ORIGINAL ARTICLE

Biosocial Background in the Development of Child Overweight and Obesity among Preschoolers in Putrajaya: An Observational Study

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ABSTRACT

Introduction: Childhood obesity becomes a global epidemic with the majority are living in developing countries. Obese children are at risk of becoming obese adults with non-communicable diseases, which may further lead to huge economic burden for the affected countries. The study objectives were to determine the biosocial background contributing overweight and obesity among preschoolers in Putrajaya (2017) - sociodemographic, pre-and perinatal factors, feeding and weaning practices. **Methods**: Cross-sectional study was performed using cluster random sampling among 897 preschoolers, whose anthropometric body weights and heights were measured. The calculated BMI was used to determine their obese status based on WHO Growth Standards 2006 and Reference 2007. Their mothers were distributed with self-administered, validated, and pre-tested questionnaires regarding their children's first two-years-of-life experience. Chi Square test was used for bivariate categorical analysis, Independent T-test and Mann Whitney U test for continuous data analysis. Multivariate binary logistic regression was executed to determine predictors of child obesity. **Results:** The prevalence of obese children was 7.4%, which can be predicted by the increase in child's age (Adjusted Odd Ratio: 2.619; 95%CI: 1.435 – 4.780), mothers with higher level of education (AOR: 3.896; 95%CI: 1.127 – 13.470), and higher maternal BMI (AOR: 1.132; 95%CI: 1.057 – 1.213). **Conclusion:** Three predictors of child obesity can be derived from sociodemographic and pre-and perinatal factors. Further application on these predictors in more targeted interventions and policies need to be considered to reduce the prevalence of obesity and related non-communicable diseases in the country.

Keywords: Childhood obesity, Overweight, Preschool children.

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INTRODUCTION

Childhood obesity is becoming one of major public health concerns worldwide in today's era. However, defining childhood obesity has been changing over the years (1) due to its measurements being affected by children's maturation and growth (2). The World Health Organization (WHO) defines child obesity as "abnormal or excessive fat accumulation that may impair health" among children, which varies according to their age and gender (3). Different classification defines child overweight and obesity differently. Body mass index (BMI) is the preferred measurement among children and adolescents although it is of relative measure of weight being compared to adiposity (4).

The escalating prevalence of overweight and obesity among children and adolescents has turned into a global epidemic. In 2014, the number of overweight children under-five worldwide was estimated to be over 42 million and more than half (18 million in 2010) are living in developing countries (3), ensuing it to be the highest absolute numbers of child overweight and obesity (5). More children in developing countries are becoming obese and overweight, with triple rates of obesity in the past 20 years due to physical inactivity and changed dietary habit (6). As an upper middle-income country, Malaysia also fronting similar problem as national statistics showed that the prevalence of obesity in children less than 18 years old has tripled from 3.9% (0.3 million) in 2011 to 11.9% (1.0 million) in 2015 (7,8). This situation is distressing as study shows that the probability of obese children who passed the age of 6 will become obese adults exceeds 50% (41). The early development of insulin resistance in obese children can be associated to future vascular complications in obese adults such as coronary heart disease with relative risk

mortality of 2.3 (95% CI: 1.4 – 4.1) in men (42). This will lead to huge economic health costs and affect the social security systems of affected countries (2).

Obesogenic environment has been one of the main factors contributing to childhood obesity, in which high saturated fat diet consumption is coupled with reduced physical activity and sedentary lifestyle behaviours (2). The unhealthy dietary habit affects the gut barrier function, elevating the systemic antigenic load and low-grade endotoxaemia that can contribute to the development of insulin resistance in diabetes and obesity among children (9). Moreover, three critical periods in a child's life-course are desired to be further looked upon, which are [1] preconception and pregnancy; [2] infancy and early childhood; and [3] older childhood and adolescence (3). The first two life-courses are considered as early life (10) that incorporate biosocial background of childhood overweight and obesity (10).

Evidences revealed that several sociodemographic factors can be associated with childhood overweight or obesity such as child's age, ethnicity, parental education status, and socioeconomic status (11,12). Factors contributing to the increasing number of childhood obesity in developing countries such as sociocultural factors may be different from the ones in developed countries (13), resulting in double malnutrition issues. Evidences also suggest that varying biological responses in different ethnic groups differently affect childhood obesity and related comorbidities (14). Hence, the variance in biosocial factors need to be observed as there are differences in gene–nutrient interactions contributing to the development of childhood obesity.

As for pre-and perinatal factors, the first 1000 days of life which begin from the first day of conception until the first two years of life, can be influenced by maternal gestational diabetes and increased birth weight (15). In a pregnancy cohort study conducted in Kelantan in 2010 (16), a significant association was found between maternal BMI and child's body mass index for age z-score (BAZ) with correlation 0.04 (95%CI: 0.01 - 0.07). This can be resulted from the modification of gene expression intrapartum (9) or the accelerated weight gain of infants with overweight or obese mothers (17).

Weight gain in the first year of life can be explained by the "early protein hypothesis" which describes early protein intakes that are higher than a child's metabolic requirements and thus may cause an increased risk of child obesity (18). This hypothesis proves that there is protective effect of breastfeeding against childhood overweight (AOR: 0.79; 95% CI: 0.68 - 0.93) and obesity (AOR: 0.75; 95% CI: 0.57 - 0.98) as the protein intake in formula-fed infants is 55-80% higher per kg bodyweight compared to breast-fed infants (10). As for weaning practices and solid food introduction in infants, early introduction of solids as early as less than three months of age can be associated with child obesity at the age of five years old (AOR: 1.2; 95%CI: 1.02 – 1.5) (43).

Being ranked as the fattest country in South-east Asia and the sixth in the Asia-Pacific region (19), overweight and obesity is considered as a national issue in Malaysia. In 2015, Putrajaya has the highest percentage (43%) of overweight, obesity and abdominally obese people in the country (8). A study conducted by the Nutrition Society of Malaysia in 2010 showed that 14.5% of children aged one to three years old and 16.6% of children aged four to six years old were overweight in Kuala Lumpur, Putrajaya, and Selangor (20). Thus, the growing prevalence of child overweight and obesity in Putrajaya should be prevented to avoid additional increment in adult overweight and obesity in the future. As most available strategies nowadays are mainly focusing on dietary habits and physical activities (22), a background study on the biosocial of childhood obesity among preschoolers in the local context is prudent to fill some of the research gaps in the region.

MATERIALS AND METHODS

Study Population/ Sample Size/ Sampling Frame

An observational cross-sectional study design was conducted in randomly selected registered preschools – governmental and non-governmental – in Putrajaya with the Ministry of Education of Malaysia. The sampling frame was the list of registered preschools in Putrajaya in 2017. The study population for this study was preschool students (aged five and six years old). These age groups are part of the two periods when adiposity increases which affects children's overweight and obesity measurements (2). The sample size was calculated using the formula for hypothesis testing of two population proportions (23). The highest feasible number of sample size were chosen based on a study on "Early life course risk factors for childhood obesity: The IDEFICS case-control study" (11). The proportion of overweight and obese child with mothers who gain weight ≥ 25 kg during pregnancy, P_1 is 0.63, whereas the proportion of overweight and obese child with mothers who gain weight <25 kg during pregnancy, P_2 is 0.49. By estimating 10% of non-response rate and considering the design effect of the study, the refined number of total respondents for this study were 862.

Sampling Method

Cluster random sampling method was used. In average, there were 59 children in each preschool. From total of 110 preschools in Putrajaya, 15 preschools were chosen by table of random sampling.

Since only attended preschoolers aged five and six years old (who were delivered in 2011 and 2012) with living mothers were included in the study, additional

five preschools were randomly chosen to achieve the study's sample size number. Respondents with underlying medical conditions that caused childhood overweight and obesity e.g. Cushing's disease, Prader Willi Syndrome, uncooperative or absent for the anthropometry measurements, or with mothers who cannot read or write to respond to the questionnaires were excluded from the study. As for respondents with same mothers, the youngest siblings were selected as respondents to minimize recall bias among mothers. Mothers who do not have previous antenatal card record keepings during child respondents' conception were also being excluded because previous maternal weight and height record were required for data collection.

Questionnaire and Anthropometry measurements

Questionnaires on early life factors associated with childhood overweight and obesity were distributed to the child respondents' mothers. Three sections were categorized based on the studied early life factors related to the child respondents' first two years of life experience.

The developed questionnaire was an adaptation from previous validated questionnaires in several related studies. Section one of the questionnaire was pertaining to the sociodemographic factors, including child's age, ethnicity, socioeconomic status, and mother's education status. On pre-and and perinatal factors questions, the questions were adapted from Malaysia's birth cohort study (16) and a study on the early life factors in Sweden (24). Factors that were looked upon during the child respondents' pre-and perinatal period were gestational weight gain and maternal BMI based on the mothers' previous antenatal record keepings. Other factors include mode of delivery, birth weight of the child, maternal smoking status, and second-hand exposure to tobacco smoke in the child's first two years of life. For infant feeding and weaning practices, Oxford Food Frequency Questionnaire (FFQ) was adapted in addition to several other related literature reviews (10,24). Factors that were investigated were full breastfeeding status and duration, formula milk types and delivery, weaning status and age of initiation, and introduction of solids in the preschoolers' first two years of life.

The questionnaire's contents were validated and amendments were made accordingly by a panel of public health physicians. The questionnaire was prepared in Malay and English and it underwent a back-to-back translation to ensure that the questions suggest similar meaning. Apart from that, a pre-test on the questionnaire was held to ensure its comprehensibility. The reliability analysis of each sections of the questionnaire showed Cronbach Alpha value range of 0.50 - 0.70 with intra-class correlation coefficient value of 0.70 (95% CI: 0.299 – 0.841, which is an acceptable degree of reliability (25).

The anthropometry measurements conducted were body weight (kg) and height (cm) of the sample unit. This was done by one researcher to avoid measurement bias, using calibrated SECA weighing scales and standing portable stadiometer. The measurement procedures followed the standard procedure of the WHO Child Growth Standards 2006 (26). Twice measurements were conducted and the mean values were used for the BMI calculation.

The calculated BMI was compared with WHO Growth Standards 2006 table for BMI-for age (z-scores) in 0-5 years old and WHO Growth Reference 2007 table of BMI-for age (z-scores) in 5-19 years old children, which varies between boys and girls. Based on this, the overweight and obesity status of the child could be determined. For children who are less than 5 years old, overweight is a BMI-for-age z score >2 and obesity is a BMI-for-age z score >3. For overweight and obese children 5 years and above, overweight and obesity were defined as BMI-for-age z score >1 and >2 respectively [26]. As for operational definition of obesity in this study, it includes both child overweight and obesity.

Statistical Analysis

By using Statistical Package of Social Sciences System (SPSS) version 22.0, descriptive statistics of variables were presented as frequency, percentage, mean, median, interquartile range, and standard deviation. Inferential statistics that were used compare the calculated BMI of the children to the BMI-for-age z-scores table, which follows WHO Child Growth Standards 2006 and Child Growth Reference 2007. Chi Square test was conducted to measure the association between the categorical independent variables and child obesity. For continuous independent variables, Independent T-test and Mann Whitney U test were conducted based on normality test findings. As for multivariate analysis, multiple logistic regression was used and results were expressed as Odds Ratio with 95% CI not including number 1 to be significant and level of significance was set at 0.05 value ($p < 0.05$).

Out of 22 independent variables that were tested in bivariate analysis, seven of them with p value less than 0.25 were selected to be included in the multivariate analysis, which were the child's age, child's gender, mother's education status, socioeconomic status, second-hand exposure to tobacco smoke, maternal BMI, and weaning status of the child. The cut-point p-value of 0.25 was used as evidence showed that the traditional usage p-value of less than 0.05 usually fails to identify some important variables in multivariate analysis (44). The final model with the highest Nagelkerke R Squared value and number of significant variables were chosen. Fitness final model was assessed using Hosmer and Lemeshow goodness of fit test, classification table, and ROC curve.

Ethics

Data collection was initiated only after the Ethics Committee for research involving Human Subjects of University Putra Malaysia gave permission and approval (Reference: UPM/TNCPI/RMC/1.4.18.2). Preschool teachers and parents were informed and explained regarding the study with additional provision of the information sheet, and parental consents were obtained prior to the anthropometry measurements and questionnaire deliveries. National Medical Research Registry (NMRR) registration was performed and respective preschool authority's permissions from Education Planning and Research Division of Ministry of Education Malaysia (BPSH), Community Development Department (KEMAS) of Ministry of Rural and Regional, and Department of National Unity and Integration (Perpaduan) of Prime Minister Department were requested and received. Upon completion of data collection, appropriate referrals on affected students with body weight problems such as severely underweight, underweight, overweight, and obese were made to the respective health clinics for health education and further intervention by the nutritionists in charge.

RESULTS

Response Rate

The overall response rate of this study was 81.5%, by mothers of anthropometry measured child respondents, who answered the distributed questionnaires.

Normality tests

The normality tests findings showed high significant levels of Kolmogorov-Smirnov and Shapiro-Wilk tests with p-values less than 0.05. However, graphical evidence of histogram, stem and leaf, box plot, and q-q plot (27) were normally distributed on child's age, child's BMI, mother's age, maternal gestational weight gain, maternal BMI, child's birth weight, and age of start weaning. Other continuous variables of monthly household income and duration of full breastfeeding were not normally distributed.

Sociodemographic Characteristics of Respondents

Not all the child respondents live in Putrajaya even though they attended registered preschools in Putrajaya. The child's mean age was 5.4 ± 0.58 whereas the mother's mean age was 34.6 ± 3.54 years with the youngest mother aged 25.6 years old and the oldest mother aged 47.7 years old. There was almost equal distribution between male and female child respondents. Majority of them were Malay (98.6%) and with working mothers (85.3%). There were proportions of mothers who were studying (2.7%), while others were housewives (12.0%) with or without side incomes. Most of the families' monthly household incomes were at the higher side (64.9%) of more than RM5000 per month. As for the mothers' education status, almost all of them had attained some types of education, whether primary and secondary (20.5%) or tertiary levels (79.3%).

Prevalence overweight and obesity

Nutritional status from the child respondents' body weight and height measurements was elicited based on the WHO Child Growth Standards 2006 and WHO Growth Reference 2007. Majority of them were in normal range of BMI (78.6%). However, 7.3% of the child respondents were obese, and the remaining 12.9% were underweight and severely underweight.

Association between sociodemographic, pre- and perinatal, feeding, and weaning practices on child overweight and obesity among preschoolers

The association of categorical socio-demographic variables and child obesity using Chi Square test was described in Table 1. Respondents with higher monthly household incomes of RM5000 per month or more and educational status of tertiary education have higher percentages of obese children with 7.9% and 8.0% respectively. However, there was no association between the children's socioeconomic status ($p = 0.288$) and the mothers' education status ($p = 0.224$). Continuous variable of child's age was tested for its association with childhood obesity using Independent T-test as it is normally distributed. The mean difference of age of 0.25 (95%CI: 0.13 – 0.37) between those who were obese and those who were normal and underweight was statistically significant ($p < 0.001$) with a higher mean age of 5.63 ±0.47 years old in respondents who were obese as shown in Table 2.

The pre- and perinatal discoveries included maternal components, newborn variables, and condition factors amid pregnancy. For maternal components, the mean gestational weight gain was 11.8 ±5.3 kg with overweight maternal BMI of 23.4 ±4.4 kg/m^2. Most of the mothers (73.6%) had history of spontaneous vaginal delivery compared to caesarean section (26.4%) and only eight (0.9%) of them admitted to smoking during the conception of child respondents. Nevertheless, almost half of the child respondents (41.8%) have been exposed to tobacco smoke from family members in which 277 (74.3%) of them smoke daily either inside or outside the house. Most of the child respondents were delivered at term (92.9%) with a mean birth weight of 3.1±0.5 kg.

As shown in Table 2, the maternal BMI mean difference of 1.76 (95%CI: 0.43 – 3.08) was not statistically significant even with p-value of 0.009. Other investigated newborn factors such as delivery status of the child ($\chi^2 = 0.116$; $p = 0.734$) and environmental factors including maternal smoking status ($p = 1.000$) were not statistically significant to child obesity among the preschoolers as described in Table 1.

Table 1. Association between socio-demographic, pre-and perinatal factors, and child obesity

Variable	Obese	Non- Obese	Test Statistics	
	n (%)	n (%)	χ^2	P value
Child's Gender (N=897)				
Male	37 (8.4)	402 (91.6)	1.445	0.229
Female	29 (6.3)	429 (93.7)		
Household monthly incomes (N=817)				
< 5000	16 (5.6)	271 (94.4)	1.558	0.212
≥ 5000	42 (7.9)	488 (92.1)		
Mother's education status (N= 894)				
No formal education and Primary/Secondary education	8 (4.3)	176(95.7)	2.936	0.087
Tertiary education	57(8.0)	653 (92.0)		
Mode of delivery (N=884)				
SVD	45 (6.9)	604 (93.1)	0.380	0.538
Caesarean	19 (8.2)	214 (91.8)		
Delivery status (N=890)				
Term	62 (7.5)	763 (92.5)	0.116	0.734
Pre-term	4 (6.3)	59 (93.7)		
Maternal smoking status (N=891)				
Yes	0 (0.0)	8 (100.0)		1.000[a]
No	66 (7.5)	815 (92.5)		
Second-hand exposure to tobacco smoke (N=892)				
Yes	22 (5.9)	350 (94.1)		
No	44 (8.5)	474 (91.5)	2.099	0.147

Note: [a] – Fisher's Exact test

Table 2. Association between child's age, gestational weight gain, maternal BMI, child's birth weight, age of start weaning and childhood obesity using Independent T-test

Variables	Obese Mean (SD)	Non- Obese Mean (SD)	Mean diff (95% CI)	t-statistics (df)	P value
Mean child's age (years) (N=897)	5.63 (0.47)	5.38 (0.59)	0.25 (0.13, 0.37)	4.13 (82.39)	<0.001*
Mean gestational weight gain (kg) (N=538)	12.17 (6.26)	11.77 (5.25)	0.399 (-1.17, 1.97)	0.50 (627)	0.618
Mean maternal BMI (kg/m^2) (N=530)	24.99 (4.85)	23.23 (4.37)	1.76 (0.43, 3.08)	2.61 (617)	0.009*
Mean birthweight (g) (N=622)	3093 (584.94)	3056 (493.56)	36.91 (-103.33, 177.14)	0.52 (724)	0.606
Mean age start weaning (months) (N=665)	6.68 (1.61)	6.68 (2.66)	-0.005 (-0.67, 0.65)	-0.02 (869)	0.987

* significant at p<0.05

Breastfeeding, formula feeding, and complementary feeding were assessed as part of the early life feeding and weaning practices. 783 mothers (88%) had fully breastfed their children with mean duration of 6.0 ± 3 months. On top of that, 788 mothers (88.1%) had given formula feeding to their children within their first two years of life with majority of them choosing cow milk formula (91.4%). As for complementary feeding, there is a small portion of mothers (2.1%) who decided not to start weaning their children within their first two years of life, and most of them claimed to fully breastfeed.

Higher percentages of child overweight and obesity were found among those who were fully breastfed (7.5%), formula fed (7.7%), and weaned in the first two years of life (7.5%). However, statistical findings using Chi Square test as shown in Table 3 revealed that there were no significant associations between feeding and weaning practices of the child respondents and childhood obesity. As for the age of weaning initiation association using Independent T-test in Table 2 and duration of full breastfeeding association using non-Parametric Mann Whitney U test in Table 4, both were statistically non-significant with p-values more than 0.05.

Predictors of childhood overweight and obesity among preschoolers in Putrajaya.

The multivariate analysis findings as showed in Table 5 described that with an increase of one year of age, the preschooler has 2.619 times likely to become obese (95%CI: 1.435 – 4.780). Mothers with tertiary education level were 3.896 times likely to have obese children (95%CI: 1.127 – 13.470). For maternal BMI, with an increase in one unit of the BMI, a mother was 1.132 times likely to have an obese child (95%CI: 1.057 – 1.213).

DISCUSSION

Research on factors associated with childhood overweight and obesity have been conducted among school children (28) and adolescents (29) locally, which mainly focused on dietary intake and physical activity. However, they were lacking data and proof in relation to the preschoolers and early life factors.

Findings on the prevalence of childhood obesity among children aged five and six years old in Putrajaya, 2017 that was elicited in this study (7.3%) showed an increasing trend of the disease burden in this age group

Table 3. Association between feeding and weaning practices and child obesity

Variable	Obese	Non- Obese	Test Statistics	
	n (%)	n (%)	χ^2	P value
Full Breastfeeding status (N=890)				
Yes	59 (7.5)	724 (92.5)	0.135	0.713
No	7 (6.5)	100 (93.5)		
Formula feeding status (N=894)				
Yes	61 (7.7)	727 (92.3)	1.250	0.264
No	5 (4.7)	101 (95.3)		
Cow milk for baby (N=790)				
Yes	57 (7.9)	663 (92.1)	0.434	0.510
No	4 (5.7)	66 (94.3)		
Goat milk for baby (N=790)				
Yes	4 (10.0)	36 (90.0)	0.307	0.580
No	57 (7.6)	693 (92.4)		
Soy milk and other special formula (N=790)				
Yes	8 (8.9)	82 (91,1)	0.194	0.659
No	53 (7.6)	647 (92.4)		
Weaning status (N=890)				
Yes	65 (7.5)	806 (92.5)	1.530	0.216
No	0 (0.0)	19 (100.0)		
Place of food preparation (N=888)				
Home	61 (7.4)	760 (92.6)	<0.001	0.992
Restaurant, Shop (ready-made) and nursery/ caretaker house	5 (7.5)	62 (92.5)		
Persons who prepare food (N=889)				
Mother/Father	64 (7.6)	776 (92.4)	0.725	0.395
Grandparents/Caretaker/maid & others	2 (4.3)	45 (95.7)		

Table 4. Association between duration of full breastfeeding and child obesity using Mann Whitney U test

Variables	n	Duration full breastfeeding Median (IQR)	Z statistics	P value
Obese	64	6.00(2.00)	-0.273	0.785
Non-obese	803	6.00(3.00)		

Table 5. Predictors for childhood obesity among preschoolers

Factors*	B	SE	AOR	95%CI	p
Child's Age	0.963	0.307	2.619	1.435 – 4.780	0.002
Mother's education level					
Tertiary education	1.360	0.633	3.896	1.127 – 13.470	0.032
Maternal BMI	0.124	0.035	1.132	1.057 – 1.213	<0.001

SE = standard error, **AOR** = adjusted odds ratio, **95%CI** = 95% confidence interval, significant at $p < 0.05$
*Final model based on'ENTER' method, Nagelkerke $R^2 = 1.121$, Cox and Snell $R^2 = 0.050$, Hosmer and Lemeshow goodness of fit test (χ^2=5.089, df=8, p=0.748), Classification table = 92.4%, No multicollinearity (VIF <10 and Tolerance = 0.901 – 0.984).

when compared to the prevalence of obesity among preschool children worldwide in 2010 (6.7%) from 450 nationally representative cross-sectional surveys included in the WHO Global Database on Child Growth and Malnutrition (5). From the latest NHMS report in 2016 on maternal and child health (30), the overall national prevalence of overweight for children less than five years old was 6.4% (95% CI: 5.40-7.49). These evidences demonstrate an expanding pattern of the advancement of overweight and corpulence among the youngsters in the nation, which has just achieved a scourge extent all around.

The 5.6 % higher prevalence of underweight and severely underweight as compared to those who were obese among preschoolers in Putrajaya, 2017 were parallel to the recent national observations of predominant under-nutrition, which includes underweight, stunting, and wasting among Malaysian children under five years old (30). This exhibited the double burden of malnutrition among the children at population level, in which under-nourishment coincides with overweight and obesity among populations throughout their life-course (31). At individual level, an obese child may have one or more various vitamins and minerals deficiency. Whereas at household level, an overweight mother may deliver a premature and underweight child. This can be influenced by socio-economic growth, urbanization, and lifestyle diet changes among the society, which resulted in malnutrition.

Multivariate analysis conducted on the independent variables of the study found three significant predictors of childhood obesity development among the preschoolers: older child's age, higher mother's education level, and higher maternal BMI. A child older by one year is three times more likely to have obesity, which contradicts findings on Kenyan children (12), whereby an older child's age was found to be a protective factor for child obesity (OR:0.95; 95%CI: 0.92-0.97). This could be due to various ecological components that present the children to obesogenic conditions such as fast food consumption and inactive ways of life. Apart from that, "adiposity rebound" of children's normal growth at the age of five and six years old may also play a role, in which the linear BMI increment with age after infancy may result in childhood overweight (32).

This study also found that the higher the mother's education level, the more likely it is for the child to become obese. Similar findings were found among Kenyan preschoolers (12), which can be related to maternal employment and higher socioeconomic status, thus provisioning more obesogenic environment such as higher fat and sugar intake for the children (33). Evidence from a study conducted among 142 kindergarteners in Selangor, Malaysia showed a positive relationship between working hours of employed mothers and their child's BMI ($r=0.21$, $p<0.05$) and weight ($r=0.16$, $p<0.05$) (34). However, there was an inverse association between parental education and both overweight (OR: 0.87, 95%CI: 0.82 – 0.92) and obesity (OR:0.80, 95%CI: 0.73–0.89) in a cross-sectional study on predictors of overweight and obesity in five to seven-year-old children in Germany (35).

Different nutritional experience at critical periods in early life, both pre- and post-natal, can program a person's future metabolism, development, and health, which is also known as nutrition programming (36). The study's significant predictors of maternal BMI in the early pregnancy of the child is similar to the findings found by Universiti Sains Malaysia (USM) Pregnancy Cohort (16), in which significant association was found between maternal BMI and child's body mass index for age z-score (BAZ) with correlation 0.04 (95%CI: 0.01 – 0.07). This prediction of maternal nutritional status towards child overweight and obesity may be due to genetic factors interacting with unhealthy environments such as increased dietary fat intake and reduced physical activity as both mother and child are sharing same environment (12). Moreover, overweight mothers tend to not breastfeed their babies, thus increasing the likelihood of childhood overweight and obesity due to the absence of breastfeeding's protective effects (37).

Early life nutrition has also been shown to have an important long-term impact on a child's health and development. This includes the period of milk-feeding in the first four to six months of life and complementary feeding until the age of two (38). Many studies have established the protective effects of breastfeeding against childhood obesity as evidence by meta analyses (39). Complementary feeding and the children's dietary behaviours in their early years were proven to influence the development of overweight and obesity (10). Ecologically, parental behaviours such as restrictive feeding practices (AOR: 1.75; 95%CI: 1.06–2.9) can further contribute to the child's early life nutrition (40).

Many of the putative factors in this study such as maternal smoking and breastfeeding practices were not independently associated with overweight and obesity among the preschoolers. This can be due to various factors ranging from study designs, data collection instruments, data analysis, and individual bias. For example, the protective effects of breastfeeding against child obesity have been established in many cohort, case-control and cross-sectional studies as evidence by meta analyses (39), which exhibited significant risk reduction of AOR 0.78 (95% CI:0.71- 0.85). For the adapted questionnaire that was used in this study, prior appropriate factor analysis was unable to be performed, which may somehow affect the outcome of the analysis. This study is mainly limited to recall bias among the mothers as the early life factors were asked based on their previous three to four years recall. Hence, the children's first two years of life experience was repeatedly stressed in the questionnaire for better answers. Several other important early life factors such as early child growth, diet and physical activity were unable to be explored in this study due to the limitation of study design and duration.

Nevertheless, this study was able to determine some of the important early life factors contributing to preschooler overweight and obesity in Putrajaya. As cluster sampling was executed, a higher number of samples of 897 was obtained compared to the calculated sample size of 862, with acceptable response rate. This study was also able to have heterogenous socioeconomic background among the study sample as both government and private preschoolers were included in the data collection.

CONCLUSION

The study elicits three biosocial factors that can be used to predict preschoolers obesity in Putrajaya, 2017, which include socio-demographic factors (older child's age and tertiary education among the mothers) and pre- and perinatal factors (higher maternal BMI).

In overcoming majority of the study constraints, a few upgrades on the research methodology can be considered for a more favourable outcome, such as conducting a prospective cohort study to elicit other important early life factors as more than 80% of them were unable to be investigated from the current study. More diverse study population with multiracial backgrounds should also be included to assess the ethnicity influence on childhood overweight and obesity locally. For a better representation of the study population, stratified sampling methods can be implemented to proportionately distribute between both public and private preschools.

As for the practical application of the research findings, further attention on the associated sociodemographic and pre- and perinatal factors needs to be delivered via more specific preventive intervention strategies against child obesity. Based on socio-ecological models, the intervention strategy delivery can be implemented at all individual, family, community, and policy levels. For instance, at the individual level, younger children should be educated earlier on healthy eating habits and physical activity before they are at risk of overweight and obesity at older age. Family education on healthy lifestyles should be promoted with regards to children's diet, play activity, screen time, and sleep behaviours, especially among mothers with higher education level. Maternal obesity prevention should also be strengthened at pre-pregnancy and early antenatal periods by delivering early health promotion and education at primary care, which may help them avoid the life-long adverse health effects related to overweight and obesity for both mother and child. At policy level, compulsory overweight and obesity screening should be enforced on all preschoolers in early detection of the problem for better obesity prevention for the children.

The early life factors that were found in this study are only the tip of the iceberg in relation to childhood overweight and obesity risk factors. This issue requires

more proactive actions by all members of the community if a healthier nation is desired for the future generations.

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