

Prevalence and risk factors of overweight and obesity in adolescents

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ABSTRACT

Background Overweight and obesity in adolescents is associated with persistent obesity and higher risk of morbidity and mortality in adulthood. The authors wanted to determine the occurrence of overweight and obesity in adolescents and to identify the associated risk factors.

Methods A cross sectional study was carried out on 600 children aged from 11 to 17 years old. Anthropometric measurements included body weight, height, and triceps skin fold thickness. The nutritional status was classified based on BMI using the WHO standard criteria. Three 24-hour dietary recalls were collected to assess the quality of food. A systematic random sampling was made according to school grade and sex.

Results Five hundred and fifty two (92%) children met the inclusion criteria, 46% were boys and 54% were girls. Most subjects (64%) had normal weight, 12% were underweight, 13% were overweight and 11% were obese. Among overweight group, 49% were boys, while among obese group, 53% were boys. On bivariate analysis, it was found that nutritional status had strong relationship with mother's education. On multivariate regression analysis, it was noted that energy expenditure and mother's education had significant negative correlation with the occurrence of overweight and obesity ($B=-0.235$; $p<0.001$ and $B=-0.171$; $p=0.006$) while energy intake and parental obesity had a significant positive correlation ($B=0.498$; $p<0.001$ and $B=0.128$; $p<0.001$).

Conclusions Energy expenditure and mother's education were inversely related to overweight and obesity, while energy intake and parental obesity were proportionally related to overweight and obesity [Paediatr Indones 2002;42:206-211].

Keywords: overweight, obesity, body mass index (BMI), risk factors.

The prevalence of pediatric obesity differs in many countries.¹ In US the prevalence of obesity is between 11-19%, while in Australia between 9-10%, and in UK 2-

11%. In Singapore the prevalence of obesity is 10.1% and in Bangkok 9.3%. In Jakarta, the prevalence of obesity in adolescents is 6.2% at the age of 12-13 years and 11.4% at 17-18 years.² More obesity is found in female than in male adolescents (10.2% vs. 3.1%).² Overweight and obese adolescents are associated with persistent obesity and higher risk of morbidity and mortality in adulthood.³⁻⁸ Factors influencing the development of obesity are high energy intake, low energy expenditure, parent's occupation or socioeconomic status, parent's education, parental obesity and ethnic.^{5,9,10}

Body mass index (BMI), expressed in kilograms per meter square, is a valid and commonly used measure of adiposity among adults.¹ BMI is safe, simple, and inexpensive as a screening tool for adolescent obesity with high accuracy.^{8,11-13} The purpose of this study was to determine the prevalence of overweight and obesity among junior high school students in Denpasar municipality and Badung residence and to identify the associated risk factors.

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Methods

This was a cross sectional study carried out on 600 children aged 11 to 17 years old who were in 1st to 3rd degree of junior high school in Denpasar municipality and Badung residency. The inclusion criteria were healthy adolescents who did not suffer from any diseases longer than 1 week in the previous week. The exclusion criteria were adolescents born from diabetic mothers, suffered from endocrine diseases, chronic diseases, or congenital anomalies, being ill for more than 1 week, and refused to participate in the study and those with incomplete data.

Height and weight were measured using a stadiometer and beam balance scale; the subjects wore light indoor clothes without shoes. BMI was calculated as weight (kilogram)/height (m²). The nutritional status was classified based on the WHO Expert Committee criteria. It was classified as overweight if BMI was >85 percentile and obesity if BMI <85 percentile with > 90th triceps skin fold (using the Lange calipers).¹² The age was categorized as early and middle adolescents.¹⁴ The food quality was identified by taking history of the food consumed by using three 24-hour recall method; it was classified as undernutrition if the food consumed was <2500 kcal/day and overnutrition if it was >2500 kcal/day.¹⁵⁻¹⁷ The energy expenditure was based on the type, the intensity, and the duration of exercise. It was classified as mild if the exercise was <30 minutes/day, mild to moderate if it was between 30 to 60 minutes/day, and moderate between 60–120 minutes/day.¹⁸ Parental obesity was measured by self-reporting; they were considered obese if the mother's BMI was >27.6 and father's BMI was >27.7.⁹

Data were recorded and analyzed with SPSS 8.0. The prevalence of overweight and obesity was determined. Bivariate analyses of categorical variables were conducted with X² test. The association between risk factors and nutrition status was calculated using two tailed Spearman's correlation and multiple linear regression analyses. A probability of <0.05 was accepted as statistically significant.

Results

Six hundred adolescents met the inclusion criteria. Forty-eight (8%) children were excluded; six had chronic diseases, i.e. one with nephrotic syndrome,

four with bronchial asthma, and one with congenital heart disease. In 42 other children data were incomplete. Of 552 (92%) of subjects analyzed, 251 (46%) were boys and 301 (54%) were girls. Mean values of adolescent's anthropometry are shown in **Table 1**. Their age ranged from 11 to 17 years old (mean 13.9; SD 1.1) and consisted of 350 (63%) of early adolescent age group and 202 (37%) of middle adolescent age group.

TABLE 1. MEAN VALUES OF ADOLESCENT'S ANTHROPOMETRY

Body weight (kg)	
Range	28.0 – 102.5
Mean	48.5 (SD 12.3)
Height (cm)	
Range	138.5 – 195
Mean	155.1 (SD 8.5)
Triceps skin fold (mm)	
Range	3.8 – 35
Mean	13.8 (SD 6.3)
Body mass index	
Range	12 – 35
Mean	20.7 (SD 5.1)

The characteristics of subjects are shown in **Table 2**. The prevalence of overweight and obesity in Denpasar municipality and Badung residence were 13% and 11%, respectively. Among the overweight group, there were 49% boys and 51% girls, while in the obesity group 53% were boys and 47% girls.

The association between the nutritional status and risk factors is shown in **Table 3**. On bivariate analyses it was noted that maternal education was the only factor associated with nutritional status, while age, father's occupation, energy intake, parental obesity, and sex were not. We used multiple linear regression models to determine the association between the risk factors and nutritional status. We found age and father's occupation did not correlate with overweight and obesity (**Table 4**). This table shows that energy expenditure and mother's education had a strong significant negative association with overweight and obesity (B = -0.235; p<0.001 and B = -0.171; p=0.006) while energy intake and parental obesity had strong significant positive association with overweight and obesity (B=0.498; p<0.001 and B = 0.128; p<0.001).

TABLE 2. SUBJECT CHARACTERISTICS

	n = 552
Age	
Early adolescence	350 (63%)
Middle adolescence	202 (37%)
Sex	
Boys	251 (46%)
Girls	301 (55%)
Father's occupation	
Not working/laborer	77 (14%)
Trader	30 (5%)
Official employee	217 (39%)
Businessman	228 (41%)
Mother's education	
Basic	142 (26%)
Advanced	410 (74%)
Energy intake	
Less	183 (33%)
Enough	217 (39%)
More	152 (28%)
Energy expenditure	
Mild	205 (37%)
Mild-moderate	301 (55%)
Moderate	46 (8%)
Parental obesity	
Both obesity	373 (68%)
Mother	92 (17%)
Father	67 (12%)
None	20 (4%)
Nutritional status	
Undernutrition	67 (12%)
Normal	353 (64%)
Overweight	72 (13%)
Obesity	60 (11%)

Discussion

In this study, mean height and weight in early adolescent group were 46.8 (SD 13.1) kg and 153.5 (SD 11.4) cm, while in middle adolescent group were 51.6 (SD 12.5) kg and 157.2 (SD 8) cm. These are consistent with the studies done by Rosner *et al*³ and Pietrobelli *et al*,¹ that weight and height at the age of 13 years were greater among boys than girls.

Most of our subjects (64%) had normal weight, 12% were underweight, 13% were overweight, and 11% were obese. In the studies done in Hong Kong and Mexico, it was found that there were behavioral changes seen in children from family with better social economic condition and with fewer physical activity.^{2,10,21}

The prevalence of obesity differs from one study to another and from one country to another.^{2,22} The differences are caused by the diversity of the anthropometric indicators, i.e., most studies used body weight for age index.^{22,23}

This study found that the proportion of children with overweight and obesity was higher than those

found in other studies in ASEAN countries such as in Singapore (11%) and in Bangkok (9%).² A study in Jakarta found that the prevalence of obesity in adolescent was increased with age from 6% at the age of 12-13 years to 11% at the age of 14-17 years.² This differences were caused by diversity of the methods (sample size and subject criteria).

Using multivariate analysis, it was found that there was no correlation between age and sex with the prevalence of overweight and obesity in adolescents. This results was due to the fact that in prepuberty period there was an adiposity rebound.^{24,25} Income and education are considered to be two of the most important factors influencing nutritional status.^{4,10} Increased income makes it possible to meet their needs, and well educated mothers are thought to be able to choose their food in a more informed way.^{4,10} On bivariate analysis, none of the factors except mother's education had significant association with overweight and obesity. The study conducted by Xillin Yang¹⁰ found that there was a association between nutritional status and parent's occupation, while Christoffel⁸ found that nutritional status was associated with father's occupation and ethnicity. Using multivariate analysis, it was noted that there was no correlation between father's occupation and overweight and obesity in adolescents; however mother's education had a significant negative association ($B = -0.171$; $p < 0.00$). A study of Baughcum *et al* found that obesity was more common in mothers with low education because of their misperception that the fatter the children, the healthier they are and it shows the family's competence.²⁶

Other important causes of overweight and obesity are dietary intake and physical activities. Excess intake of 50–100 calories per day will lead to 2.25-4.5 kg weight gain over one year.⁵ Low level of activity that is less than 35 hours in one week while the dietary intake remain unchanged will lead to obesity.⁸ On multivariate analysis, it was found that there was a strong significant positive association between dietary intake and overweight and obesity ($B = 0.498$; $p = 0.000$), while the energy expenditure had a highly significant negative association with overweight and obesity ($B = -0.235$; $p = 0.000$). A study of Dixon *et al* finds that there are changes in body mass index in children aged 4-10 years old who reduced their percentage of fat calories by replacing their high fat foods with lower fat foods by consuming more fruits, vegetables and very low fat desserts.⁷

TABLE 3. THE ASSOCIATION BETWEEN RISK FACTORS AND NUTRITIONAL STATUS: BIVARIATE ANALYSIS

Risk factors	Overweight n=72	Obesity n=60	p value
Age			
Early adolescence	39 (54%)	38 (63%)	0.288
Middle adolescence	33 (46%)	22 (37%)	
Sex			
Boys	35 (49%)	32 (53%)	0.589
Girls	37 (51%)	28 (47%)	
Father's occupation			
Not working/laborer	4 (6%)	4 (7%)	0.114
Trader	11 (15%)	2 (3%)	
Official employe	23 (32%)	26 (43%)	
Bussinesman	34 (47%)	28 (47%)	
Mother's education			
Basic	10 (14%)	33 (55%)	<0.001
Advanced	62 (86%)	27 (45%)	
Energy intake			
Less	7 (10%)	1 (2%)	0.148
Enough	17 (23%)	14 (23%)	
More	48 (67%)	45 (75%)	
Energy expenditure			
Mild	38 (53%)	42 (70%)	0.095
Mild-moderate	31 (43%)	15 (25%)	
Moderate	3 (4%)	3 (5%)	
Parental obesity			
Both obese	25 (35%)	22 (37%)	0.456
Mother obese	33 (46%)	21 (35%)	
Father obese	10 (14%)	10 (17%)	
None obese	4 (5%)	7 (11%)	

TABLE 4. ASSOCIATION BETWEEN NUTRITIONAL STATUS AND AGE, FATHER'S OCCUPATION, MOTHER'S EDUCATION, ENERGY INTAKE EXPENDITURE, AND PARENTAL OBESITY

Variable	B	S.E	Sig	95% Confidence Interval	
				B	A
Age	0.0008666	0.056	0.877	-0.101	0.118
Father's occupation	0.0042	0.027	0.121	-0.011	0.095
Mother's education	- 0.171	0.062	0.006	-0.292	-0.050
Energy intake	0.498	0.038	0.000	0.424	0.572
Energy expenditure	- 0.235	0.045	0.000	-0.323	-0.147
Parental obesity	0.128	0.034	0.000	0.062	0.194
Constant	1.750	0.183	0.000	1.390	2.110

Obesity tends to aggregate within families because of shared genes and environments, but dissecting its relative contribution has been difficult.²⁷ Obesity risk and persistence obesity are more common in children whose one or both parents are obese. The risk of obesity increases 50% in children if one parent is obese and increases to 70-80% if both are.^{5,22} In this study, obesity had a strong significant positive association with parental obesity (B=0.304; p=0.000;

95% CI 0.228 – 0.460). Whitaker *et al* found that weight gain are relatively increased at the age of 5-10 years compared to those of the age of 3 years because this age was regarded as a critical period in the development of obesity when adiposity rebound occurs and at this age parental obesity accounted for more than double risk of obesity in childhood.^{27,28}

Our study has some limitations; the cross sectional design made the analyses done superficially,

causes less accurate results, and cannot explain cause-effect relationship. The operational definitions are not universal, such as educational status and the energy expenditure are referred to adult one.

Our study shows that the occurrence of overweight and obesity were 13% and 11%, respectively. The energy expenditure and mother's education are inversely proportional to the occurrence of overweight and obesity in adolescents, while energy intake and parental obesity were proportional to the occurrence of overweight and obesity.

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