study support the viewpoint by Gan *et al.* (2011) and Abdull Hakim *et al.* (2012) that mean EI is consistently higher in male than female university students; and daily EI is below, while fat intake exceeds the recommended levels among university students. Growing evidence shows that diet quality rather than diet quantity is more reflective as an indicator of healthy eating (Echouffo-Tcheugui & Ahima, 2019). This current study showed that none of the study participants had good diet quality and very few included adequate amounts of fresh produce such as fruits, vegetables, and dairy products, into their daily diet. This data confirms previous findings that only 2% of Malaysian university students have good diet quality (Rosnani & Nor Azwani, 2020) and that university students often fail to meet the recommended intakes for fruits and vegetables (Pengpid & Peltzer, 2020; Moy *et al.*, 2009). Indeed, the National Health and Morbidity Survey 2019 showed that the highest prevalence of inadequate fruit and vegetable intakes was among young adults (IPH, 2020). Local cross-sectional studies have shown that access to fresh produce at an affordable price point can affect diet

Table 3. Predictors for diet quantity and diet quality from the multiple linear regression model (N=132)

	B	*SE B*	*95% CI B*	*Standardised β*	*p-value*
Predictors of energy intake[a]					
Intercept	2438.440	235.711	1972.081, 2904.800		<0.001
Female*	-232.830	101.206	-433.068, -32.593	-0.193	0.023
SREBQ score*	-232.623	87.579	-405.901, -59.345	-0.223	0.009
Predictors of carbohydrate intake[b]					
Intercept	43.865	0.945	41.995, 45.735		<0.001
Indian ethnicity*	11.668	4.972	1.832, 21.505	0.202	0.020
Predictors of protein intake[c]					
Intercept	17.296	0.377	16.550, 18.041		<0.001
Indian ethnicity*	-6.098	2.499	-11.040, -1.151	-0.209	0.016
Predictors of M-HEI scores[d]					
Intercept	38.006	4.410	29.280, 46.732		<0.001
University course*	5.409	1.891	1.667, 9.151	0.240	0.005
SREBQ score*	3.555	1.651	0.288, 6.821	0.181	0.033

SREBQ=Self-Regulation of Eating Behaviour Questionnaire; M-HEI= Malaysian Healthy Eating Index
[a] R=0.307, R^2=0.094, F(2,129)=6.698, p=0.002
[b] R=0.244, R^2=0.059, F(2, 129)=4.076, p=0.019
[c] R=0.209, R^2=0.044, F(1,130)=5.948, p=0.016
[d] R=0.303, R^2=0.092, F(2,129)=6.526, p=0.02
*Significant at p<0.05

quality (Karupaiah *et al.*, 2013; Pondor *et al.*, 2017). In this current study, data on dietary intake were collected during a period of national quarantine in response to the COVID-19 pandemic. During the quarantine period, Malaysians behaved in a way that leaned towards cost savings and away from purchase of fresh produce. Changes to eating behaviour included cooking at home to save money, reducing food wastage, eating according to needs and affordability, and choosing to buy food with a longer expiration date (Norshariani, 2020). The current study also highlighted that few study participants met their daily recommendations for milk and dairy products. In general, milk and dairy products are not widely consumed by Malaysians (Goh *et al.*, 2020). Since there is no culture of milk production in Malaysia, most dairy products are imported, and this increases the cost of dairy products (Goh *et al.*, 2020).

This study showed that the study participants from the Nutrition and Dietetics course had better diet quality scores than participants from non-Nutrition and Dietetics courses. A similar study conducted among university students from the east coast of Malaysia showed that health sciences students had higher diet quality scores than non-health sciences students and attributed this difference to the fact that health sciences students had better nutrition knowledge than non-health sciences students (Rosnani & Nor Azwani, 2020). On the contrary, a review showed that university students' food intake was unhealthy regardless of their undergraduate course, and that health sciences students did not have healthier diets than their non-health sciences counterparts (Bernado *et al.*, 2017). The review by Bernado *et al.* (2017) also showed that unhealthy eating was especially reported among students who left their parents' homes and became responsible for their own food (Bernado *et al.*, 2017). While nutrition knowledge is an important determinant of diet quality, other factors can affect the diet quality of students, including individual factors, the physical environment, and university characteristics (El-Kassas & Ziade, 2016). The mediating role of nutrition knowledge was further explored in a study that differentiated practical nutrition knowledge from factual knowledge about nutrition. Practical nutrition knowledge is considered more relevant and closely related to behaviour than factual nutrition knowledge. Deroover *et al.* (2020) showed that practical nutrition knowledge explained part of the association between sociodemographic characteristics and diet quality.

This study showed that few participants had high self-regulation and that higher self-regulation scores were correlated with lower EI and better diet quality scores. Students who attended a different university in Malaysia reported similar average self-regulation score of 3.0±0.5, with few categorised as having high self-regulation (Tan, Tan & Tan, 2022). A study on American undergraduates showed that eating self-regulation was positively correlated with fruit and vegetable intakes, but negatively correlated with sweet intake, suggesting an association between self-regulation and diet quality (Ling & Zahry, 2021). The ability to self-regulate eating has been measured as meal planning skills, self-monitoring behaviour, and dietary restraint. Indeed, the planning and monitoring of eating have been shown to be strongly and positively associated with healthy eating, while strongly and negatively associated with unhealthy eating behaviours (Guertin & Pelletier, 2021). Dietary restraint has also been shown to partially mediate the relationship between stress and dietary intake (Royal & Kurtz, 2010). Although

this current study indicated the role of self-regulation of eating behaviour and dietary intake, the low proportion of study participants categorised as having high self-regulation of eating behaviour and good diet quality underscores the importance of future interventions aimed at developing university students' self-regulation skills to promote healthy eating. Interventions that improve self-regulation of eating behaviour have resulted in short- and long-term increases in fruit and vegetable intakes (Stadler, Oettingen & Gollwitzer, 2010). A systematic review on dietary interventions among undergraduate students showed that the inclusion of self-regulation components, including self-monitoring and goal setting, may maximise dietary outcomes towards better diet quality (Kelly, Mazzeo & Bean, 2013). Improving the diet quality of undergraduate students is important as high diet quality is inversely associated with the risk of all-cause mortality and disease-specific incidence or mortality (Morze *et al.*, 2020).

The findings from this study must be interpreted within its limitations. Most of the participants were young Chinese female adults, and this limits the generalisability of the findings. The cross-sectional nature of the study also precludes inference of causation. Intention is associated with self-regulation. However, the study participants were not screened to exclude individuals who do not have healthy eating intentions.

CONCLUSION

In conclusion, this study showed that having higher self-regulation of eating behaviour score is a factor that contributes to lower daily EI and higher diet quality score. This study identified possible predictors of diet quantity and diet quality, that can be explored in future nutrition-based studies. Additionally, health promotion efforts to combat obesity and NCDs with healthier eating behaviours should include strategies that improve eating self-regulatory skills.

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Authors' contributions

Lee CL, conceived and designed the project, study recruitment and screening, data collection and analysis, drafting and critical revisions of manuscript; Jamilah AJ, designed the project, study recruitment and screening, data collection and analysis, drafting and critical revisions of manuscript; Chang JT, Yap KX, Yap HY, Khoo WJ, involved in study recruitment and screening, data collection and analysis, and drafting of manuscript. The authors agree with the manuscript and declare that the content has not been published elsewhere.

Conflict of interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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