



## Individual and Social Environmental Factor as Risk Factor of BMI-for-Age in School Children



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### Keywords

*BMI-for-age;  
body dissatisfaction;  
body image;  
obesity;  
school children;*

### Abstract

The purpose of the study was to determine the risk factor of body weight status in school children. This is a cross-sectional study using 266 samples of 10-12 years old. Samples were chosen using a multi-stage sampling approach. Individual factors including age, sex, dissatisfaction with body shape, eating disorder, and social environmental factors such as parental and peer judgments were collected and analyzed as a risk factor of BMI-for-age. The prevalence of overweight and obesity (36.9%) was higher than the prevalence of severe thinness and thinness (4.9%). Individual characteristics of sex ( $p=0.014$ ), body shape dissatisfaction ( $p=0.001$ ), and eating disorders ( $p=0.001$ ) were substantially linked with body mass index (BMI)-for-age in bivariate analysis. In multiple linear regression analysis, dissatisfaction of body shape ( $\beta=0.908$ ), with sex (boys) ( $\beta=-0.459$ ), with the age of samples (young) ( $\beta=-0.250$ ), and with mother's comment ( $\beta=0.022$ ) significantly explained a total of 57.8% of the variances in BMI-for-age of the samples ( $F = 89.450$ ;  $p<0.05$ ). The aforementioned findings highlighted the need of including individual characteristics such as age, sex, and body shape dissatisfaction, as well as a social-environmental element such as a mother's comment, in an obesity prevention intervention program for school-aged children.

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## 1 Introduction

The issue of diverse nutrition is a complicated phenomenon that Indonesia must address. On the one hand, there are still many cases of malnutrition, while on the other hand, there is an increasing number of cases of obesity. In Indonesia, the prevalence of childhood overweight and obesity was 18.8% in 2013. Meanwhile, the prevalence of overweight and obesity in Bali exceeds the national average of 20.3% (Indonesia Ministry of Health, 2013), a figure that has more than doubled since 2007, when it was just 10.15 percent (Indonesia Ministry of Health, 2007). Nutritional problems in childhood have the potential to be a risk factor for adult obesity (Tanofsky-Kraff et al., 2006; Belizario Jr et al., 2011; Fitzgibbon et al., 2005), so it's important to identify ways to prevent it.

Many researchers have looked into the factors that influence school-aged children's nutritional status, such as parental education, maternal work, and nutritional understanding (Hs et al., 2011; Singh & Babu, 2013; Galgamuwa et al., 2017). However, there is a scarcity of information on the effects of individual factors and the social environment on school-aged children's nutritional health. Obesity and eating disorders have major physical and psychological effects, however, the factors that influence eating and weight-related problems in children in Denpasar City have not been thoroughly investigated.

Several studies have looked at these characteristics independently, although nutritional issues (underweight, overweight, and obesity) and eating disorders are often identified in the same person. As a result, identifying these factors can aid in the development of effective prevention initiatives aimed at this critical issue. Published research has mostly focused on body image and a few eating disorders, and it has only looked at small samples of teenagers (Soo et al., 2008; Khor et al., 2009; Pon et al., 2004; Mellor et al., 2009). This study aims to study individual factors and social environment as risk factors for nutritional problems in school children. Individual aspects include age, gender, body shape satisfaction, eating disorders, and social contextual influences such as parental and peer judgments.

## 2 Materials and Methods

This was a cross-sectional study using 266 samples of 10-12 years old. The study population consisted of school children from Denpasar, Bali, who were chosen using a multi-stage sampling approach depending on their location and kind of primary school (public vs. private). All primary schools were documented in each sub-district, namely East Denpasar, South Denpasar, West Denpasar, and North Denpasar, based on the types of public and private primary schools. Simple random selection was used to select one public elementary school and one private elementary school in each sub-district. Furthermore, the number of students in grades 4 to 6 at each selected primary school was recorded and selected at random. The sample size is calculated based on the prevalence of overweight and obese in Bali, which is 20.3%, using a sample formula (Daniel, 1999; Ludwig et al., 2001; Sur et al., 2005):  $n = (Z_{1-\alpha})^2 (P (1-P)) / D^2$ , with a total of 249 samples. To account for the response rate, an additional 25% must be included, resulting in a minimum sample size of  $249 + (249 \times 25\%) = 312$  samples. The results of data collection with complete questionnaires were 266 samples.

Nutritional status was calculated using the WHO Anthro Plus version 1.0.3 software and the body mass index according to age (BMI/age) (z-score) (World Health Organization, 2009). The WHO Growth Reference was used to classify their body weight (de Onis et al., 2007; Fox et al., 2009; Hirschler et al., 2008). A seven-figure Collins' body image silhouette (Collins, 1991), was used to measure satisfaction with body shape. Samples were asked to choose between a figure that approximated their actual body figure and a figure that resembled their desired body figure. The body form discrepancy score was calculated by subtracting the numeric values that matched the "actual" and "ideal" figures. The score showed the degree of body shape dissatisfaction. A positive body shape difference score indicates a preference for a thinner body, while a negative score indicates a preference for a bigger body.

Eating disorders were identified by asking 26 questions about children's food attitudes and behaviors, including fearful behavior of being overweight, avoiding food, thinking too much about food calories, being annoyed with food, slowing down eating, and other activities to limit food intake into the body. The 6-choice Likert scale was used with scored as Always (3) - Very often (2) - Often (1) - Sometimes (0) - Rarely (0) - Never (0).

Social environment variables consisting of comments from father, mother, male and female friends were collected using 13 questions each with a Likert scale. Three questions related to comments about the size and shape of the child's body, changes in body shape, how to eat for body shape on a scale of 1-5, namely Extremely positive (1), Positive (2), In Between (3), negative (4), Extremely negative (5) and a value of 0 if there is no answer. Ten questions related to opinions and suggestions, consisting of urges to lose weight, increase body weight, become more muscular, diet to be thin, want weight gain, desire for children to be more muscular, laugh with thin weight, laugh because they are quite muscular, think important about body shape. The scale used is 1-5, namely Always (5), Almost Always (4), Frequently (3), Sometimes (2) and Never (1).

The data was acquired and input into a study form, which was then analyzed with computer software. Significant differences were considered if the p-value was less than 0.05. The continuous data in this study were normally distributed. Statistical tests including the Pearson's product-moment correlation, independent samples t-test, and chi-squared test were used in bivariate analyses, and the factors associated with BMI-for-age were found using a multiple linear regression model (stepwise technique). This research has been approved ethically by the Research and Development body of the Faculty of Medicine, Udayana University/Sanglah Hospital.

### 3 Results and Discussions

The study consisted of a total of 266 samples, with 47,0% boys and 53,0% girls (mean age of  $10.8 \pm 0.7$  years old). The mean age of fathers and mothers of the sample were  $42,6 \pm 6.3$  years old and  $39.2 \pm 5.4$  years old respectively. Meanwhile, the level of education of the fathers in the sample had more education at a Diploma and above (54.9%), while the mothers were mostly High School and below (53.0%). The mothers of the sample were more likely to work as much as 57.1%, while the fathers were more likely to work in the private sector as much as 93.2%.

The mean body weight and height of the samples were  $38.8 \pm 10.9$  kg and  $142.0 \pm 7.2$  cm, respectively. The mean BMI was  $19.0 \pm 4.2$  kg/m<sup>2</sup> and the mean z-score of BMI-for-age was  $0.48 \pm 1.55$ . Figure 1 shows that the prevalence of overweight and obesity were 17.7% and 19.2%, respectively, while the prevalence of severe thinness and thinness were 0.8% and 4.1%, respectively.

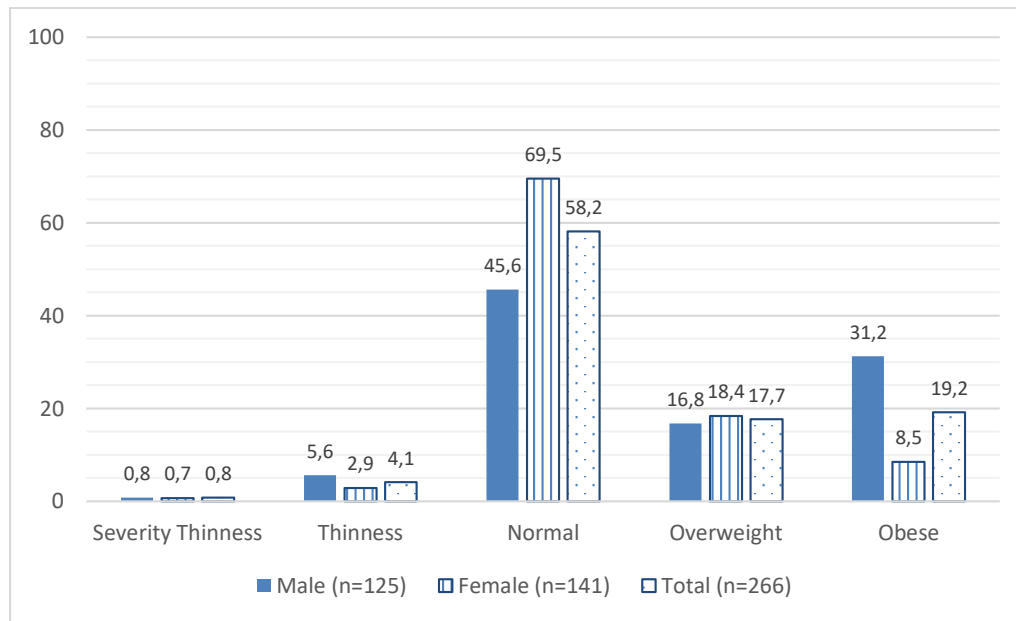


Figure 1. Distribution of samples according to body weight status (N=266)

Table 1 demonstrates the distribution of respondents according to individual and social environmental factors. The prevalence of body shape dissatisfaction was 69.5%, with a mean score was  $0.32 \pm 1.26$ . Meanwhile, the prevalence of eating disorders was 87.6%, with a mean score of  $0.30 \pm 0.28$ . The study found that the mean of mother's comment and boyfriend's comment was with a mean score of  $1.73 \pm 0.51$  and  $1.57 \pm 0.62$ , respectively.

Table 1  
Distribution of respondents according to individual and social environmental factors (N = 266)

Factors	Boys (n=125)		Girls (n=141)		Total (N=266)		t / X <sup>2</sup>	p-value
	Mean $\pm$ SD	n(%)	Mean $\pm$ SD	n(%)	Mean $\pm$ SD	n(%)		
Individual Satisfaction of body shape	0.29 $\pm$ 0.10		0.35 $\pm$ 0.11		0.32 $\pm$ 1.26		-	0.739
Satisfied		38 (30.4)		43 (30.5)		81 (30.5)		
Dissatisfied		87 (69.6)		98 (69.5)		185 (69.5)		
Eating disorder	0.35 $\pm$ 0.31		0.26 $\pm$ 0.25		0.30 $\pm$ 0.28		2.533 <sup>a</sup>	0.012*
No		8 (6.4)		25 (17.7)		33 (12.4)		
Yes		117 (93.6)		116 (82.3)		233 (87.6)		
Social Environmental Father's	1.81 $\pm$		1.72 $\pm$		1.76 $\pm$		1.544	0.124

comment	0.55	0.47	0.51	a	
Mother's comment	1.80 ± 0.58	1.66 ± 0.44	1.73 ± 0.51	2.210	0.028*
Boyfriend's comment	1.67 ± 0.71	1.49 ± 0.53	1.57 ± 0.62	2.422	0.016*
Girlfriend's comment	1.58 ± 0.68	1.53 ± 0.53	1.56 ± 0.60	0.679	0.498

n, number of samples; N, the sample size of this study; a refers to t, a statistic that compared whether sexes had different means through the independent samples t-test; \* Statistical significance at  $p < 0.05$ .

Table 2 shows the bivariate analyses of individual and social environmental factors and BMI-for-age. Sex boys had significantly higher mean BMI-for-age compare to girls ( $p < 0.05$ ). Satisfaction of body image was positively correlated with BMI-for-age of the samples ( $r = 0.727$ ;  $p < 0.05$ ). Eating disorder had a significant correlation with BMI-for-age ( $r = 0.206$ ,  $p < 0.05$ ). Other factors did not have a significant correlation with BMI-for-age ( $p > 0.05$ ).

Table 2  
Association between individual and social environmental factors and BMI-for-age (z-score) (N = 266)

Factors	BMI-for-Age (z-Score) Mean ± SD	r/t - Value	p-Value
Individual			
Age of Samples		-0.107 <sup>a</sup>	0.081
Sex			
Boys	0.728 ± 1.749	2.484 <sup>b</sup>	0.014*
Girls	0.259 ± 1.313		
Age of father		0.026 <sup>a</sup>	0.677
Age of mother		0.117 <sup>a</sup>	0.056
Maternal work			
Not Working	0.489 ± 1.496	0.086 <sup>b</sup>	0.932
Working	0.472 ± 1.591		
Satisfaction of body shape		0.727 <sup>a</sup>	0.001*
Eating disorder		0.206 <sup>a</sup>	0.001*
Social Environmental			
Father's comment		0.104 <sup>a</sup>	0.091
Mother's comment		0.085 <sup>a</sup>	0.168
Boyfriend's comment		0.077 <sup>a</sup>	0.210
Girlfriend's comment		0.097 <sup>a</sup>	0.113

N, the sample size of this study, was 266; BMI, body mass index; SD, standard deviation; <sup>a</sup> refers to r, the correlation coefficient that measured the strength and direction of a linear relationship between two variables through Pearson's correlation analysis; <sup>b</sup> refers to t, a statistic that compared differences between means of two groups through the independent samples t-test; \*Statistical significance at  $p < 0.05$ .

In addition, multiple linear stepwise regression was used to identify the factors that influence BMI-for-age (z-score). Table 3 shows that samples that were dissatisfied with their body shape, sex (boys), young age, and mother's comment had a higher BMI-for-age (z-score). Body shape dissatisfaction was the most powerful factor in the BMI-for-age model ( $\Delta R^2 = 52.8\%$ ), followed by sex (boys) ( $\Delta R^2 = 2.8\%$ ), sample age (young) ( $\Delta R^2 = 1.4\%$ ), and mother's comment ( $\Delta R^2 = 0.8\%$ ), which explained a total of 57.8% of the variances in BMI-for-age of the samples ( $F = 89.450$ ;  $p < 0.05$ ).

Table 3  
Multiple linear stepwise regression of BMI-for-age (z-score) (N = 266)

Variables	Unstandardized Coefficients		Standardized Coefficients	t	$\Delta R^2$	p-Value
	$\beta$	Std. Error	Beta			
(Constant)	2.643	0.930		2.841		0.005*
Body shape dissatisfaction	0.908	0.050	0.736	18.295	0.528	0.001*
Sex (boys)	-0.459	0.126	-0.148	-3.651	0.028	0.001*
Age of samples (young)	-0.250	0.048	-0.120	-2.987	0.014	0.003*
Mother's comment	0.022	0.009	0.093	2.293	0.008	0.023*

N, the sample size of this study, was 266; R, the multiple correlation coefficient, was 0.760; R<sup>2</sup>, the coefficient of determination was 0.578; F, the ratio of the model mean square to the error mean square was 89.450;  $\beta$ , values for the regression equation for predicting the dependent variable from the independent variables, Beta was the standardized coefficient; t, a statistic used to check the significance of individual regression coefficients in the regression model;  $\Delta R^2$ , incremental increase in the model R<sup>2</sup> resulting from the addition of a predictor to the regression equation; \*Statistical significance at  $p < 0.05$ .

### Discussion

Multiple nutritional problems in school children were still found in Denpasar City, apart from being severely thinness and thinness, overweight, and obesity was also found. The study showed that the prevalence of overweight and obesity was higher than that of severe thinness and thinness. When compared with other studies, the prevalence of overweight and obesity in Denpasar, Bali, Indonesia is higher where a total of 36.9% was found, while research in Southeast Nigeria was 30.0% (Ribeiro et al., 2018; Martin & Ferris, 2007; Roberts et al., 2010), in Malaysia, it was 30.4% (Institute for Public Health (IPH), 2017). In boys, the prevalence of overweight and obesity was higher than in girls, namely 16.8% and 31.2%, respectively, compared to 18.4% and 8.5% in girls, respectively. The results of this study are different from the research conducted by Adewale Elijah et al. (2019) which found a higher incidence of overweight and obesity in girls. While the prevalence of severely thinness and thinness in this study was relatively low, at just 4.9%, previous studies in Bangladesh and Nigeria, in contrast, found that the prevalence of underweight was higher than that of overweight (Huq et al., 2013; Nwaneri & Omuemu, 2013).

Individual factors that were included in this study, apart from gender and age, were also investigated for dissatisfaction with body shape and eating disorders. The result of the study showed dissatisfaction with body shape was by 69.6%, and there was no difference between sex ( $p > 0.05$ ), where both boys and girls felt more dissatisfied with their body shape (Ricciardelli et al., 2003; Lee & Ham, 2015; Vignerová et al., 2007) found that body dissatisfaction and a desire to be thinner are equally prevalent among overweight boys and girls. However, other research (Mäkinen et al., 2012), found that the girls were less satisfied with their bodies than boys were with theirs (mean score (SD): 30.6 (SD 12.2) vs. 18.9 (SD 9.5);  $p < 0.001$ ).

Meanwhile, eating disorders were significantly more common in the male group than the female group, with an average score of  $0.35 \pm 0.31$  for boys compared to  $0.26 \pm 0.25$  for girls ( $p < 0.05$ ). The bivariate test found a substantial positive connection between eating disorders and BMI-for-age in this study. The higher the eating disorder score the higher the BMI-for-age z-score. Previous research has revealed that eating disorders, which are diseases characterized by a loss of control over eating and the consumption of enormous amounts of food, are a risk factor for gaining weight and fat over time (Field et al., 2003; Tanofsky-Kraff et al., 2006). Another study found that children with binge eating disorders not only had a higher BMI but were 5.33 times more likely to develop metabolic syndrome in a follow-up study conducted (Tanofsky-Kraff et al., 2012). However, in this study, we only looked at eating disorders in general concerning children's eating behaviors and body image concerns. The results showed that eating disorder was not a good predictor of BMI-for-age after being added in the multivariate model.

Furthermore, the results of the multivariate test found that the BMI-for-age value was significantly higher in children who were dissatisfied with their body shape, being male, younger children, and children who

received comments from their mothers. These factors account for 57.8%% of the variance in the BMI-for-age model. The results of another study showed that physical activity, body image, and energy intake factors explained 36.9% of the variance in the BMI-for-age of adolescents aged 13 to 15 years old model (Rezali et al., 2012). In this study, physical activity and energy intake factors were not included in the model, but the results of this study confirm that dissatisfaction with body shape is an important factor in determining BMI-for-age. This finding is in line with (Pallan et al., 2011; Layuk et al., 2021; Fatimah et al., 2021), that perceived body image size was positively associated with weight status (partial regression coefficient for overweight/obese vs. non-overweight/obese was 0.63 (95% CI 0.26-0.99) and for BMI z-score was 0.21 (95% CI 0.10-0.31), adjusted for sex, age and ethnicity).

Another BMI-for-age model of early adolescents aged 10 to 11 years old in Malaysia found that energy expenditure per kilogram body weight, being male, and the mothers' BMI explained 66.7 percent of the variations in high BMI-for-age models (Woon et al., 2015; Dharmayuda et al., 2021). In line with Woon et al.'s findings, the results of this study confirm that boys have a higher BMI for age, thus becoming an important variable that needs to be considered as a risk factor for overweight and obesity problems. Meanwhile, the social and environmental factors, namely comments given by mothers to their children, could be a risk factor that could determine BMI-for-age.

This research has certain drawbacks. The cause and effect of individual and social environmental factors on BMI-for-age were not found in this cross-sectional study. However, this study could add to the body of knowledge about the relationship between individual and social environmental factors and schoolchildren's weight status. The immediate effort is essential to avoid childhood obesity and to limit the growth in BMI-for-age in children.

## 4 Conclusion

The results of the study found more overweight and obesity problems in school children. Individual factors such as age, sex, dissatisfaction with body shape, and social environmental factor of mother's comments could be used as predictors of increasing BMI-for-age in school children. A comprehensive approach is needed to overcome the problem of overweight and obesity in schoolchildren.

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