ORIGINAL ARTICLE

SOCIODEMOGRAPHIC DETERMINANTS OF OBESITY AMONG 12 YEARS OLD SCHOOL ADOLESCENTS IN KUALA TERENGGANU AND BESUT DISTRICTS, MALAYSIA

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ABSTRACT

Worldwide prevalence of obesity among children and adolescents increased substantially over decades. Addressing potential risk factors of obesity among adolescents is very important for a successful intervention program in this population. The present study aimed to identify the sociodemographic determinants of obesity among school adolescents in Terengganu. A cross-sectional survey involving 3,798 school adolescents age 12 years old from 136 government primary schools in Kuala Terengganu and Besut districts were carried out from November 2014 to June 2015. For the purpose of this paper, the data for 2,842 school adolescents classified as either normal BMI (< +1SD) (*n*= 2,305) or obese (+2SD) (*n*= 537) based on WHO cut-off points were taken for analysis. Sociodemographic information on subjects and their parents were obtained from self-reported questionnaire. Anthropometric measurements were conducted by Physical Education teachers and uploaded into a specific developed database. The prevalence of obesity was relatively high in both genders in this study. Binary logistic regression analysis found gender, parental BMI, household income, household size and maternal working status were independently associated with obesity among school adolescents in this population. In the final model, being male, having working mother, and having obese parents were identified to be potential risk factors for obesity whilst having large household size lower the risk of obesity among these adolescents. Prevention programs are needed to increase awareness about the risk factors of obesity in adolescent and interventions should now focus on family member as well mainly the parents.

Keywords: sociodemographic, obesity, school adolescents, Terengganu, Malaysia

INTRODUCTION

In the recent decades, obesity among children and adolescents has been one of the major public health concerns worldwide. Due to economic transition, obesity which previously only affect high income countries is now becoming epidemic in developing countries. Worldwide, the prevalence of obesity among children and adolescents increased substantially. In 2013, approximately 24% and 13% of adolescents in developed and developing countries were obese/ overweight compared to only nearly 17% and 8% respectively in 1980s[1]. Due to numerous detrimental health problems of obesity that lead to high morbidity and mortality among children and adolescents[2], WHO has now declared childhood obesity as a serious public health challenge of the 21st century[3]. Adolescents which currently constitute 20% of the world population, will determine the adult health status, due to many health-related factors in adulthood are associated with conditions or behaviours that develop during adolescence[4,5]. Nonetheless, an obese child or adolescent has also a greater risk of being obese during adulthood compared to the normal children[6].

Obesity epidemic has triggered a tremendous global concern including Malaysian population. Recently, Malaysia National Health and Morbidity Survey (NHMS 2015)[7] reported that, prevalence of obesity among children aged below 18 years had increased from 6.1% in 2011[8] to 11.9% in 2015. Adolescence phase is a critical life cycle phase in which major biological, psychological, social and environmental changes that occur may contribute to the changes in the body weight status leading to obesity[9]. The fact that obese adolescents have higher probability to becoming obese during adulthood, it is necessary for planning and evaluating evidenced-based public health intervention programs starting from adolescents[10]. Previous studies have identified numerous determinants and risk factors related to the

development of obesity among adolescents. In a review on childhood obesity development in developing countries, Gupta *et al*. (2012)[11] stated that, the key determinants of childhood obesity in developing countries were mainly low physical activity, unhealthy nutrition, high socioeconomic status and urbanization in metropolitan cities. Indeed, these modifiable risk factors mainly sedentary behaviour, dietary intake and physical activity levels are closely related with the individual daily lifestyle. Moreover, socioeconomic factors may also influence these modifiable risk factors. With the socioeconomic trajectories in Malaysia, the potential determinants linked to obesity in both urban and rural areas may have shifted. However, in Malaysia, majority of studies exploring the obesity determinants among adolescents were conducted in central peninsular area[12,13] while study on the east coast area especially in Terengganu are still in infancy. Nonetheless, studies among schools children/ adolescents in Kelantan and Pahang found significant relationship between household incomes, area of residence and unhealthy eating behaviours on the body weight status[14-16]. With the substantial increment of obesity prevalence among children and adolescents in Terengganu (i.e. from 5.5% in 2011 to 10.6% in 2015)[7,8], it is crucial to determine the associated factors related to obesity among these population. For the first time, comprehensive and state-level representative total population data of school adolescents in Terengganu, Malaysia are now available in the Health of Adolescents in Terengganu study (HATs). The purpose of the present paper was therefore to identify socio-demographic determinants of obesity among 12 years old school adolescents in Terengganu, Malaysia.

METHODOLOGY

Study design and subject recruitment

From November 2014 to June 2015, a total of 3,798 adolescents aged 12 years participated in the HATs. This cross-sectional study involved the whole population of school adolescents from all government primary schools in Besut and Kuala Terengganu districts in Terengganu, Malaysia. These two districts were purposively selected based on accessibility and logistics reasons as it is where university campuses were located. Terengganu is located within the East Coast of Peninsular Malaysia. Schools within districts were classified as rural and urban by the Terengganu State Education Department (JPNT). The inclusion criteria include school adolescents aged 12 years' Malaysian citizen attending government primary school with informed parental consent.

Subjects

The present analysis is restricted to 2,842 school adolescents aged 12 years (Boys: 1237, Girls: 1605) from 136 primary schools in Kuala Terengganu and Besut districts. BMI was classified as either normal (> -1 SD to +1SD) or obese (> +2SD) based on World Health Organization (WHO) z-score 2007[17]. Subjects with z-score < -1SD or between >+1SD and +2SD were excluded from the analysis.

Anthropometry measurements

Using a standardized protocol, height and weight were measured by the trained Physical/Health Education (PE) teachers in each school based on the reference material provided[18]. The data were uploaded into the specific developed database in the Health Monitoring and Surveillance System (HEMS) web portal[19] for data collection and processing. Body weight and stature were measured using calibrated analogue health scales to the nearest 0.1 kg and 0.1 cm respectively. Data on height, weight, gender, and age were used to compute the BMI-for-age Z-score using WHO AnthroPlus software[20]. Age of each subjects were calculated to the precise day by subtracting the date of birth from the date of measurement while the BMI were calculated by dividing body weight in kilograms (kg) by height in metre squared (m^2). At the time of data collection, all subjects were apparently healthy and all measurements were taken in light sports attire without shoes during mornings or early afternoons. BMI categories were defined using age- and sex- specific cut-off points relative to WHO 2007 classifications[17]. The interpretation of the cut-offs classifies overweight as having z-score > +1SD, obesity as having z-score > +2SD, normal as having z-score between -1SD and +1SD; and thinness as having z-score < -2SD.

Parental survey data

Data on sociodemographic determinants were collected using a structured parent-report questionnaire. The questionnaire collected information on the biological factors (gender, breastfeeding history, parental BMI), socioeconomic status (household income, maternal working status), parental education status and family structure (household size). Self-reported weight and height of mothers and fathers were used to calculate parental BMI and classified based on WHO cut-off point[21] into obese (BMI > 30kg/m^2) and non-obese (BMI<30kg/m^2). Total household income was classified into three categories based on 10th Malaysian Plan (Rancangan Malaysia ke-10)[22] where classifies 'low' as having income less than RM2300, 'middle' as having income between RM2300 to 5599 and 'high' as having income more than RM5600. Low birth weight was defined as having reported birth weight less than 2500g[23] and defined as high when more than 4000g. Household

size was classified into three groups (i.e. Small: <5 persons, Medium: 5-7 persons, Large: >7 persons) [24].

Statistical Analysis

Data entry and analysis was performed using IBM SPSS Statistics for Windows, Version 22.0 software (IBM Corporation, Armonk, New York, USA). A two-sided *P* value of less than 0.05 was considered as statistically significant. Anthropometric data from HEMS portal was calculated into BMI and the results were examined for extreme values where reported BMI were below -5SD and exceeded +5SD, these were the arbitrary cut points by NHMS[8]. Descriptive statistics were presented as means with their standard deviation or percentage of prevalence. It was used to describe the characteristics of the subjects in term of mean weight, height, and BMI. Independent sample t-test was used to test the difference in mean of BMI between genders. Logistic regression reporting odds ratios (ORs) was used to determine the potential risk factors and obesity. The final model of risk factors of obesity using multiple logistic regressions was checked for fitness using Hosmer-Lemeshow goodness-of-fit test. The *P*-value was not significant; thus the model had fit. Two-way interactions test was used to check interactions in the main effect model and if it was not significant, there were no significant interactions between each variable in the final model

RESULTS

A total of 2,842 school adolescents (normal BMI, *n* = 2,305; obese, *n* = 537) aged 12 years were involved in this study (43.5% boys and 56.5% girls). Of all subjects, majority were from Kuala Terengganu district (75.6%) whilst 24.4% were from Besut. Subjects' distribution by school locations was almost equal, 48.6% were from rural and 51.4% were from urban area. Table 1 summarises the anthropometric measurements of subjects by genders. On average, mean BMI of total subjects was 18.9 ± 4.5 kg/m^2 with boys showed significantly higher mean BMI than girls (*P* < 0.001).

Table 1: Anthropometric measurements by gender

	Boys (*n* = 1237)	Girls (*n* = 1605)	All (*n* = 2842)
Height (cm)	142.9 ± 8.3	145.1 ± 7.5	144.1 ± 8.0
Weight (kg)	39.5 ± 13.0	39.8 ± 10.9	39.7 ± 11.9
BMI (kg/m^2)	19.1 ± 4.9*	18.7 ± 4.2	18.9 ± 4.5

BMI, Body mass index; Data are (mean ± SD)
** Significant difference in mean of BMI between genders (Independent sample t-test)*

Determinants of obesity

Table 2 shows the sociodemographic characteristics of between normal and obese subjects. There were significant associations between adolescents BMI status and gender, and also parents' BMI (*P* < 0.001). The prevalence of obesity was higher in boys compared to girls (23.8% *vs*. 15.1%), and adolescents with obese mother and father compared to their counterpart (32.1% *vs*. 16.1% and 33.5% *vs*. 16.0%). Pearson's chi-square test also showed significant association between socioeconomic determinants including household income, maternal working status, parental educational level and household size with normal and obese group (*P* < 0.001).

Bivariate analysis showed that, gender, parental BMI, household income, household size and maternal working status were associated with obesity among school adolescents in this population (Table 3). In multivariate analysis (Table 4), having obese parents, being male, having working mother and having large household size remained associated with obesity (*P* < 0.005). Subjects where mother and father were obese were 2.22 and 2.07 times more likely to be obese respectively (adjusted OR (AOR 2.22, 95% CI 1.44 to 3.41 and AOR 2.07, 95% CI 1.34 to 3.19). Male students were 2.03 times more likely to be obese than female students (AOR 2.03, 95% CI 1.42 to 2.91). Likewise, having working mother were 1.88 times more likely to be obese than non-working mother (AOR 1.88, 95% CI 1.31 to 2.7). Whilst, adolescents with large household size (> 7 persons) were 0.45 times less likely to be obese than those with smaller household size (AOR 0.45, 95% CI 0.24 to 0.83).

DISCUSSION

This study data confirmed the association between obesity and majority of the listed sociodemographic determinants. Being male, having working mother, and having obese parents were the potential risk factors for obesity among subjects. Whilst, having larger household size are found to lower the risk of being obese. Findings from this study clearly indicated that boys had significantly higher risk of obesity than girls. This

finding was supported by the recent national survey (NHMS 2011 and NHMS 2015) that reported higher prevalence of obesity among boys than girls[7,8]. Generally, boys consumed larger meals and energy[25] whereas girls were more cautious about their dietary intake[26]. Moreover, girls were more concern about their body image due to sociocultural pressure emphasizing a thin or lean body is ideal of beauty leading to dieting and food restriction[27]. In addition, specifically in Asian culture, boys usually are encouraged to consume larger meal by their parents[12].

Inconsistent with previous study, findings from the current study revealed that urbanites were more likely to be obese compared to school adolescents in rural[12]. Urbanised areas are known to have different lifestyle, occupational composition and dietary patterns related to obesity compared to rural[28]. In addition, with different sociodemographic, the availability of unhealthy foods may lead to higher consumption of sugar-sweetened beverages, and fast foods while limited availability of open spaces and parks may contribute to reduced physical activity level[29]. Interestingly, Lee and Ham (2015)[30] found contradict result among elementary schoolchildren in Korea in which rural schoolchildren were more likely to become obese despite having higher level of physical activity than those living in urban areas.

The present study also showed that, school adolescents having working mother were almost twice as likely to be obese than those with non-working mother. The fact that behavioural aspect and upbringing were shaped at home, having working mother had a greater influence on obesity[31]. Generally, mothers are more responsible for dietary intake and activity of their children than father. However, being married and working mothers, especially blue collar work[32], they have less time spent for taking care of their children. As a result, they have less control over food intake, eating habit and physical activity of their children. Mothers with a long working hours had been shown to increase the BMI of their children[33]. Conversely, Hofferth and Curtin, (2005) suggested that higher household income as contributed by working mother may also change their children's lifestyle by having greater purchasing ability for healthy and nutritious foods and participation in structured sports[34].

The direct association between the subjects' BMI and parental weight status in the present study accords with the findings from other cross-sectional study in Segamat, Malaysia[35]. Parental obesity was found to be strongly associated with child obesity in the population. As such, higher parental BMI was reported to be highly related with genetic, social and home environment[36,37]. A family history of overweight or obesity is an important determinant of the genetic risk of being overweight in childhood. The impact of parental BMI on severity of obesity increased with advancing age of the children[6]. At the age of seven years, only maternal BMI were positively correlated with adolescents' BMI and by the age of 15, BMI of both parents were found to be correlated with the severity of obesity[36]. Indeed, other than inheriting obesity-susceptible genes, parental BMI is also responsible for shaping dietary habit and activity environment. In most cases, the obesogenic environments were created and sustained not only for themselves but also to their children. These shared family environment and behaviours may explain the intergenerational relationship in obesity development[35].

The findings from the present study reinforce the available evidences on the relationship between household size and BMI status. Adolescents with larger household size had significantly lower risk of being obese than those with smaller household size. Similarly, study among South African adolescents reported higher proportion of overweight/ obesity among smaller household size in all ethnic groups[38]. Additionally, previous study also showed an inverse relationship between the number of children in the family and overweight[39]. Nonetheless, with smaller family number within household, the children living in the family also reported to consume the most energy as they have more food available per person and better access to food[38].

Table 2: Sociodemographic characteristics between normal and obese groups

Determinants	Normal (*n*= 2,305)	Obese (*n*=537)	*P*-value (x^2)[a]
School location			
Rural	882 (80.7)	211 (19.3)	0.659
Urban	1423 (81.4)	326 (18.6)	(0.194)
Gender			
Male	943 (76.2)	294 (23.8)	< 0.001
Female	1362 (84.9)	243 (15.1)	(33.93)
Ethnicity			
Malay	2188 (81.1)	509 (18.9)	0.825
Non-Malay	98 (80.3)	24 (19.7)	(0.05)
Breastfeeding history			
No	102 (80.3)	25 (19.7)	0.741
Yes	2130 (81.5)	484 (18.5)	(0.11)
Birth weight (kg)			
Low birth weight (<2.5)	286 (84.4)	53 (15.6)	0.104
Normal (2.5 – 4.2)	1620 (80.6)	389 (19.4)	(2.64)
Mother's BMI (current)			
Non-obese	1210 (83.9)	232 (16.1)	< 0.001
Obese	226 (67.9)	107 (32.1)	(45.07)
Father's BMI (current)			
Non-obese	1022 (84.0)	195 (16.0)	< 0.001
Obese	167 (66.5)	84 (33.5)	(41.13)
Household income (RM)			
Low (< 2300)	1136 (84.5)	208 (15.5)	< 0.001
Middle (2300 – 5599)	293 (74.9)	98 (25.1)	(42.39)
High (> 5600)	205 (70.0)	88 (30.0)	
Mother's working status			
Not working	724 (77.3)	213 (22.7)	< 0.001
Working	1325 (84.1)	251 (15.9)	(18.08)
Mother's educational level			
No formal schooling	41 (82.0)	9 (18.0)	0.001
Primary	204 (84.6)	37 (15.4)	(17.38)
Secondary	1663 (82.3)	357 (17.7)	
Tertiary	278 (73.7)	99 (26.3)	
Father's educational level			
No formal schooling	49 (86.0)	8 (14.0)	< 0.001
Primary	276 (89.0)	34 (11.0)	(29.62)
Secondary	1426 (81.7)	320 (18.3)	
Tertiary	289 (73.4)	105 (26.6)	
Household size			
Small (< 5 persons)	284 (77.0)	85 (23.0)	< 0.001
Middle (5-7 persons)	1280 (79.7)	326 (20.3)	(19.522)
Large (> 7 persons)	685 (86.2)	110 (13.8)	

Data are frequency (%); Sociodemographic characteristics vs. BMI categories (Pearson's chi-square test)

Table 3: Determinants for obesity among school adolescents in Terengganu

Determinants	Unadjusted OR (95% CI)	*P*-value[a]
School location		
Rural	1	
Urban	1.04 (0.86, 1.27)	0.659
Biological factors		
Gender		
Female	1	
Male	1.75 (1.45, 2.11)	<0.001
Ethnicity		
Non-Malay	1	
Malay	0.95 (0.6, 1.5)	0.825
Breastfeeding history		
No	1	
Yes	1.08 (0.69, 1.69)	0.741
Birth weight (kg)		
Low birth weight (<2.5)	1	
Normal (2.5 – 4.2)	1.3 (0.95, 1.77)	0.105
Mother's BMI (current)		
Non-obese	1	<0.001
Obese	2.47 (1.89, 3.23)	
Father's BMI (current)		
Non-obese	1	<0.001
Obese	2.64 (1.94, 3.57)	
Socioeconomic status		
Household income (RM)		
Low (< 2300)	1	
Middle (2300 – 5599)	1.84 (1.4, 2.42)	<0.001
High (> 5600)	2.36 (1.76, 3.17)	<0.001
Mother's working status		
Not working	1	
Working	1.55 (1.27, 1.9)	<0.001
Mother's educational level		
No formal schooling	1	
Primary	0.83 (0.37, 1.84)	0.641
Secondary	0.98 (0.47, 2.03)	0.952
Tertiary	1.62 (0.76, 3.46)	0.210
Father's educational level		
No formal schooling	1	
Primary	0.76 (0.33, 1.73)	0.505
Secondary	1.37 (0.65, 2.93)	0.410
Tertiary	2.23 (1.02, 4.86)	0.044
Household size		
Small (< 5 persons)	1	
Middle (5-7 persons)	0.851 (0.65, 1.12)	0.243
Large (> 7 persons)	0.537 (0.39, 0.74)	<0.001

[a] *Binary logistic regression, Obesity was defined as BMI z-score > +2SD for age*

Strength and limitation

To the best of our knowledge, this is the first study that attempted to identify the potential sociodemographic determinants of obesity among school adolescents aged 12 years in Terengganu, Malaysia. This study covered all government schools where most children in Terengganu are studying. Thus, it provides an insight and underlines the complexity and interaction of obesity aetiology specifically in Terengganu. The findings of the present study should lead to more accurate target of prevention and intervention programs for obesity among school adolescents especially in Terengganu. However, parent-reported and anthropometrics data compiled by PE teachers may had introduced an inaccuracy and inter-researcher variability. Since anthropometry measurement is a part of SEGAK test and was conducted bi-annually, PE teachers involved were fully trained with the accurate method in taking the measurements.

Table 4: Multivariable regression for obesity determinants

Determinants	AOR	95% CI	Wald statistic	*P*-value
Mother's BMI (current)				
Non-obese (ref.)				
Obese	2.22	1.44, 3.41	13.216	<0.001
Father's BMI (current)				
Non-obese (ref.)				
Obese	2.07	1.34, 3.19	10.871	0.001
Gender				
Female (ref.)				
Male	2.03	1.42, 2.91	14.912	<0.001
Mother's working status				
Not working (ref.)				
Working	1.88	1.31, 2.7	11.660	0.001
Household size				
Small (< 5persons) (ref.)				
Large (> 7persons)	0.45	0.241, 0.834	6.423	0.011

AOR: Adjusted OR, Forward LR Multiple Logistic Regression model was applied; Multicolinearity and interaction term were checked and not found. Hosmer-Lemershow test (P = 0.182), classification table (overall correctly classified percentage = 81.1 %) was applied to check the model fitness.

CONCLUSIONS

This representative cross-sectional study on 2,842 school adolescents in Terengganu had identified major potential determinants related to obesity. Being male, having working mother and higher parental BMI highly account for the obesity development among school adolescents. In addition, findings from this study were also found to be comparable with previous local studies conducted in southern and central Malaysia. Therefore, adolescents with identified risk factors are the important group that should be focused in the prevention programs. These findings contribute to the body of knowledge thus providing evidence for Ministry of Health and Ministry of Education to initiate policies and programs to address this fast growing problem at its roots. Future studies on prevention and treatments of obesity should also consider focusing on both parents and their children.

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