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Original article

Prevalence of underweight and overweight among school-aged children and it's association with children's sociodemographic and lifestyle in Indonesia

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ABSTRACT

Objectives: Underweight remains a health problem among Indonesian children, and the incidence of overweight continuously increases. This study aims to determine factors associated with underweight and overweight in school-aged children in Indonesia.

Methods: This study is a cross-sectional investigation on parents and children aged 6–13 years in elementary schools in Makassar, Indonesia. The participants included 877 children and their parents. Anthropometric data were obtained using standardized equipment, and sociodemographic and lifestyle data were determined using a questionnaire. The nutritional status of the children was assessed based on the child growth standard prescribed by the WHO.

Results: The prevalence rates of underweight and overweight among the children were 14.5% and 20.4%, respectively. Underweight was more prevalent in boys. Factors such as mother's level of education, having an underweight father, and playing outdoors on weekends for more than 2 h were significantly associated with underweight children. By contrast, mothers with high levels of education, overweight parents, sleeping for less than 9 h, and playing outdoors on weekends for less than 1 h were significantly associated with overweight children.

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Conclusions: The prevalence of underweight and overweight among school-aged children in Makassar, Indonesia is high. These conditions are associated with the sociodemographic characteristics of children and parents, as well as the lifestyle of children. Parental characteristics and children's lifestyle should be considered when planning prevention and intervention programs for underweight or overweight children.

1. Introduction

The prevalence of underweight decreases, whereas that of overweight increases in Indonesia [1–3]. The National Baseline Health Research found that the prevalence rates of underweight and obesity among school-aged children were 12.1% and 7.95%, respectively, in 2007 [1,2]. The prevalence of underweight slightly decreased to 11.2%, and that of obesity increased to 8.8% in 2013 [3]. Issues related to underweight and overweight can negatively affect the physical growth and psychological development of children [4]. Lack of muscular strength, late maturation, decreased bone density, and low work productivity later in life are possible consequences of underweight [5]. Overweight or obese children show high risks for hypertension, diabetes mellitus type 2, metabolic disorder, and mental disorders [6–8].

Few studies have investigated the risk factors of underweight in school-aged children in Indonesia. Research has mainly focused on underweight children aged below 5 years, whereas the population of school-aged children has been neglected. Studies in other developing countries have revealed that socioeconomic status, poverty, low educational level of parents, knowledge of mothers on nutrition, family income, infectious diseases, and poor housing are risk factors for undernutrition [5,9–11]. In Indonesia, the effect of lifestyle and sociodemographic characteristics on the occurrence of underweight among school-aged children has not yet been investigated.

Although the number of overweight children increases, few researchers have explored this issue. In other developing countries, obesity and overweight among children are influenced by increased caloric intake, reduced physical activity, high socioeconomic status, age, female gender, involvement in a school meal program, and urbanization [12–14]. Data on underweight and overweight cases among school-aged children in Indonesia remain insufficient. Therefore, this study aims to determine the prevalence of underweight and overweight among school-aged children in Indonesia and explore the association between children's weight with their lifestyle and sociodemographic characteristics.

Nurses play a significant role in preventing and providing intervention to children suffering from nutritional problems. To ensure the appropriateness of a treatment, nurses must recognize the characteristics and lifestyles of the children and their families as well as the risk factors of being underweight or overweight among the children. Nurses and other health professionals can provide intervention to families and children regarding the basic concepts of balanced nutrition and undesirable effect of insufficient nutrition.

2. Methods

2.1. Design

This cross-sectional study was conducted in Makassar from August to November 2014. Makassar is the largest city in eastern Indonesia and one of the fastest growing cities in terms of economy because of the rapid influx of people from other regions. Hence, Makassar could be suitable for studies to provide valuable insights into the effect of development, which is also likely to occur in other big cities in eastern Indonesia.

2.2. Participants

This study included 877 children in grades 1 through 6 (6–13 years old) and their parents, who completed and returned the questionnaire. Makassar comprises 14 districts. One public school was selected to represent two neighboring districts. Therefore, seven public elementary schools were selected from the city. Interviews were used to collect data on food intake of a subsample of the following participating children based on their nutritional status: 43 underweight subjects, 70 normal-weight subjects, and 53 overweight subjects.

2.3. Instruments

Body weight of children was measured with an Omron digital weighing scale (HBF-251). Standing height was measured using microtoise (SECA). Body mass index (BMI) for-age z-scores (BAZs) were calculated using WHO Anthro Plus version 1.0.3 [15]. To determine the nutritional status of children, the Ministry of Health of Indonesia adopted growth standards that correspond to those established by the WHO in 2007; hence, the present study also used these standards to classify the nutritional status of the participating children [1,3,16].

The questionnaire, which consisted of 23 items, was developed to collect information, including child's date of birth, gender, and sociodemographic characteristics as well as weight and height of his/her parents. The questionnaire also contained questions on children's physical activities, sleeping behavior, and other health-related behavior. Items in the

questionnaire were mostly close-ended questions. The following is an example of a question on physical activity: "How much time would you say your child spends playing outdoors on a typical weekday?" The choices for this question are as follows: 1 h or less, 2 h, 3 h, 4 h, and 5 h or more. Questions on sleeping behavior were open-ended, such as "On average, what time does your child go to sleep?"

The questionnaire was first tested on 15 parents whose children are studying in elementary schools to ensure its readability and understandability. Some revisions were then employed based on the feedback of the parents; the changes mostly dealt with the choice of words. The questionnaire was further reviewed by the researcher's colleagues at the Department of Pediatric School of Nursing and the Department of Community Nutrition Faculty of Public Health, Hasanuddin University.

Children's food intake was measured using 24-h food recall method. The use of this method for assessment of populations of Indonesian children was validated by Cunanan-Aquino [17] and is recommended as suitable for populations of Asian children [18]. Data obtained from the interview were analyzed using the Nutrisoft program developed by the Food and Nutrition Research Center to determine the actual amount of food intake [19].

2.4. *Classification of the nutritional status of children and parents*

A cut-off point z-score <−2.00 SD and >1 SD for BAZ (BMI-for-age z-score) were used to classify underweight and overweight children, respectively, to determine the BMI status of children [15]. The parents were classified into underweight, normal, and overweight when BMIs are as follows: below 18.5 kg/m^2, 18.5 kg/m^2 to below 24.9 kg/m^2, and 25 kg/m^2 or higher, respectively [3].

2.5. *Procedures*

This study was approved by the Ethical Clearance Committee of Medical and Health Research of Hasanuddin University. This research was also approved by the Makassar Government and Elementary School Administration and conducted in seven elementary schools by a principal investigator and well-trained nutritionists and nurses. Six to nine classes in each school were visited by the team, one class at a time. Prior to distributing the questionnaire, a brief explanation of the study was given to the students. With the assistance of the class teacher, each student was provided with a questionnaire to bring home. The questionnaire was accompanied by a letter outlining the survey, explaining the voluntary nature of the research, and soliciting informed written consent from the parents. When students returned the questionnaires, their body weight and height were measured.

Subsamples of underweight, normal weight, and overweight children were selected for interview to determine their food intake. A dietary recall for one weekday and one weekend day was obtained; the average amount of food intake from those 2 days was calculated and used in the analysis. Samples of food portions were weighed during data collection to accurately quantify the foods or food products. Analysis of dietary intake was performed using Nutrisoft [19]. Dietary intakes were subsequently compared with the Indonesian Recommended Dietary Allowance (RDA) [20].

2.6. *Data analysis*

All data were entered into the Statistical Package for Social Science Version 22.0. Descriptive statistics was employed to analyze the characteristics of the subjects and describe anthropometrical data. Family income was categorized based on the median value of the data (Rp. 2.000.000), which was nearly the same as the regional minimum standard salary in Makassar in 2014 (Rp. 1.900.000) [21].

The answers provided by the participants on questions on lifestyle were classified into two categories. The cut-off point for each lifestyle variable (Table 2) was based on its median value. Chi-square test was used to achieve the main objective of this study, that is, determine the relationship between the selected variables and nutritional status. Kruskal–Wallis test was applied to compare food intake among the nutritional status groups. Multiple comparisons were performed to determine differences in food intake among underweight, normal weight, and overweight children. Moreover, a stepwise binary logistic regression was performed to determine the effect of factors on the occurrence of underweight and overweight in children. P values <0.05 were considered statistically significant.

3. Results

3.1. *Sociodemographics of children and parents*

From the total sample of 877 respondents, 14.5% (n = 127) of the children were underweight and 20.4% (n = 179) were overweight. As shown in Table 1, the number of underweight boys (p = 0.001) is significantly higher than the number of underweight girls (18.6% vs. 11.0%). The education of both parents was significantly related to whether their children are underweight and overweight. A greater number of children whose mothers achieved low educational attainment was underweight (20.8%) compared with those whose mothers were well educated (12.6%). By contrast, 22.9% of the children whose mothers are highly educated mothers were overweight, significantly higher than the number of overweight children whose mothers were less educated (11.7%). Approximately 30% of children whose fathers or mothers are overweight were also overweight. A significantly high prevalence of underweight children have underweight fathers (28.1%) and underweight mothers (23.4%). Furthermore, a high number of underweight children was observed in low-income families (17.1%), whereas a high number of overweight children (28.8%) was found in middle and high-income families.

3.2. *Physical activity and health-related behavior of the children*

As shown in Table 2, underweight in children is significantly related to their physical activity, such as playing outdoors on weekends (p = 0.006); 17.8% of children who played outdoors

Table 1 – Socio-demographic data of children and parents.

Variables	Underweight 127 (14.5)	p^a	Overweight 179 (20.4)	p^b
Children's gender				
Boys	75 (18.6)	0.001	72 (17.9)	0.085
Girls	52 (11.0)		107 (22.6)	
Children's age				
6–9 years old	72 (15.6)	0.314	85 (18.4)	0.127
10–13 years old	55 (13.2)		94 (22.6)	
Father's occupation				
Civil servant	24 (12.8)	0.298	50 (26.7)	0.003
Private employee	34 (14.5)		47 (20.0)	
Self-employed	42 (13.2)		68 (21.5)	
Daily laborer	27 (19.6)		14 (10.1)	
Mother's occupation				
Household wife/unemployed	98 (15.3)	0.276	126 (19.6)	0.341
Employed	29 (12.3)		53 (22.6)	
Father's education				
Low education	29 (20.0)	0.039	16 (11.0)	0.002
High education	98 (13.4)		163 (22.3)	
Mother's education				
Low education	41 (20.8)	0.004	23 (11.7)	0.001
High education	86 (12.6)		156 (22.9)	
Overweight father				
No	–		99 (16.1)	0.001
Yes	–		80 (30.5)	
Overweight mother				
No	–		110 (16.6)	0.001
Yes	–		69 (32.1)	
Underweight father				
Yes	18 (28.1)	0.001	–	
No	109 (13.4)		–	
Underweight mother				
Yes	22 (23.4)	0.009	–	
No	105 (13.4)		–	
Family income	*(n = 83)*		*(n = 136)*	
≤Rp. 2.000.000,–	49 (17.1)	0.048	50 (17.4)	0.001
>Rp. 2.000.000,–	34 (11.4)		86 (28.8)	

[a]Chi-Square test; the analysis is a crosstabulation between underweight and non-underweight (normal and overweight) with independent variables.
[b]Chi-Square test; the analysis is a crosstabulation between overweight and non-overweight (normal and underweight) with independent variables. *n* = 877, *n* (%).

Table 2 – Lifestyle and health-related behavior and their association in underweight and overweight children.

Variables	Underweight 127 (14.5)	p^a	Overweight 179 (20.4)	p^b
Playing outdoors on weekdays				
≤1 h or not	48 (12.0)	0.065	105 (26.2)	0.001
>1 h	79 (16.6)		74 (15.5)	
Playing outdoors on weekends				
≤2 h or not	50 (11.2)	0.006	104 (23.4)	0.027
>2 h	77 (17.8)		75 (17.4)	
Watching TV during weekdays				
≤1 h or not	42 (11.7)	0.055	72 (20.1)	0.855
>1 h	85 (16.4)		107 (20.6)	
Watching TV on weekends				
≤1 h or not	28 (11.7)	0.146	43 (17.9)	0.261
>1 h	99 (15.5)		136 (21.4)	
Playing computer/tablet on weekdays				
≤1 h or not	100 (14.1)	0.515	141 (19.9)	0.145
>1 h	27 (16.1)		38 (22.6)	
Playing computer/tablet on weekends				
≤1 h or not	95 (14.5)	0.923	123 (18.8)	0.048
>1 h	32 (14.3)		56 (25.0)	
Playing videogames on weekdays				
≤1 h or not	97 (13.3)	0.020	152 (20.8)	0.558
>1 h	30 (20.7)		27 (18.6)	
Playing videogames on weekends				
≤1 h or not	80 (13.3)	0.155	123 (20.5)	0.923
>1 h	47 (17.0)		56 (20.2)	
Bedtime				
≤9 pm	79 (16.4)	0.149	91 (22.9)	0.097
>9 pm	48 (12.6)		88 (18.0)	
Wake-up time				
≤6 am	90 (16.0)	0.269	147 (18.4)	0.011
>6 am	37 (12.5)		32 (23.0)	
Sleeping hours (including naps)				
<9 h	41 (13.7)	0.021	92 (22.4)	0.003
≥9 h	86 (16.7)		87 (14.5)	
Weight monitoring				
Irregular	63 (11.2)	0.081	53 (25.2)	0.001
Regular	64 (16.8)		126 (17.0)	
Breakfast				
Rarely (<5×/week)	83 (16.9)	0.043	88 (14.2)	0.016
Almost daily (≥5×/week)	44 (12.7)		91 (25.0)	

[a] Chi-Square test; the analysis is a crosstabulation between underweight and non-underweight (normal and overweight) with independent variables.
[b] Chi-Square test, the analysis is a crosstabulation between overweight and non-overweight (normal and underweight) with independent variables. *n* = 877, *n* (%).

for more than 2 h on weekends were determined to be underweight compared with those playing outdoors for 2 h or less on weekdays (11.2%). For children who play videogames for more than 1 h on weekdays, 20.7% were underweight, which is significantly higher than the number of children who play videogames for 1 h or less on weekdays (13.3%). A greater number (16.7%) of children who sleep for 9 h or more were underweight, whereas the prevalence of underweight was low in children who sleep for less than 9 h (13.7%). The rate of underweight significantly varied ($p = 0.043$) between children who eat breakfast for less than five times a week (16.9%) and those who eat breakfast at least five times a week (12.7%).

Children who play outdoors for 1 h or less on weekdays were significantly ($p < 0.001$) more likely to be overweight (26.2%) than those playing for more than 1 h on weekdays (15.5%). Children playing outdoors for 2 h or less on weekends displayed a significantly ($p = 0.027$) higher incidence of being overweight (23.4%) compared with children who play outdoors for more than 2 h on weekends (17.4%). A significantly higher incidence of overweight was found among children who play games in a computer/tablet for more than 1 h on weekends (25.0%) compared with children who play games in a computer/tablet for an hour or less (18.8%). Overweight among children was also significantly related to children's wake-up time ($p = 0.011$) and sleep duration ($p = 0.003$). Higher incidence of overweight was found in children who sleep for less than 9 h (22.4%) than in those who sleep for 9 h or more (14.5%). A significant relationship was also found between the incidence of overweight and frequency of weighing ($p = 0.001$)

and eating breakfast (p = 0.016). A higher percentage of children (25.2%) who were weighed irregularly were overweight compared with children who were weighed at least once in 3 months (17.0%). A higher percentage of children who eat breakfast nearly every day were overweight (25.0%) than children who rarely eat breakfast (12.7%).

3.3. Children's food intake

Table 3 shows the children's intake of macronutrients, fiber, and selected micronutrients (calcium, ferrum, vitamin C, and vitamin A). Data show that the children's overall intake of both macronutrients and micronutrients was below the Indonesian RDA, except for protein intake. The total intake of energy, carbohydrates, and fiber significantly varied among the groups of children's with different nutritional status. The intake of macronutrients and fiber was generally higher in overweight children than in normal and underweight children. The lowest intake of calcium was found in children of the normal group, whereas no significant difference in calcium intake was observed between underweight and overweight children. In addition, no significant differences in the intake of ferrum, vitamin C, and vitamin A were observed among the three groups.

The average nutrient intake does not reflect the possible insufficient nutrient intake among individuals. According to the Indonesian Ministry of Health, a minimum of 70% of the RDA is regarded as normal intake. The percentage of children whose nutrient intake is below 70% is shown in Table 4 according to nutritional status. Data indicate that the percentage of children whose nutrient intake is less than 70% is higher in the underweight group than that in the normal and overweight groups. The proportion of children whose intake of fiber and micronutrients is below 70% of the Indonesian RDA was very high, that is, nearly 100% in all three groups.

3.4. Factors associated with underweight and overweight among children

Table 5 shows the results of the logistic regression analysis. Boys show a higher risk to be underweight than girls by 1.7 times (OR = 1.7, CI = 1.1–2.5); children whose fathers are underweight are twice as likely to be underweight (OR = 2.1, CI = 1.1–4.0); and children who play outdoors on weekends for more than 2 h are more likely to be underweight (OR = 1.5, CI = 1.1–2.3). However, the high level of education of mothers reduces the risk of children of becoming underweight (OR = 0.6, CI = 0.4–0.9).

The risk of being overweight of the children of overweight parents and highly educated mothers is more than doubled (OR = 2.0, CI = 1.2–3.3; OR = 2.3, CI = 1.5–3.3; and OR = 2.0, CI = 1.4–2.8, respectively). Children who sleep for less than 9 h a day and play outdoors on weekdays for less than 1 h display a significantly increased risk of being overweight (OR = 1.5, CI = 1.1–2.1; and OR = 1.8, CI = 1.3–2.6, respectively).

4. Discussion

Our findings on the prevalence of overweight in school-aged children are similar to the results of a national survey conducted by the Indonesian Ministry of Health, which revealed that 18.8% of Indonesian children are overweight [3]; however, this value is higher than that reported by Sandjaja et al. [2], who found that 14.6% of children in urban areas are

Table 3 – Food intake and compliance to RDA by children nutritional status.

Nutrient	Total (n = 166) Median (P_{25}-P_{75})	Nutritional Status			p[a] value
		Underweight (n = 43) Median (P_{25}-P_{75})	Normal (n = 70) Median (P_{25}-P_{75})	Overweight (n = 53) Median (P_{25}-P_{75})	
Energy (kJ)	5671.5 (4632.5–6956.1)	5249.6 (4265.3–6347.8)[b]	5792.2 (4401.8–7400.5)	6095.1 (5199.1–7224.3)	0.034
Energy fulfillment (%)	63.3 (53.2–80.8)	58.0 (49.0–68.5)[b]	63.9 (52.1–87.5)	70.7 (56.5–84.6)	0.032
Carbohydrate (g)	200.5 (165.4–241.1)	187.4 (143.6–228.6)	199.2 (155.7–245.1)	210.3 (178.1–246.1)	0.099
Carbohydrate fulfillment (%)	63.7 (51.9–78.0)	57.5 (47.5–73.5)[b]	65.5 (49.7–81.3)	68.7 (58.4–78.9)	0.044
Protein (g)	39.0 (32.4–48.7)	38.9 (32.1–48.8)	38.7 (30.7–48.0)	42.6 (34.2–51.4)	0.646
Protein fulfillment (%)	116.1 (92.5–140.3)	113.0 (91.5–150.0)	110.2 (82.0–139.7)	122.1 (99.3–139.9)	0.571
Fat (g)	34.3 (24.8–49.6)	33.0 (20.4–41.7)	34.5 (24.5–56.6)	34.9 (26.2–55.8)	0.135
Fat fulfillment (%)	46.5 (33.8–68.4)	43.5 (28.5–54.5)	45.8 (32.9–74.6)	48.1 (36.9–81.7)	0.103
Fiber (g)	4.2 (3.1–5.4)	3.7 (2.7–5.4)	3.9 (3.0–4.9)	4.6 (3.6–5.7)	0.038
Fiber fulfillment (%)	15.0 (11.4–19.0)	13.5 (9.5–19.0)	14.0 (10.7–17.6)	16.5 (13.0–20.5)	0.034
Calsium (mg)	219.7 (103.8–360.7)	238.4 (100.8–380.6)	198.3 (98.5–301.3)	245.1 (138.6–398.7)	0.123
Calsium fulfillment (%)	20.0 (9.5–33.6)	21.5 (9.0–34.5)	18.0 (9.0–29.7)	22.5 (12.5–36.0)	0.148
Fe (mg)	3.8 (3.0–5.2)	3.8 (2.9–5.4)	3.8 (3.0–4.8)	3.9 (3.0–5.4)	0.895
Fe fulfillment (%)	28.7 (21.0–37.1)	31.0 (20.5–43.0)	29.2 (21.0–33.7)	27.5 (21.2–37.2)	0.756
Vitamin C (mg)	10.2 (3.2–20.5)	5.3 (1.2–19.6)	8.5 (3.1–19.6)	13.1 (5.0–22.5)	0.089
Vitamin C fulfillment (%)	11.7 (3.5–23.5)	6.0 (1.5–21.5)	9.5 (3.9–21.6)	16.0 (5.7–24.2)	0.089
Vitamin A (mcg)	299.0 (193.9–453.1)	271.8 (186.4–436.7)	328.7 (224.7–449.6)	296.4 (182.1–501.3)	0.434
Vitamin A fulfillment (%)	34.2 (21.5–51.6)	30.0 (21.0–48.5)	36.5 (25.1–50.0)	33.0 (20.0–56.0)	0.429

P_{25}-P_{75}: 25th and 75th percentiles.
[a] Differences within group using Kruskal Wallis test.
[b] Underweight is significantly lower than overweight (p < 0.05) using Mann Whitney (Bonferroni correction).

Table 4 – Percentage of children consuming macronutrients and selected micronutrients below the Indonesian RDA by nutritional status.

	Total ($n = 166$)	Nutritional status			p^*
		Underweight ($n = 43$)	Normal ($n = 70$)	Overweight ($n = 53$)	
Energy	61.4	76.7	61.4	49.1	0.021
Carbohydrate	57.8	67.4	54.3	54.7	0.353
Protein	10.8	14.0	10.0	9.4	0.744
Fat	75.9	88.4	71.4	71.7	0.085
Fiber	100.0	100.0	100.0	100.0	na[a]
Calcium	98.8	97.7	100.0	98.1	0.469
Ferrous	98.8	97.7	100.0	98.1	0.469
Vitamin C	89.2	90.7	90.0	86.8	0.793
Vitamin A	99.4	100.0	98.6	100.0	0.502

*Probability using chi-square test.
[a] Not applicable.

Table 5 – Binary logistic regression analysis of factors associated with underweight and overweight in school-aged children ($n = 877$).

Underweight[a]			Overweight[b]		
Influencing factors	p value	OR (95.0% CI)	Influencing factors	p	OR (95.0% CI)
Age	0.174	1.078 (0.967–1.202)	High education of mother	0.003	2.068 (1.274–3.358)
Boys	0.005	1.737 (1.178–2.563)	Overweight mother	0.001	2.305 (1.588–3.347)
High education of mother	0.042	0.639 (0.416–0.983)	Overweight father	0.001	2.009 (1.406–2.871)
Underweight father	0.012	2.198 (1.192–4.054)	Sleeping hours <9 h	0.019	1.518 (1.072–2.149)
Playing outdoors on weekends >2 h	0.023	1.572 (1.063–2.324)	Playing outdoors on weekdays <1 h or not	0.001	1.878 (1.325–2.662)

CI: confidence interval; OR: odds ratio.
[a] Hosmer and Lemeshow test: 0.240.
[b] Hosmer and Lemeshow test: 0.710.

overweight. This study reveals that more boys than girls are underweight. By contrast, the incidence of overweight in girls is slightly higher than that in boys. Sandjaja et al. reported that no difference exists between the number of underweight boys and girls in urban areas; in addition, the prevalence of overweight is considerably higher in boys than that in girls [2]. This finding demonstrates that the tendency of the nutritional status of school-aged children in Makassar differs from the national condition. However, the information that will explain this situation in Makassar is inadequate. The present study confirms that the nutrient intake of boys is significantly lower than that of girls, and boys spend more time playing outdoors than girls, potentially causing their being underweight.

The prevalence of underweight is high among children of less educated parents. Similarly, a study undertaken in Ethiopia by Wolde et al. [9] found that less educated parents are more likely to have underweight children compared with the children of highly educated parents. The present study confirms that children of less educated parents rarely eat breakfast and their food intake is lower compared with the children of highly educated parents. Low education levels negatively influence the parents' capacity to show health-related behavior or provide high-quality care, including ensuring that children eat breakfast and providing balanced diet. In addition, parents who received low education level tend to receive low incomes, resulting in household food insecurity. Both low-quality care and household food insecurity can result in the undernutrition of children [5].

This study indicates that overweight is prevalent among children of highly educated parents. Studies conducted in Turkey [12] and Malaysia [22], which are developing countries similar to Indonesia, revealed that the incidence of overweight is higher among children of highly educated parents. Studies in developed countries have strongly indicated the opposite relationship; children of parents who received low education displayed an approximately higher risks of being obese by two to threefold [23,24]. Highly educated parents are more aware of potential health problems and therefore are more likely to protect their children from an unhealthy lifestyle [25]. Moreover, parents in developed countries are likely aware of risks associated with excess body weight in children, whereas parents in developing countries are possibly unaware of these health issues. Highly educated parents can easily obtain high incomes; thus, they purchase more unhealthy foods. In addition, most parents are likely to be proud when their children look fat, which apparently makes their children look cute and may reflect their high socioeconomic status.

In this study, highly educated mothers seem to strongly influence their children's BMI. An educated mother protects her children against being underweight and at the same time increases her child's risk of being overweight. This relationship exists possibly |because mothers in Indonesia strongly influences the food intake of their children. The current study confirms that most highly educated mothers come from middle- and high-income families. This finding is consistent with

studies conducted in some developing countries [11,12,22]. Food consumption of high-income families is high. Another possible explanation is that rich families often opt to eat out rather than at home, and foods served in restaurants typically contain increased amount of calories and fat and supplied with fewer vegetables and fruits. This trend is opposite to that in developed countries, showing an inverse relationship between household income and overweight children [25]. In developed countries, high-income families tend to purchase expensive healthy food, whereas higher-income households in developing countries buy food beyond their needs. In this study, children of highly educated mothers eat breakfast nearly daily and they consume more nutrients than children of less educated mothers. In addition, the majority of children of highly educated mothers spend more time in sedentary activities and less time in physical activities. This condition contributes to the incidence of overweight among these children.

Health education, which is necessary to improve their children's nutritional status, is easily understood by highly educated mothers; they then apply the knowledge they acquired in feeding their children. However, the current study found that the consumption of micronutrients is very poor among both underweight and overweight children. This finding indicates that children do not consume sufficient amount of foods rich in vitamins and minerals, such as fruits and vegetables. The unavailability of various fruits and vegetables and/or picky eating behavior of children is possibly responsible for this phenomenon. More studies are needed to investigate the eating behavior of children in Indonesia. The awareness of parents in providing and encouraging children to consume not only sufficient macronutrients but also micronutrients is crucial, considering that children in this age group are still dependent on their parents. Present-day mothers were educated based on past issues, which possibly emphasized only on the nutrition aiming to prevent underweight children younger than 5 years old, as this was the most prominent health problem in Indonesia. Even at present, education on healthy eating in elementary schools only aims to prevent underweight, encouraging children to eat more; however, no discussion on preventing overweight and on ensuring balanced physical activities is being provided. Overweight may cause adverse effects, such as the risk of hypertension, diabetes mellitus type 2, and metabolic disorder that starts in childhood. Thus, an intervention program to prevent and treat unbalanced diet is needed. School-based nutritional promotion effectively improves knowledge on nutrition and promotes consumption of balanced diet among children [26]. In addition, intervention that involves family members positively affects the children's weight [27].

This study also suggests that the prevalence of underweight and overweight in children increases proportionally with the incidence of underweight and overweight among parents. This finding is consistent with those reported by Naidu et al. [22] and Çalişir et al. [12]. Furthermore, other studies have reported that children with at least one parent (either father or mother) who is obese/overweight exhibit a higher risk of being obese or overweight by approximately three-fold compared with those whose parents are normal, and the chance of being overweight is even higher when both parents are obese/overweight [13,14,28]. Tang et al. [14] reported that overweight parents are strongly associated with overweight children. The results indicate that overweight and obesity in children are influenced by genes and by the environment, including eating patterns of their families and their habitual activities. The contribution of genetics versus environment to body weight remains underexplored. The present study indicates a significant relationship between the children's nutritional status and their physical activities, such as playing outdoors, playing games in computers/tablets, and playing videogames; however, watching TV and playing on computers or tablets do not reflect a significant relationship with nutritional status. Bhuiyan et al. [29] showed that those engaged in more than 30 minutes of physical activity displayed a significantly lower odds of being overweight than those who spend less than 30 minutes of physical activity; this result is consistent with our findings. The prevalence of overweight is lower in children who regularly play outdoor games [30]. Thus, the inclusion of physical exercise in health education in school should be implemented, which will promote normal weight among children [31].

Long hours of playing videogames are a risk factor for overweight and obesity among children [13]. This result is contrary to the findings of the present study, in which children who played videogames for more than 1 h tended to be underweight rather than overweight. This phenomenon was observed possibly because at the present time, overweight children, who generally come from high socioeconomic families, spend much of their sedentary time playing with a tablet rather than with videogames. Children, particularly boys from low-income families and who in the past cannot play videogames because they are expensive, may now be able to play videogames by renting them by the hour. Therefore, children tend to spend their money on renting videogames rather than for food, and they sometimes skip their lunch or dinner when playing videogames. This scenario may contribute to the incidence of underweight among children from low-income families.

The association of shorter sleep hours and the incidence of overweight found in this study is consistent with the findings of Carter et al. [32] and Garaulet et al. [33]. However, the mechanism of the relationship between short sleeping hours and obesity is unclear. Liu et al. [34] postulated that inadequate sleep can increase ghrelin levels and reduce leptin, thereby enhancing the appetite and contributing to increased consumption of excessive calories from unhealthy foods. In addition, short sleeping hours can reduce energy expenditure and cause fatigue, contributing to physical inactivity. Short sleep duration is also associated with altered metabolic homeostasis, high low-density lipoprotein, and high-sensitivity C-reactive plasma [35].

Few children who rarely eat breakfast are overweight, inconsistent with other results, in which eating breakfast occasionally increases the risk of being overweight. According to Mushtaq et al. [36], children who skip breakfast show a two-fold higher risk of becoming overweight. Liou et al. [37] found that adolescents who eat breakfast every day showed a lower rate of obesity compared with those who skip breakfast.

Our study found that a greater number of children who are weighed irregularly were overweight, indicating that parents do not have adequate awareness of the need to monitor their children's weight. In contrast to the practice in developed

countries, no regular monitoring of children's body weight and height is not practiced in Indonesian schools. Regular monitoring of children's anthropometrics depends on their own parents' awareness. In addition, no information campaign regarding the standard indicators of children's body weight and height is provided by the government or any responsible parties.

This study indicates that the dietary intakes of more than half of the children is below the Indonesian RDA, except for protein. These low intake levels contribute to a high prevalence of underweight children. The intake of total energy and carbohydrates among underweight children is lower than that of normal-weight children, and intake of total energy among overweight children is higher than that of normal-weight children. This finding is similar to the results of Agustina et al. [38]. Moreover, protein intake is adequate in all groups of children because the Makassar people consume a considerably high amount of fish. The Millennium Development Goal of Indonesia in 2010 found that the total energy consumption (62%) of the population is below the minimum requirement (8368 kJ/capita per day or 2000 kcal/capita per day) [39]. In addition to the low intake of macronutrients, the recent study reveals that children in Makassar, including the normal-weight and overweight children, have low intake of micronutrients, such as calcium, ferrum, vitamin C, and vitamin A.

This study has some limitations. First, the information regarding the body weight and height of parents was based on their own reports. Therefore, the data might be different from those measured by health professionals. Second, food intake was measured in subsamples of fifth- and sixth-grade students only; data might not represent the school-age children in general.

5. Conclusion

This study reveals that the prevalence of underweight and overweight school-age children in Makassar was 14.5% and 20.4%, respectively. Children's gender, education level of their mothers, BMI of their parents, and children's lifestyle, particularly the time they spend playing outdoors and for sleep, are associated with their nutritional status. These findings demonstrate the need to improve the parents' awareness of the implications of excessive body weight of their children; comprehensive education and promotion of healthy nutrition is thus needed. Nurses play an important role in assessing the nutritional status of children and in identifying risk factors, as well as initiating treatment. Furthermore, nurses should provide information to families and children regarding the principles of balanced nutrition, as well as explain the undesirable effects of imbalanced or insufficient nutrition.

Authors' contributions

All authors contributed extensively to the work presented in this paper. SS, RK, & AT designed the study, constructed the questionnaire, interpreted the data, and made critical revisions to the paper. SS was responsible in data collection and writing the original draft. TS & FA performed the analysis and interpretation of data. RS participated in the questionnaire construction and helped to draft the manuscript. All authors read and approved the final manuscript.

Conflict of interest

All authors declare they have no conflicts of interest.

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