Journal of Public Health: From Theory to Practice
https://doi.org/10.1007/s10389-019-01111-2

ORIGINAL ARTICLE

Influences of genetics, lifestyle and environment on obese and non-obese university students in Malaysia

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Received: 14 February 2019 / Accepted: 20 June 2019

Abstract

Aim To investigate the association among genetics, lifestyle and environmental factors in obese and non-obese university students in Malaysia.

Subjects and methods A cross-sectional study was conducted on students who were studying at universities in Selangor and Kuala Lumpur, Malaysia. Face-to-face interviews were conducted using a pre-tested, self-administered questionnaire, consisting of three major parts: demographics, factors influencing body weight and actions to alter or maintain the present body weight.

Results Most of the parents and siblings of young obese participants were also obese compared with non-obese participants ($p < 0.001$). Family and friends had an influence on the eating habits of both obese and non-obese participants. About 40% of obese participants had a smoking habit. Non-obese participants did not eat much differently, whilst obese participants increased their food intake when they had fewer sleeping hours ($p = 0.002$). Only 29% of obese participants preferred fruit or vegetables, while 71% preferred salty, baked, fatty and sugary food. More than 50% of non-obese participants always had breakfast. None of the obese participants exercised daily. Stress and poor time management were the major factors preventing obese participants from losing body weight, while encouragement from family members, peers and social influencers were the major motivators for non-obese participants to maintain their body weight.

Conclusion Genetics, family and friends, sleep, eating habits, smoking, physical activity and stress have influences on both obese and non-obese cohorts. Obese populations should adopt good discipline, have adequate sleep, observe a healthy diet and maintain an active lifestyle to reduce body weight.

Keywords Obese · Non-obese · University students · Malaysia

Introduction

Obesity is a public health concern as it can lead to various diseases including type 2 diabetes mellitus, cardiovascular disease, stroke and cancer (WHO 2018). According to the World Health Organization (WHO), > 1.9 billion adults were overweight in 2016. Of this population, > 650 million were obese. It was estimated that > 340 million children and adolescents aged 5–19 years old were overweight or obese in 2016 (WHO 2018). The worldwide prevalence of obesity nearly tripled between 1975 and 2016. The prevalence of overweight and obesity among children and adolescents aged 5–19 years old rose dramatically from 4% in 1975 to just over 18% in 2016, occurring similarly in both genders (WHO 2018).

Malaysia has recorded the most overweight population in Southeast Asia. Based on the Malaysia National Health and Morbidity Survey (NHMS 2015), 17.7% of the population was obese, while 30% were overweight, meaning that almost one in two Malaysians was either obese or overweight (Institute for Public Health 2015). Although numerous studies have shown that genetics, lifestyle and environmental factors are associated with the prevalence of obesity worldwide, studies on non-obese groups and the elements influencing non-obesity, especially in young adults, are scanty. Hence, our present study compared the association of genetic, lifestyle

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10389-019-01111-2) contains supplementary material, which is available to authorized users.

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Published online: 02 July 2019

and environmental factors between obese and non-obese young adults in Malaysia to establish a recommended referral strategy for weight reduction programs.

Methodology

Research design

A cross-sectional study was conducted on students studying at universities in Selangor and Kuala Lumpur, Malaysia, as part of a medical school undergraduate's research project. Both obese/overweight and non-obese students were randomly selected from these institutions prior to face-to-face interviews. The WHO classification of body mass index (BMI) was used to categorize students into obese and non-obese groups (WHO 2018). The target population age ranged from 18 to 25 years old. Participants were assured of the confidentiality of their personal and demographic details. The participation agreement was only considered upon completion and submission of the questionnaire. The study was approved by the institutional scientific review panel and performed in accordance with ethical standards as stated in the 1964 Helsinki Declaration.

Survey tools

Data were collected using a structured questionnaire in English, prepared using Google® Docs. To evaluate the validity of the questionnaire content, a pre-pilot study comprising five participants was conducted prior to the main study. Subsequent modifications were made based on the feedback comments from the participants. Data from the pilot study were not included in the final assessment. The questionnaire was divided into three parts. Part 1 comprised demographics, factors influencing body weight and action to alter or maintain present body weight. Part 2 (factors influencing body weight) consisted of 18 questions related to dietary habits, lifestyle and exercise preference. Questions in Part 3 were modified according to obese and non-obese participants. For instance, questions regarding actions taken to reduce body weight were directed to obese participants, while questions on strategies to maintain body weight were directed to non-obese participants. Most of the questions were close-ended to obtain quantitative data (Supplementary Documents 1 and 2).

Data analysis and interpretation

All data from the respondents were collected and analyzed using the Microsoft® Excel and Statistical Package for the Social Sciences (SPSS®) version 20 (IBM SPSS New York, USA). Descriptive statistics including frequencies and percentages were calculated. Bivariate analysis using the chi-square test was performed to determine the associations between obese and non-obese groups and different variables. $p < 0.05$ was considered statistically significant.

Results

A total of 90 obese and 101 non-obese students took part in the present study (Table 1). The number of male obese participants was slightly higher compared with obese female interviewees. There were almost three times as many female non-obese participants as males. Most of the non-obese group were Chinese, but the number of obese individuals was evenly distributed among ethnicities. None of the obese sample but 5% of the non-obese cohort was vegetarians. Among the obese subjects, < 30% were overweight while almost all non-obese subjects had a normal BMI (Table 1).

Bivariate analysis showed that most parents of young obese participants were also obese while most of the parents of non-obese, individuals were not ($p < 0.001$) (Tables 2 and 3). Similar findings were observed among the obese and non-obese groups regarding their respective siblings ($p < 0.001$) (Tables 2 and 3). Family and friends had an influence on the eating habits and patterns of both obese and non-obese respondents ($p = 0.463$) (Tables 2 and 3). About 40% of the obese sample had a smoking habit, while the majority of the non-obese interviewees were non-smokers ($p < 0.001$) (Tables 2 and 3). The availability of amenities and sport facilities did not affect the body weight changes in either the obese or non-obese participants ($p = 0.605$) (Tables 2 and 3).

Both obese and non-obese participants stopped eating when they were full ($p = 0.103$) (Tables 2 and 4). Non-obese individuals did not eat more, even when they had less sleep. However, obese respondents increased their food intake when they had fewer sleeping hours ($p = 0.002$). There was no increase in food intake in either the obese or non-obese group when sleeping hours were adequate ($p = 0.343$) (Tables 2 and 4).

Almost 50% of non-obese participants but only 29% of obese respondents preferred fruit and vegetables in their respective meals (Fig. 1). Inversely, about 71% of obese interviewees favored salty, baked, fatty and sugary food as opposed to only half of the non-obese group.

Non-obese respondents did not eat out as often, while most members of the obese group ate out for at least two meals a day (Fig. 2). More than 50% of non-obese respondents always had breakfast and took three meals a day. Obese individuals only ate breakfast sometimes (25.6%) and consumed two (43.3%) or three (44.4%) meals per day. About 16% of the obese and 9% of the non-obese cohort never exercised, while no obese and 5% of non-obese subjects exercised daily (Table 5). More than 50% of the obese interviewees said that stress and poor time management were the major factors

Table 1 Demographic data of obese and non-obese participants

Parameter		Obese		Non-obese	
		Number[a]	(%)	Number[a]	(%)
Gender	Male	48	(53.3)	28	(27.7)
	Female	42	(46.7)	73	(72.3)
Nationality	Malaysian	55	(61.1)	101	(100.0)
	Non-Malaysian	35	(38.9)	–	–
Ethnicity	Malay	20	(22.2)	0	(0)
	Chinese	28	(31.1)	98	(97.0)
	Indian	19	(21.1)	0	(0)
	Other	23	(25.6)	3	(3.0)
BMI classification[b]	Obese	68	(75.6)	–	–
	Overweight	22	(24.4)	–	–
	Normal	–	–	98	(97.0)
	Underweight	–	–	3	(3.0)
Diet preference	Vegetarian	0	(0)	5	(5.0)
	Non-vegetarian	90	(100.0)	96	(95.0)

[a] Data indicate the number of participants for obese ($n = 90$) and non-obese ($n = 101$). Value in parentheses indicates the percentage of the number over the respective total number of obese and non-obese participants for each parameter

[b] Body mass index (BMI) based on WHO BMI classification

preventing them from losing body weight, while encouragement from family members, peers and social influencers was a major motivator (61.4%) for the non-obese sample to maintain their body weight.

Discussion

Modernization has created changes in the diet, eating habits, sleep and physical activity of individuals causing some to gain in body weight. While obesity is still largely viewed as an alterable cosmetic concern, various studies have also concluded that there is a genetic predisposition to obesity. Our present study revealed that most of the parents and siblings of young obese participants were also obese, while the parents and siblings of non-obese participants were not obese. Thus, a genetic influence could be strongly associated with obesity as well as non-obesity. Indeed, one molecular genetic study showed that more than 20 obesity susceptible loci have been detected (Herrera and Lindgren 2010). Mutations in those genes encoding food-intake-regulating factors, such as leptin and its pro-opiomelanocortin and melanocortin-4 receptors, are associated with hyperphagia (Shawky and Sadik 2012). Although there is a genetic predisposition to obesity, the risk of obesity is only manifested in an "obesogenic environment," following the interaction between susceptible genes and unfavorable conditions, which include unhealthy lifestyles, food-rich surroundings and influence from family and friends (Pigeyre et al. 2016; Higgs and Thomas 2016). This observation is consistent with our present results showing that the eating habits of obese and non-obese participants were influenced by their family and friends. It is therefore important to cultivate healthy eating among family, friends and fellow students.

Table 2 Number of obese and non-obese participants associated with various influences and eating behaviors

Influences and eating behaviors	Obese		Non-obese	
	Yes	No	Yes	No
Obese parent	52	38	30	71
Obese sibling	43	47	23	78
Influences of family and friends	65	25	68	33
Smoking habit	33	57	4	97
Availability of amenities	24	26	53	48
Eat more even though full	16	74	28	73
Sleep less and eat more	46	44	29	72
Sleep more and eat more	15	75	12	89

It has been reported that there is a genetic predisposition to low satiety responsiveness and the associated weight gain (Llewellyn et al. 2014). Genes responsible for the appetite regulatory system affect satiety responsiveness, influencing adiposity and leading to early onset obesity. Persons with obesity-related genotypes (fat mass and obesity-associated genes/FTOs) have a preference for high-fat foods and have a lower satiety effect, resulting in an increase in caloric intake

Table 3 Bivariate analysis of various influences on obese and non-obese participants

Influence	*p* value	Odds ratio	95% confidence interval
Obese parent	< 0.001*	3.239	1.782–5.887
Obese sibling	< 0.001*	3.103	1.665–5.781
Family and friends	0.463	1.262	0.678–2.348
Smoking habit	< 0.001*	14.039	4.730–41.674
Availability of amenities	0.605	0.836	0.424–1.648

* *p* value statistically significant

and risk of obesity (Melhorn et al. 2018), consistent with our present finding which showed that obese participants favored salty, baked, fatty and sugary food over vegetables and fruit. Moreover, we could demonstrate that more obese participants chose to smoke compared with non-obese participants, consistent with another study which reported that smoking was associated with poor diet control, physical inactivity, elevated cortisol levels and insulin resistance, eventually leading to an increase in abdominal fat distribution (Kim et al. 2016).

Indeed, food preference highly affects body weight. Studies have shown that an increase in body weight is associated with a preference for sweet and fatty foods (Lanfer et al. 2012; Drewnowski et al. 2012; Meer et al. 2016). Our present study showed that non-obese participants preferred fruit and vegetables. Fruit and vegetables are high in fiber and have a low glycemic index, hence increasing satiety with fewer calories and optimizing resting energy expenditure (Bertoia et al. 2015). Eating out is also related to a higher BMI, since outside foods are energy-dense and higher in fat and sugar than food prepared at home (Seguin et al. 2016). Portions of outside food are also often larger, contributing to a higher energy intake. In another study, a meta-analysis reported that there was a positive association between skipping breakfast and obesity (Horikawa et al. 2011). This is also consistent with the present study which revealed that more non-obese than obese participants preferred to have breakfast. Although skipping breakfast is commonly believed to lower the intake of calories, it actually promotes a tendency to have dinner after 8 p.m., eat snacks late at night and consume more snacks and soft drinks, overall causing weight gain (Watanabe et al. 2014). It has also been found that eating meals regularly is not associated with metabolic syndrome and insulin resistance (Sierra-Johnson et al. 2012). The present study showed that most of the non-obese respondents had three meals a day, while the obese participants had an inconsistent two or three meals a day. In fact, regular eating patterns are more beneficial in weight regulation than eating meals irregularly and infrequently (Ekmekcioglu and Touitou 2012).

The present study showed that non-obese participants did not prefer to have more meals, regardless of their adequacy in sleeping hours, while obese participants tended to eat more when lacking in sleeping hours. With the advancement of technology, the use of electronic gadgets such as smartphones, laptops and television has been associated with sleep deprivation and a predominantly sedentary lifestyle (Bayon et al. 2014). Sleep deprivation leads to changes in the levels of appetite-regulating hormones such as ghrelin and leptin, which are contributing factors to the risk of obesity (Bayon et al. 2014). Food intake is increased to compensate for the energy spent on wakefulness. Poor diet from energy-dense foods and increased sedentary behavior due to tiredness and fatigue cause obesity (Chaput and Dutil 2016). Indeed, there is growing evidence to show that adequate sleep is beneficial for weight loss interventions.

In Malaysia, a study on the prevalence of overweight and obesity among adults showed that obesity is strongly linked to socio-cultural and behavioral factors (Mohamud et al. 2011). With the present modes of transportation and the means by which they spend their leisure time, Malaysians generally lack physical activity, putting them at risk of obesity (Lim 2016). Moreover, our obese respondents did not exercise on a daily basis and some even never exercised. This lack of physical activity as shown by our participants may predispose a person to becoming obese as studies have shown that there is an association between physical inactivity and obesity (Montgomerie et al. 2014). Our present study also showed that the availability of amenities and facilities did not significantly influence the body weight of obese and non-obese participants, a finding contradicted by a previous study (Singh et al. 2010) which found that childhood obesity was more

Table 4 Bivariate analysis of effect of sleep on eating behavior of obese and non-obese participants

Eating behavior	*p* value	Odds ratio	95% confidence interval
Eat more even though full	0.103	0.504	0.282–1.129
Sleep less and eat more	0.002*	2.596	1.429–4.716
Sleep more and eat more	0.343	1.483	0.654–3.364

* *p* value statistically significant

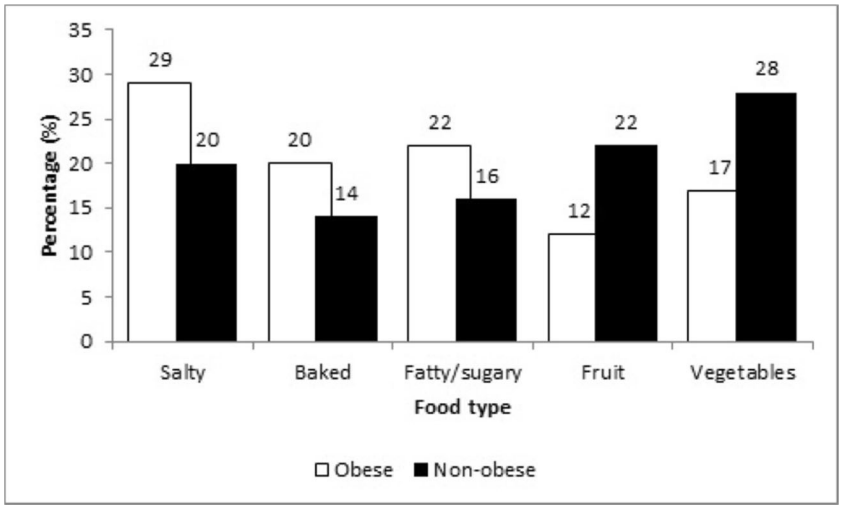

Fig. 1 Obese and non-obese participant preference for food types

prevalent where the neighborhood socio-economic conditions and built-up environments were unfavorable. A perceived safe neighborhood, on the other hand, has been associated with higher levels of physical activity, lowering the risk of obesity among children, as reported in the USA (Singh et al. 2010).

Indeed, lack of time and stress were the two major factors that prevented our young obese participants from reducing their body weight. Jackson et al. (2017) reported that stress is an environmental factor which has an effect on weight gain due to increased levels of the hormone cortisol. Cortisol increases appetite, with a preference for fatty food, and promotes triglyceride accumulation and redistribution of adipose tissue to the abdominal region (van der Valk et al. 2018). Other factors hindering individuals from reducing body weight include a perception that being overweight is normal, subjection to norms and inaccessibility to facilities (Okop et al. 2016). On the other hand, social support from family, friends and colleagues has been found to play a significant role in weight management among individuals (Wang et al. 2014), consistent with our present findings.

To the best of our knowledge, this is the first study conducted to compare eating behaviors between young obese and non-obese populations. Although our present study showed that neither obese nor non-obese participants ate more when they were full, we did not quantify the amount of food intake before they achieved satiety. Also, data on the sleeping hours and quality of sleep of our obese and non-obese respondents were not included in the present study. Perhaps these aspects are worth investigating in future studies. Precaution should also be taken with regard to the findings; first, the study group was limited to university students with an age range from 18 to 25 years old. The target population and sample size should be expanded to obtain more substantial findings. Second, ethnic groups of obese and non-obese participants should be more comprehensive as Malaysia is a multiracial country. Hence, a broader context covering different age groups from different ethnicities and the associated factors including dietary patterns, eating habits and lifestyles would be beneficial and advantageous, reducing the prevalence of obesity domestically and globally.

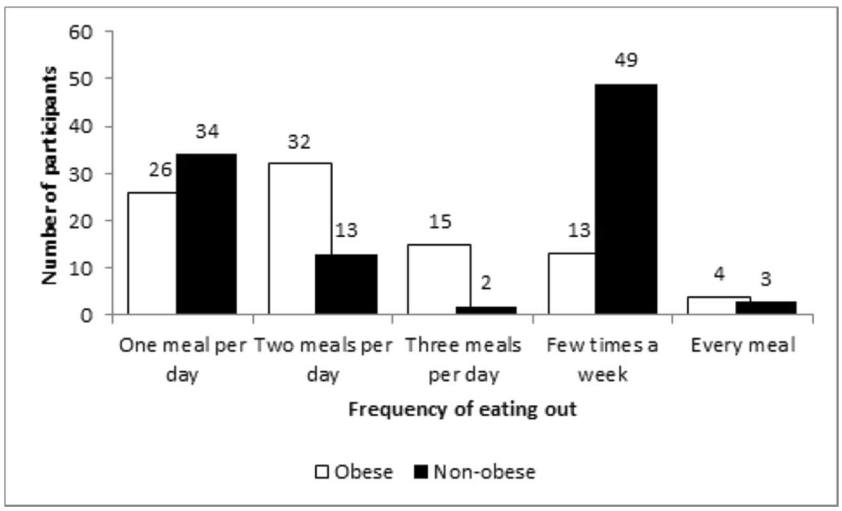

Fig. 2 Frequency per week of eating out by obese and non-obese participants

Table 5 Obese and non-obese participants and frequency of exercise

Frequency of exercise	Obese (%)	Non-obese (%)
Daily	0	5
Three or more times per week	14	18
Once or twice per week	18	19
Occasionally	52	49
Never exercise	16	9

Conclusion

In conclusion, the genetic influence on obesity is further confirmed in the present study, although eating habits were also found to be influenced by family and friends, regardless of whether individuals were obese or non-obese. Sleep deprivation, smoking and eating out were associated with weight gain. Habitual consumption of breakfast, a high-fiber intake and an active lifestyle were common practice among non-obese participants, and we therefore recommend that these approaches be incorporated into nationwide weight loss programs. Moreover, health education and campaigns should be revamped to increase more fitness awareness. A healthy lifestyle should be cultivated among individuals in families and among peers to reduce weight gain.

Acknowledgements The authors express their gratitude to the participants for providing their honest and unbiased data. The authors also thank the university for providing incentive support from a Taylor's University research grant under the Emerging Research Fund Scheme.

Compliance with ethical standards

Ethical approval All procedures performed in the above study involving human participants were in accordance with the ethical standards of the institution and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflict of interest The authors declare that they have no conflict of interest.

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