Amerta Nutrition
e-ISSN: 2580-1163 (Online)
p-ISSN: 2580-9776 (Print)
Salisa et al. | Amerta Nutrition Vol. 7 Issue 1SP (May 2023). 1-7

RESEARCH STUDY
English Version

OPEN ACCESS

Nutritional Status, Dietary Intake, and Sleep Duration Among School Children: A Comparative Study

Status Gizi, Asupan Makan, dan Durasi Tidur Anak Sekolah: Studi Komparasi

Wizara Salisa[1], Rachmahnia Pratiwi[1], Kamila Dwi Febrianti[1], Annis Catur Adi[2]*, Siti Rahayu Nadhiroh[2]

[1]Public Health Master Programme, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia
[2]Nutrition Department, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia

ARTICLE INFO

Received: *31-01-2023*
Accepted: *12-04-2023*
Published online: *12-05-2023*

Correspondent:
Annis Catur Adi
annis_catur@fkm.unair.ac.id

DOI:
10.20473/amnt.v7i1SP.2023.1-7

Available online at:
https://e-journal.unair.ac.id/AMNT

Keywords:
Children, Comparative research, Diet, Malnutrition, Nutritional status

ABSTRACT

Background: There are differences in the prevalence of malnutrition between rural and urban areas due to differences in consumption patterns. However, data regarding differences between rural and urban areas in Indonesian cities still need to be investigated, even though this information is essential for the government to use when creating policies to eradicate malnutrition.

Objectives: To determine the effects of differences in school location (rural and urban) on the nutritional status, food intake, and sleep duration of children in junior high school.

Methods: The research employed a cross-sectional design, which comprised 102 junior high school students in Jombang (a rural area) and 101 junior high school students from Surabaya (an urban area) served as the sample. Nutritional status was determined using anthropometric measurements of z-score BMI-for-age, performing the 2x24H food recall interviews to determine food intake and the questionnaire to determine sleep duration.

Results: The findings revealed a significant difference between rural and urban areas in nutritional status ($p=0.002$) and food intake, namely carbohydrate intake ($p<0.001$). The issue of malnutrition that differed significantly between the two regions was obesity ($p<0.001$), which was more prevalent in urban areas; on the other hand, undernutrition did not ($p=0.556$). In addition, sleep duration did not differ significantly ($p=0.327$).

Conclusions: In conclusion, differences in nutritional problems between urban and rural areas were not constantly caused by food intake or sleep duration; however, indirect factors such as physical activity could also play a role. This finding resulted in recommendations for schools to conduct a balanced nutrition education program and for the government to implement various policies to eliminate malnutrition in urban and rural areas.

INTRODUCTION

Nutrition is essential for the human brain's health, life, and growth at all ages[1]. Balanced nutrition is necessary for endurance, physical development, cognitive growth, and productivity. Nutritional status in early infancy significantly affects health, particularly the growth and development of children and the country's economic development[2]. Nutritional conditions are crucial for children under five and during their education years, as they affect cognitive abilities and the future generation[4,5].

Poor nutritional status among schoolchildren is a significant public health issue that negatively affects academic achievement[6]. Malnutrition is an urgent issue affecting children's learning capacity, resulting in lower academic achievement. In Indonesia, stunting is a significant nutritional issue (rural: 39.2%; urban: 25.5%) based on research involving anthropometric measurements and intake assessment in school-aged children[7]. In rural areas of Indonesia, Thailand, and Vietnam, stunting and malnutrition are more prevalent. The nutritional status of overweight and obesity also occurs; however, its prevalence is larger among urban children (10.7%) than among rural children (5.0%). Malnutrition occurs when food intake falls short of nutritional requirements, which are affected by residence[8].

Demographic differences, socioeconomic disparities (income, employment), and education levels between rural and urban areas can affect consumption patterns and nutritional sufficiency, resulting in different lifestyles[9]. The research results in India indicate that urban communities consume more fruits and vegetables than rural communities[10]. On the other hand, macronutrient consumption is higher in China's urban communities[11]. The consumption of food affects nutritional sufficiency and determines nutritional status. However, the increased risk of obesity and malnutrition

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is also affected by several other factors, including sleep duration[12].

Adequate sleep duration is associated with optimal adolescent health (physical and psychological) and academic achievement[13]. The optimal amount of sleep for adolescents (12 to 18 years) is 8 to 9 hours[14]. In addition, it is recommended by the American Academy of Sleep Medicine are a minimum sleep duration of 9 hours for children and 8 hours for adolescents. Short sleep duration is defined as a duration that falls below the recommended hours[15]. In children and adolescents, short sleep duration is associated with several cardiometabolic risk factors, including dyslipidemia, blood sugar imbalance, elevated blood pressure, and an increased risk of obesity[16,17]. According to research on adolescents aged 10 to 12 years, children's body composition is partially mediated by consuming sugary beverages, physical activity, and sleep duration[18].

The prevalence of high nutritional status in various regions heightens anxiety regarding children's current growth and brain development, and maturation into adulthood. The incidence of malnutrition and risk factors for malnutrition are likely to be influenced by differences in location characteristics, namely rural and urban areas; thus, further research is necessary. This study aimed to determine differences in the nutritional status, food intake, and sleep duration of junior high school students based on their school location (rural or urban).

METHODS

This study utilised a cross-sectional method to compare the nutritional status, food intake, and sleep duration of urban and rural schoolchildren. One school from each region was selected using systematic sampling. Observations were conducted in schools in each city/district for the prior preliminary study. Surabaya was selected to represent the urban area since it exemplifies urban conditions encompassed by numerous public spaces and a dense population. As the provincial capital of East Java, the city has become a hub for government services and social and economic activities. Jombang was selected to represent the rural area since it has a reduced population density (half that of Surabaya) and a lower per capita expenditure index than the provincial average in East Java[19]. The election for rural and urban areas is described under Article 26 of the Constitution (Law) of 2007 regarding Indonesian Spatial Planning[20]. Subsequently, one school from each region with the appropriate characteristics was selected to depict rural and urban settings. The research was conducted in August 2019 with approval from the Health Research Ethics Committee of the Faculty of Nursing at Airlangga University (certificate number: 1385-KEPK).

Sample

The minimum sample size was determined using the formula of Lemeshow et al. (1990)[21]. The confidence level was 95%, and the error margin was 8%. The proportion of pupils based on BMI by age with a Z-score (BAZ) <-2 and >2 in East Java was 26.5%[22]. There were 459 and 513 students in rural and urban schools, respectively. The calculation results demonstrated that the minimum sample sizes for rural and urban schools were 94 and 96.

The study's subjects comprised Junior High School students from grades 7 to 9 from each school. Students were selected at random based on the planned sample size. Students who satisfied the inclusion criteria were healthy, did not fast on the day of data collection and the day before, were willing to participate (as evidenced by parental consent) and could complete all data collection procedures. Ultimately, 203 students satisfied the criteria for following and completing all procedures, including 102 students from rural areas and 101 from urban areas.

Nutritional Status

Data on nutritional status consisted of height and weight measurements obtained through direct measurement. The individuals' height was measured using a stadiometer, and their weight was determined using a digital scale. Using the WHO Anthro Plus application, the BMI/U Z-score is calculated. According to the Indonesian Minister of Health Number 2 (2020), BMI/U nutritional status is classified as undernutrition if the Z-score is -3 SD to -2 SD, good nutrition/normal if the Z-score is -2 SD to +1 SD, overnutrition if the Z-score is +1 SD to s/d +2 SD, and obesity category if the Z-score is >++2 SD. All data were collected by trained enumerators, who were nutrition graduates capable of conducting interviews and anthropometric measurements.

Food Intake

Data was collected using a 2x24-hour food recall interview, and the subject recalled all foods and beverages from waking up to bed the previous day. The interviewer utilised a digital food photo book published by the Ministry of Health[23]. Food recall information was entered into the Nutrisurvey 2007 software to determine daily energy, protein, fat, and carbohydrate intake. The adequacy of the subject's consumption was determined by comparing the total daily intake to individual requirements based on the RDA by age[24]. Food intake was categorised as adequate, suppose it satisfies the 90-110% requirement, low if it falls < 90% requirement, and excessive if it falls > 110% requirement.

Sleep Duration

The sleep duration was determined using the self-reports of each participant on the questionnaire. Sleep duration was calculated on average from weekday and weekend sleep patterns. An enumerator explained the meaning of the question, "How many hours do you typically sleep per day?"[25,26]. This question was posed twice to represent the duration of sleep on school days (weekdays) and weekends (weekends). In addition, the subject's responses were recorded on the questionnaire. Based on recommendations for sleep duration by the Indonesian Ministry of Health (2018), adolescents should sleep at least 8 to 9 hours per day (12 to 18 years old)[14]. Therefore, the classification was considered adequate if the subject sleeps ≥8 hours per day and inadequate if <8 hours per day.

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Data Analysis

The software Nutrisurvey 2007, which was outfitted with an Indonesian food database, was used to analyse energy and nutrient intakes. Food commodities unavailable in the database were manually added to the software. The analysis of data was conducted in two stages: univariate and bivariate. Univariate analysis was performed to determine the frequency distribution of subject characteristics, namely gender and age. A bivariate analysis was conducted between rural and urban areas to determine differences in nutritional status z-score BMI/A, food intake (nutritional sufficiency), and sleep duration. The test employed the Mann-Whitney method with a significance level of $p<0.05$ since the normality test results indicated that the data distribution was non-parametric ($p<0.05$). All data analysis was performed utilising IBM SPSS Statistics 22.

RESULTS AND DISCUSSION

Table 1 presents the distribution of subjects based on gender and age. A total of 102 (50.2%) students were from rural schools; the other hand, 101 (49.8%) were from urban schools. Urban areas had a higher percentage of male pupils (44.6%); on the other hand, rural areas had a higher percentage of female students. Most study participants were 14 years old (50.2%), the same as in rural areas. In urban areas, however, most participants were 13 years old (36.6%). No students in the 12-year-old age bracket participated in rural research activities; thus, the percentage was 0%.

Table 1. Frequency distribution of characteristics of schoolchildren by gender and age in rural areas of Surabaya and Urban Areas of Jombang

Variable	Rural (%)	Urban (%)	Total (%)
Gender			
Male	41 (40.2%)	45 (44.6%)	86 (42.4%)
Female	61 (59.8%)	56 (55.4%)	117 (57.6%)
Age (years)			
12	0 (0.0%)	27 (26.8%)	27 (13.3%)
13	18 (17.6%)	37 (36.6%)	55 (27.1%)
14	68 (66.7%)	34 (33.7%)	102 (50.2%)
15	16 (15.7%)	3 (3.0%)	19 (9.4%)
Total	102 (100.0%)	101 (100.0%)	203 (100.0%)

Table 2. Average BMI-for-age Z-score, nutritional status, and sleep duration in rural areas of Surabaya and urban areas of Jombang

Classification	Rural	Urban	Total	p-value
Nutritional Status				0.002*
Undernutrition	1 (1.0%)	2 (2.0%)	3 (1.4%)	0.556
Normal	84 (82.4%)	63 (62.4%)	147 (72.4%)	0.001*
Overnutrition	14 (13.7%)	19 (18.8%)	33 (16.3%)	0.327
Obesity	3 (2.9%)	17 (16.8%)	20 (9.9%)	0.001*
Z-score	-0.3±1.3 SD	0.4±1.4 SD	0.1±1.4 SD	
Sleep Duration				0.327
Average	9.0±1.5 hours	8.2±1.9 hours	8.6±1.7 hours	
Insufficient	50 (49.0%)	41 (40.6%)	91 (44.8%)	
Sufficient	52 (51.0%)	60 (59.4%)	112 (55.2%)	

*p-value <0.05 demonstrated a significant difference based on WHAT test

The study results indicated that the nutritional status with a significant difference was obesity; on the other hand, the prevalence of poor and poor nutritional status was highly low in each region, and the difference between them was insignificant. Urban children were found to have substantially higher rates of obesity. According to Insani's (2018) study, obesity is higher in urban areas[27]. In addition, this study confirms that, as in other developing nations, the overweight problem appears to be more prevalent among urban youth[28-30]. According to a study conducted in Ghana on the causes of childhood obesity in urban areas, the most significant factors were high socioeconomic status, consumption of sweet foods and beverages, and accumulation of 2 hours of daily television viewing[31]. The same study also mentions that fruit and vegetable consumption, physical activity, including pedaling a bicycle or walking to school, and sleeping for fewer than nine hours per night were obesity preventive factors[31].

Furthermore, Table 2 displays the average duration of slumber for students, which is longer in rural areas (9.0 1.5 hours) than in urban areas (8.9 1.9 hours). The average sleep duration in the two regions and categories did not differ significantly. The prevalence of adequate sleep duration varies between 50 and 50 percent between the two regions, with rural at 51.0% and urban at 59.4%. There was no significant difference in sleep duration between rural and urban areas. Based on the classification of sleep duration, it was determined that the prevalence of adequate and insufficient sleep was nearly identical. Multiple studies indicated a correlation between insufficient sleep duration and overweight or obesity in infants and adolescents[32,33]. The study discovered a significant inverse relationship between sleep duration and overweight or obesity, indicating that short/less sleep duration increased the risk of infancy and adolescent obesity[34]. The mechanisms by which sleep duration affects body weight have not

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been optimally elucidated. The findings of a literature review (comprising 29 studies in 16 countries) with a sample of children and adolescents indicated, however, that sleep duration affected changes in food intake patterns and excessive use of gadgets, which in turn affect nutritional status[34,35] and an increased desire to consume fast food and sweets[36]. In this study, the relationship between sleep duration and nutritional status was insignificant, nor did it have a definite effect on nutritional status.

Table 3 displays the mean and percent adequacy of daily intake from the 2x24-hour food recall interviews. Among the energy and macronutrients analyzed, the nutrients with significant differences between rural and urban areas were carbohydrates (p<0.001), with the number of children with better consumption, i.e. the excellent category, being higher in the urban group (61.4%) than in the rural group (36.4%). No significant differences in the other nutrient categories resulted in a nearly identical average total consumption between the two regions. Regarding the prevalence of total energy consumption, for instance, the urban and rural groups have comparable percentages in the outstanding category, namely 38%, with an average consumption of approximately 1500 kcal. The same holds for protein, which had a comparable average consumption of 54 grams between the two regions. The rural group had a similar higher average consumption (70.9±25.7 grams). Nonetheless, the consumption category had a similar percentage, approximately 46%. Therefore, the two regions' energy, protein, and fat consumption did not differ significantly.

Table 3. Average food intake and nutritional adequacy of schoolchildren in rural areas of Surabaya and urban areas of Jombang

Food Intake	Nutrition Adequacy	Rural	Urban	Total	p-value
Energy	Average	1511.9±432.4 kcal	1583.4±458.2 kcal	1547.5±445.8 kcal	0.655
	Low	60 (58.8%)	57 (56.4%)	117 (57.6%)	
	Adequate	39 (38.2%)	39 (38.6%)	78 (38.4%)	
	Excess	3 (2.9%)	5 (5.0%)	8 (3.9%)	
Protein	Average	53.8±19.5 grams	54.9±16.1 grams	54.4±17.9 grams	0.767
	Low	37 (36.3%)	32 (31.7%)	69 (34.0%)	
	Adequate	51 (50.0%)	58 (57.4%)	109 (53.7%)	
	Excess	14 (13.7%)	11 (10.9%)	25 (12.3%)	
Fat	Average	70.9±25.7 grams	66.9±22.9 grams	68.9±24.3 grams	0.776
	Low	25 (24.5%)	26 (25.7%)	51 (25.1%)	
	Adequate	47 (46.1%)	47 (46.5%)	94 (46.3%)	
	Excess	30 (29.4%)	28 (27.7%)	58 (28.6%)	
Carbohydrate	Average	150.5±56.7 grams	180.0±48.6 grams	165.2±54.8 grams	<0.001*
	Low	65 (63.7%)	39 (38.6%)	104 (51.2%)	
	Adequate	37 (36.3%)	62 (61.4%)	99 (48.8%)	
	Excess	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Total		102 (100.0%)	101 (100.0%)	203 (100.0%)	

*p-value <0.05 indicated a significant difference based on WHAT test

Carbohydrate consumption was the variable in the nutritional consumption variable with significant differences. Compared to other adequacy categories, the distribution of children with excessive intake of all nutrients was generally lower. Specifically, in terms of protein and fat intake, the number of rural children with excessive intake was more significant. It is conceivable that the high prevalence of obesity in urban areas is due to factors other than nutritional intake. This study did not analyse students' socioeconomic background, breakfast habits, food diversity, or daily physical activity. Nevertheless, based on regional per capita income data, families living in urban areas are presumed to have a higher economic status, correlated with greater access to high-energy foods and beverages. In addition to having more accessible access to transportation to traverse any distance, children from affluent households also engage in less physical activity. The findings of Euler et al. (2019) indicate that schoolchildren in rural areas engage in more physical activity than their urban counterparts. Sedentary activity is rising due to the widespread use of electronic devices and others[37]. These factors explain why fat consumption is higher in rural areas without a corresponding increase in obesity prevalence[38]. The factor of breakfast habits was not addressed in this study; however, the results of low daily intake demonstrated that children do not consume breakfast regularly; it could be determined from the results of the study that a low frequency of breakfast was positively correlated with a 1.48-times increase in the incidence of obesity and a 1.48- times decrease in abdominal obesity[39].

Consumption of macronutrients was calculated to determine the effect on nutritional status, particularly body weight. The effect of nutrient metabolism prevents energy and macronutrients from directly affecting weight gain. Different macronutrient compositions have varying effects on adiposity because their effects on appetite, thermogenesis, and metabolism vary and depend on the microbiome and genotype of the individual[40]. It is determined that an increase in carbohydrate consumption causes an increase in body weight, whereas an increase in fat consumption increases the prevalence of obesity[41]. There was evidence, however, that polyunsaturated fatty acid consumption has a significant inverse relationship with childhood adiposity[42]. Consequently, the effect of nutrient consumption on

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nutritional status was contingent upon numerous other factors, in addition to the type of food constituents and their processing. Physical activity, for instance, plays a crucial role in fat distribution within the body. Physical activity could assist the body in utilising its stored energy reserves, with the quantity of energy used depending on the activity's type, intensity, and duration. Inactivity causes a significant amount of energy to be stored as fat; thus, inactive individuals tend to gain weight.

Urban energy consumption is similar to rural energy consumption. However, the average urban energy consumption and the number of children with excess intake are more significant than in rural areas. According to the Constitution (Law) Number 26 of 2007 concerning Spatial Planning in Indonesia, urban areas are characterised by the concentration of government services, social services, and economic activities[20]. Rural and urban areas have distinct demographic, occupational, and sociological conditions, which in turn affect the food environment/culture of the community, according to the definition of the area[43]. The prevalence of processed and nutrient-dense immediate foods in the city centre has increased urban children's nutritionally adequate food preferences. On the other hand, students in rural areas may have different preferences for the types of food available at their schools. If there is a food shortage in urban areas, the same food shortage exists in rural areas, and vice versa[44]. This concept ensured that the accessibility of a food ingredient in rural areas was dependent on its accessibility in urban areas. In addition, the availability of supermarkets contributed to the diversity and accessibility of food sources in urban areas[45]. In addition to the proliferation of supermarkets, fast food restaurants, cafes, and small restaurants, they were becoming increasingly accessible in urban schools. This condition gave urban students more options for purchasing food from these stores[46,47]. Students were at an age where the school food environment significantly affected their diet. Therefore, schools play a crucial role in moulding students' eating habits[48].

CONCLUSIONS

This study confirms the hypothesis that rural and urban schoolchildren had different nutritional statuses and food intakes in several categories. The prevalence of nutritional status differed significantly, with normal (more prevalent in rural areas) and obesity being significantly different (higher in urban areas). Total carbohydrate intake demonstrated significant differences; however, intake categories in rural areas were excessive or low. An excessive nutrient intake did not accompany the high prevalence of obesity in urban areas; therefore, other factors such as family income, knowledge, facilities/access to food, breakfast practices, and low physical activity affected the possibility of obesity. Sleep duration did not differ significantly between the two regions, and the proportions of students who slept sufficiently and those who slept insufficiently were similar. Considering that students spend most of their time in the school environment, this study recommends school policies or programmes to enhance student knowledge and healthy canteen facilities and facilities to support physical activity to create a balanced and sufficient diet (including breakfast habits) and better nutritional status.

ACKNOWLEDGEMENTS

The authors would like to express their deepest gratitude to the collaboration of the Directorate of Occupational Health and Sports staff from the Indonesian Ministry of Health. The authors are deeply indebted to the entire research team (Mahmud Aditya Rifqi, Rian Diana, Qonita Rachmah, Stefania Widya Setyaningtyas, Dominikus Raditya Atmaka, and Nila Reswari Haryana), and the enumerator team, who have contributed to the successful completion of the research and data collection.

Conflict of Interest and Funding Disclosure

There are no conflicts of interest among the authors of this article. This research was supported by the Indonesian Ministry of Health's Directorate of Occupational Health and Sports.

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