Is adolescent obesity influenced by parental BMI during post-pandemic COVID-19?

ABSTRACT

This study seeks to look at the prevalence of adolescent obesity during post-pandemic and whether they are influenced by their parental BMI. A cross-sectional study design was used to conduct this study which included 386 participants from institutions of higher education in Jakarta City. Anthropometric data were obtained by trained volunteers and other variables were obtained via a self-administered questionnaire completed using a Google online form. Of the 420 questionnaires that were distributed, 386 (almost 92%) were sent back and completed. Data were analyzed by bivariate and multivariate analysis using chi-square and logistic regression adjusted by some lifestyle covariates. In the overweight or obesity category, 59.65% and 63.16% of participants have a father or mother who was overweight and obese in their BMI category. Adolescents were 2.93 times more likely to be obese if their fathers were obese compared to their mothers (OR=2.93; 95% CI=1.61-5.33). Similarly, girls who had obese fathers were more likely to be obese than their peers who had normal-weight or underweight fathers (OR=4.00, 95% CI=1.96-8.19). When stratified by gender, in boys, adolescents were not associated with their parents and even subsequent analyses by father or mother's BMI (OR=1.14; 95% CI=0.28-4.54). There was a correlation between parental BMI and overweight/obesity in adolescents, fathers' BMI was a stronger predictor than mothers' BMI. The current study emphasizes the significance of adolescent obesity and overweight as a public health issue in this demographic and suggests that preventive measures must be taken.

Keywords: Overweight; Obesity; Adolescent; Parental BMI

Conflict of Interest

The author has no conflict of interest in this study.

INTRODUCTION

Undernutrition in all its forms is a concern in low- and middle-income countries (LMICs), where childhood and teenage obesity incidence is extremely high and continues to rise (1). Simultaneously, the epidemic was associated with a rise in childhood obesity in many countries. These shifts are concerning since there is mounting evidence that connects childhood obesity to a host of adverse short- and long-term health outcomes, including reduced quality of life (2), a higher likelihood of seeking medical attention (3), and higher financial expenses for both individuals and society.

An abnormal or excessive fat buildup that poses a health risk is called overweight or obesity. Over 25 is classified as overweight, and over 30 as obese based on body mass index (BMI). The worldwide burden of illness report from 2017 shows that the problem has escalated to epidemic proportions, with over 4 million deaths annually attributable to overweight or obesity. Globally, the percentage of children and adolescents aged 5-19 who are overweight or obese grew by more than four times, from 4% to 18%, between 1975 and 2016 (4,5).

Childhood obesity is associated with a variety of adverse effects issues, as well as an increased chance of the beginning of connected disorders at a young age. According to studies, children and adolescents who are fat will most likely remain obese throughout adulthood (6). Obesity data in Indonesia shows that 13.5% of adults aged 18 years and over are overweight. Meanwhile, 28.7% were obese (BMI> 25) based on the 2016 National Health Survey; the obesity rate increased to 20.7% (BMI> 27) and became 33.5% at BMI> 25 (7).

Besides the increasing number of obesities, which continues to increase every time, another health problem that is currently being faced by all countries in the world is the threat of the

Dikomentari [A1]: You want to talk about the undernutrition or obesity? I don't think mentioning undernutrition is necessary here.

Dikomentari [A2]: Please stated your topic sentences in the beginning of every paragraph to make it easier for the reader navigate your point.

Here you talk about the definition and the prevalence, what exactly you want to talk about?

Dikomentari [A3]: Previous comment also applied here. Obesity effects and prevalence (again)?

COVID-19 pandemic. Obesity raises a person's risk of developing COVID-19-related severe illness as well as numerous other significant chronic diseases. To combat adult and childhood obesity as well as its disparate impact on racial and ethnic minority groups, everyone has a part to play (8).

Adolescent obesity is a multifactorial chronic disease influenced by biological, behavioural, and environmental factors (9). Obesity in children and adolescents can affect a child's immediate health, educational attainment, mental health, and quality of life. Furthermore, childhood obesity is linked to problems throughout the life course and continues throughout adolescence and maturity (10). A higher risk of several health consequences, including metabolic illnesses including elevated fasting glucose, impaired glucose tolerance, type 2 diabetes mellitus (T2DM), metabolic syndrome, and fatty liver disease, is associated with an increased body mass index (BMI), particularly in adolescence (11,12).

Many studies have reported the association between a parent's obesity and the underlying mechanisms, which are poorly understood. This study seeks to look at the prevalence of obesity during the post-pandemic and whether they are related to parental obesity or lifestyle behavior.

Dikomentari [A4]: So what about it?

Dikomentari [A5]: Is this assumption? Also, this statement is jumping from previous sentences.

Dikomentari [A6]: Suddenly talk about racial and minority groups? Are you okay? What exactly you want to talk about in this paragraph?

Dikomentari [A7]: You want to talk about the cause of the impact of obesity?

Dikomentari [A8]: What are the studies? Conduct by whom and where? What did they find? How this study fills the existence gaps?

Dikomentari [A9]: Why suddenly you mention about parental obesity which does not mention anywhere in this introduction? And what kind of lifestyle behaviour you mean here?

MATERIAL AND METHODS

This survey was performed in urban and suburban areas in Jakarta during the post-pandemic, and most of the participants still study from home. Participants were selected from Institutions of higher education by cluster random sampling method. The total sample size was calculated as 386 participants. Trained volunteers conducted the physical examination for height and weight using calibrated instruments to measure participants' body mass index. These volunteers were selected from health students in every institution of higher education in the Jakarta area. These volunteers were trained to measure anthropometric indices according to standard protocols.

Dikomentari [A10]: So the enumerator come to the participants' home? Also meet with both of respondents' parents to measure their BMI?

Dikomentari [A11]: Please explain more about this method. What exactly the researcher do to obtain the participants?

Standing height was recorded without shoes to the nearest 0.1 cm. Weight was measured with the subject in light clothing to the nearest 0.1 kg. BMI was calculated as weight (Kg) divided by height in square meters (m2). BMI categories were defined according to World Health Organization (WHO) reference for different ages and groups [13]. Parents were asked to report their weight and height. Parental and adolescent BMI was calculated as underweight (BMI <18.5), normal weight (18.5<BMI<24.9), overweight (BMI >= 25-29.9), and obese (BMI >=30). Age and sex information were also collected, including lifestyle behavior (sleep duration, breakfast habit, stress level, physical activity, and sedentary lifestyle). This study has been granted ethical review by the Institutional Review Board or health research ethics committee of the Faculty of Medicine and Health, University of Muhammadiyah Jakarta 071/PE/KE/FKK-UMJ/IX/2020.

Dikomentari [A12]: Why self-report when the adolescents were being measured?

Dikomentari [A13]: Please specify these variables by explaining the operational definition of each variable.

From the variable mentioned here, it is unclear how the researchers measure the influence of COVID-19 in this study. It seems like post COVID-19 is only the period of this study was conducted without any variables measuring this COVID-19 influence on the relationship between parents and adolescents obesity.

Statistical Analyses

All analyses were conducted using the survey analysis method in SAS software. Categorical data were presented as numbers and percentages. The weight status of the adolescents was analyzed as an ordinal outcome variable. Parental weight status was categorized into four group categories (underweight, normal, overweight, obese) which was investigated as an ordinal response variable. Person chi-square statistic was used to determine the association between the weight status and participant's characteristics. Logistic regressions were applied to the odds ratios (ORs) and 95% confidence interval (CIs) of obesity by parental BMI status and adjusted for potential confounders. Model 1 was adjusted by age and sex, model 2 was further adjusted by breakfast habit and sleep duration, model 3 was further adjusted by physical activity variable, and model 4 was further adjusted by condition of participants (stress level). All the tests were two-sided, and the significance level was 0.05.

RESULT

In total, 370 participants (84.6% girls) completed the study. The mean and SD age of the subjects was 19.91±1.03 years. In the overweight or obesity category, 59.65% and 63.16% of participants have a father or mother who was overweight and obese. Almost half of adolescents had 3-5 times/week of breakfast habit, more than half 54.39% had a less active category of physical activity, 64.91% had average sleep duration, and 45.61% of adolescents had a sedentary lifestyle and experienced stress, respectively. The primary and demographic characteristics of the study participants are given in Table 1. We also did subsequent analyses by boys and girls, and simple bivariate analyses were performed for boys and girls.

Table 2 reported the multivariate regression models for the association of obesity and parental BMI in adolescents, adjusted for potential confounders. The analyses were stratified by gender. In models 1-4, adolescent obesity was significantly associated with parental obesity after adjusting for confounders. Parental overweight increased the odds ratio of obesity among adolescents, and strong associations were found between overweight and obese parents and the BMI of the adolescents ($p<0.05$). Adolescents were 2.93 times more likely to be obese if their fathers were obese compared to their mothers (OR=2.93; 95% CI=1.61-5.33). Similarly, girls who had obese fathers were more likely to be obese than their peers who had normal-weight or underweight fathers (OR=4.00, 95% CI=1.96-8.19) Table 3. When stratified by gender, in boys, adolescents were not associated with their parents and even subsequent analyses by father or mother's BMI (OR=1.14; 95% CI=0.28-4.54) Table 4.

Dikomentari [A14]: This number is inconsistent with the abstract. Also, the thing about respondents' adherence to complete the study is not mentioned here, but mentioned in the abstract.

Of the 420 questionnaires that were distributed, 386 (almost 92%) were sent back and completed.

Dikomentari [A15]: Choose one, mentioning the number or explaining it. Please don't do both.

Dikomentari [A16]: This paragraph is hard to follow by the reader. What kind of findings that author want to point out? Please make the paragraph clear and easy to understand. Do not just point out number randomly.

Dikomentari [A17]: What are the potential cofounders?

Dikomentari [A18]: Why stratified by gender? Please elaborate this in method section.

Dikomentari [A19]: Please don't repeat yourself.

Dikomentari [A20]: ???

Dikomentari [A21]: Do you mean obesity among male adolescents?

Table 1. Study sample characteristics

Characteristics	Normal or Underweight (n=313)	Overweight or Obesity (n=57)	*p* value	Normal or Underweight (n=313)	Overweight or Obesity (n=57)	*p* value	Normal or Underweight (n=313)	Overweight or Obesity (n=57)	*p* value
Father's BMI			0.0003			<.001			0.216
Normal or Underweight	206 (65.81)	23 (40.35)		178 (67.68)	14 (35.00)		28 (56.00)	9 (52.94)	
Overweight or Obesity	107 (34.19)	34 (59.65)		85 (32.32)	26 (65.00)		22 (44.00)	8 (47.06)	
Mother's BMI			0.0061			0.0002			0.2158
Normal or Underweight	177 (56.55)	21 (36.84)		147 (55.89)	10 (25.00)		30 (60.00)	11 (64.71)	
Overweight or Obesity	136 (43.45)	36 (63.16)		116 (44.11)	30 (75.00)		20 (40.00)	6 (35.29)	
Age			0.4993			0.0228			0.0272
less than equal 19	101 (32.27)	21 (36.84)		78 (29.66)	18 (45.00)		23 (46.00)	3 (17.65)	
More than 19	212 (67.73)	36 (63.16)		185 (70.34)	22 (55.00)		27 (54.00)	14 (82.35)	
Breakfast habit			0.4508			0.6856			0.259
less than equal 2 times/week	66 (21.09)	15 (26.32)		57 (21.67)	10 (25.00)		9 (18.00)	5 (29.41)	
3-5 times/ week	122 (38.98)	24 (42.11)		102 (38.78)	17 (42.50)		20 (40.00)	7 (41.18)	
more than 6 times/week	125 (39.94)	18 (31.58)		104 (39.54)	13 (32.50)		21 (42.00)	5 (29.41)	
Physical Activity			0.4992			0.0464			0.0918
Less active	155 (49.52)	31 (54.39)		125 (47.53)	24 (60.00)		30 (60.00)	7 (41.18)	
Active	158 (50.48)	26 (45.61)		138 (52.47)	16 (40.00)		20 (40.00)	10 (58.82)	
Sleep Duration			0.2345			0.8284			0.0227
less than equal 6 hours	93 (29.71)	11 (19.30)		77 (29.28)	10 (25.00)		16 (32.00)	1 (5.88)	
7-8 hours	169 (53.99)	37 (64.91)		145 (55.13)	24 (60.00)		24 (48.00)	13 (76.47)	
more than 8 hours	51 (16.29)	9 (15.79)		41 (15.59)	6 (15.00)		10 (20.00)	3 (17.65)	
Sedentary life style			0.4715			0.1334			0.0954
No	154 (49.20)	31 (54.39)		128 (48.67)	19 (47.50)		26 (52.00)	12 (70.59)	
Yes	159 (50.80)	26 (45.61)		135 (51.33)	21 (52.50)		24 (48.00)	5 (29.41)	
Stress			0.6498			0.1262			0.114
No	160 (51.12)	31 (54.39)		133 (50.57)	19 (47.50)		27 (54.00)	12 (70.59)	
Yes	153 (48.88)	26 (45.61)		130 (49.43)	21 (52.50)		23 (46.00)	5 (29.41)	

Significant at p<0.05

Dikomentari [A22]: I do not think it is appropriate to combine normal and underweight in a same category since underweight is a malnutrition condition while normal is not.

Table 2. Adjusted odd ratios of parental BMI with overweight and obesity in adolescents.

Dikomentari [A23]: The same comment applied here and the tables after this.

	Crude	Model 1	Model 2	Model 3	Model 4
	OR 95% CI	**OR 95% CI**	**OR 95% CI**	**OR 95% CI**	**OR 95% CI**
Parent's BMI					
Normal or underweight	Ref	Ref	Ref	Ref	Ref
Overweight or obesity	4.07 (1.86-8.89)	4.14 (1.88-9.09)	4.08 (1.85-9.00)	4.15 (1.88-9.19)	4.18 (1.89-9.27)
Father's BMI					
Normal or underweight	Ref	Ref	Ref	Ref	Ref
Overweight or obesity	2.85 (1.59-5.07)	2.75 (1.53-4.93)	2.79 (1.55-5.03)	2.89 (1.59-5.24)	2.93 (1.61-5.33)
Mother's BMI					
Normal or underweight	Ref	Ref	Ref	Ref	Ref
Overweight or obesity	2.23 (1.25-3.99)	2.40 (1.33-4.36)	2.38 (1.31-4.34)	2.40 (1.32-4.39)	2.41 (1.32-4.39)

Model 1 adjusted by age and sex

Model 2 adjusted by model 2+breakfast habit and sleep duration

Model 3 adjusted by model 2+physical activity and sedentary life style

Model 4 adjusted by model 3+stress

Table 3. Adjusted odd ratios of parental BMI with overweight and obesity in adolescents for girls.

	Crude	Model 1	Model 2	Model 3	Model 4
	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI
Parent's BMI					
Normal or underweight	Ref	Ref	Ref	Ref	Ref
Overweight or obesity	27.16 (3.68-200.57)	26.48 (3.58-195.80)	26.11 (3.53-193.30)	28.63 (3.85-213.09)	28.55 (3.83-212.49)
Father's BMI					
Normal or underweight	Ref	Ref	Ref	Ref	Ref
Overweight or obesity	3.89 (1.93-7.82)	3.78 (1.87-7.63)	3.79 (1.88-7.68)	4.02 (1.97-8.23)	4.00 (1.96-8.19)
Mother's BMI					
Normal or underweight	Ref	Ref	Ref	Ref	Ref
Overweight or obesity	3.80 (1.78-8.09)	3.84 (1.79-8.20)	3.78 (1.76-8.10)	4.11 (1.89-8.93)	4.10 (1.89-8.91)

Model 1 adjusted by age and sex
Model 2 adjusted by model 2+breakfast habit and sleep duration
Model 3 adjusted by model 2+physical activity and sedentary life style
Model 4 adjusted by model 3+stress

Table 4. Adjusted odd ratios of parental BMI with overweight and obesity in adolescents for boys.

	Crude	Model 1	Model 2	Model 3	Model 4
	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI
Parent's BMI					
Normal or underweight	Ref	Ref	Ref	Ref	Ref
Overweight or obesity	0.74 (0.24-2.28)	0.87 (0.27-2.81)	0.96 (0.28-3.32)	0.98 (0.26-3.69)	1.14 (0.28-4.54)
Father's BMI					
Normal or underweight	Ref	Ref	Ref	Ref	Ref
Overweight or obesity	1.13 (0.37-3.41)	1.17 (0.37-3.68)	1.19 (0.36-4.00)	1.38 (0.39-4.93)	1.89 (0.46-7.85)
Mother's BMI					
Normal or underweight	Ref	Ref	Ref	Ref	Ref
Overweight or obesity	0.82 (0.26-2.57)	0.94 (0.28-3.09)	1.20 (0.33-4.36)	1.26 (0.33-4.84)	1.26 (0.32-4.92)

Model 1 adjusted by age and sex
Model 2 adjusted by model 2+breakfast habit and sleep duration
Model 3 adjusted by model 2+physical activity and sedentary life style
Model 4 adjusted by model 3+stress

DISCUSSION

This study examines the association between adolescents' BMI and BMI's parents. We found that adolescents from families with overweight or obese parents were at significantly higher risk of obesity compared to children of normal-weight or underweight parents. Both genetic and lifestyle behavior factors contribute to childhood obesity. Previous studies in Iranian

Dikomentari [A24]: Please put the study findings in context and elaborate the implication of the findings. Do not forget to tailor your findings to other studies. Do not just explaining findings from other studies without context. Also, please keep in mind the cohesion and coherent things when you write the paragraphs.

children/adolescents showed that children or adolescent obesity was significantly associated with parental obesity in both genders, boys, and girls, after adjusting for confounders (13). Other studies from rural north China and Mashhad, Iran, also showed that obese parents were more likely to have overweight or obese children compared to normal-weight parents (14,15).

Being overweight or obese in children/adolescents was affected by lifestyle habits. The fact that adult obesity rates increase quickly is primarily due to the significant changes in people's lifestyles that have occurred in recent decades. People spend much time sitting down and being immobile because of their jobs and dietary habits; consuming calorie-rich meals is pretty straightforward (16).

A systematic review and meta-analysis of prospective cohort studies showed that sleep duration was significantly associated with obesity in children (17). Children or adolescents who experienced short duration of sleep were more likely to have obesity. Other studies in 8,718 children or adolescents aged 16 years in the USA reported sleep duration significantly associated with obesity (18). Skipping or changing one's breakfast routine has been linked to childhood obesity in numerous studies (19). Furthermore, daily breakfast may reduce childhood obesity by 34%, according to a systematic review and meta-analysis (20). Similarly, a different systematic study found that missing breakfast might be a straightforward way to gauge the risk of becoming overweight or developing metabolic illnesses (21). An energy imbalance from unhealthy eating patterns and insufficient physical activity defines obesity (22,23). These behaviors are also highly linked to the development of obesity. More precisely, a strong correlation exists between the onset of obesity and sedentary behaviors, including increasing video gaming, television watching, and computer screen time. (24,25).

Dikomentari [A25]: This paragraph is more suitable in the introduction part to justify variables in this study.

The psychological element is one of the other significant causative elements for obesity that has been found. Recent research has shown a connection between obesity and psychological stress. (26). Stress is associated explicitly with dietary patterns, including eating more food, eating more high-calorie foods, or eating less low-calorie meals. Stress can negatively affect weight and health status by increasing body adiposity (27). Furthermore, stress may influence children's negative behaviors related to their bodies and weight, which may result in eating disorders, including bulimia, anorexia nervosa, or binge eating disorder (caused by an overwhelming concern for regulating one's weight); the latter may be particularly challenging to detect in young patients. (28). Children who suffer from eating disorders may experience weight gain and obesity as a result.

The current study showed that children or adolescent obesity was significantly associated with parental obesity after adjusting lifestyle confounders. An established correlation between higher parental BMI and higher childhood BMI has been shown (29). A direct intrauterine effect of the mother's BMI, a shared environment, shared genetics, or a mix of these variables could cause this association. When a child has shared genetics, one or both parents may pass on genetic variations that raise BMI to the child. Shared environmental factors, including lifestyle choices or diet, can also lead to a higher BMI in the child and parents. Furthermore, an intrauterine environment that programs the fetus's metabolic processes may be created by maternal obesity, raising the chance of children's obesity. While evidence pointing to a possible causative intrauterine mechanism for maternal obesity is growing, some research indicates that maternal BMI has more significant impacts than paternal BMI (10).

Another mechanism that also plays an essential role in parent and child obesity is epigenetics. One example of DNA methylation is the epigenetic mechanism that shows how inherited

childhood or adulthood-related genes interact with environmental variables to cause the development of childhood obesity (30). Epigenetic changes can affect obesity-related hormones such as leptin, insulin, and ghrelin and are dynamically regulated by nutritional and metabolic status (31). Leptin plays a role in reducing food intake and decreasing body weight (Halaas et al., 1997). Basic, translational, and clinical research on childhood and teenage obesity still has many gaps (10). Since adopted children and their parents have a paradoxically weak BMI association and known genetic loci associated with obesity have a modest effect size, the mechanisms (genetic, epigenetic, environmental, and social) underlying the overwhelming association between parental obesity and child and adolescent obesity remain unclear (33).

Some limitations need to be considered regarding our findings of this study. The first limitation is that this study is cross-sectional; thus, it needs to be confirmed by the prospective study. Second, self-reporting lifestyle variables and parental weight and height may result in potential bias. Other limitations: We did not collect another sociodemographic variable from children or adolescents and parents that may also influence the risk of obesity.

Dikomentari [A26]: Please mentioned about the population generalisability of this study also the strength if this study.

Dikomentari [A27]: This is not a sentence.

RECOMMENDATIONS

Dikomentari [A28]: Please offer more concrete recommendation resulting from your studies

Overweight and obesity in children or adolescents appear to be rising at a startling rate. The relationship takes into account both environmental and genetic factors. While there was a correlation between parental BMI and overweight/obesity in adolescents, fathers' BMI was a stronger predictor than mothers' BMI. The current study emphasizes the significance of childhood obesity and overweight as a public health issue in this demographic and suggests that preventive measures must be taken. Health experts and legislators should concentrate on preventing childhood obesity through the primary means of children and their parents.

ACKNOWLEDGMENT

The author thanks to Dean of the Faculty of Public Health Universitas Muhammadiyah Jakarta and the Rector of Universitas Muhammadiyah Jakarta for support of this research.

Dikomentari [A29]: What kind of support?

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