The Association between Sleep Duration, Breakfast Routine and Nutritional Status in Indonesian Adolescents during COVID-19 Pandemic

Muhammad Nadzir Mushoffa Suja'I [1], Reny Noviasty [1], Eva R Kurniawati [2], Ratih W Wisnuwardani[1*]

ABSTRACT

Background*: Adolescents are susceptible to nutritional status issues, both undernutrition, and over-nutrition, becoming a public health concern promptly. There were 912 junior and high-school adolescents who were obese and 249 high-school adolescents who had low body mass index (BMI) in Samarinda City. During the COVID-19 pandemic, adolescents experienced changes in sleep duration, and many adolescents were skipping breakfast. Sleep duration and breakfast can affect the nutritional condition of adolescents.*

Objectives*: The purpose of this study was to determine the association between sleep duration, breakfast routine and BMI in Samarinda, Indonesian adolescents during COVID-19 pandemic.*

Materials and Methods*: A total of 340 adolescents was sampled and assessed using a cross-sectional technique to ascertain their sleep duration, breakfast routine, and nutritional status. Nutritional status was classified based on BMI-for-age and z-value BMI. The amount of sleep duration was calculated by the average wake time and sleep time. Breakfast routine was obtained from seven days of breakfast before 9 am. Then, using multivariate analyses were tested for sleep duration, BMI z-value, breakfast routine, and nutritional status.*

Results*: This study revealed that 68.5% had good nutrition, with an average sleep duration of 8 hours (65.9%) and irregular breakfast (59.1%). Nutritional status was significantly influenced by breakfast routine (p=0.044), gender (p<0.001), and mother's employment (p<0.001). A cubic association was found between sleep duration and BMI (p=0.045); and a significant association between breakfast routines and BMI, independent from age, gender, ethnicity, school.*

Conclusion*: Adolescents must consider their sleep duration and the frequency and composition of their breakfast. Future study in the longitudinal study is needed to explore in more detail.*

Keywords *: Sleep Duration; Breakfast; Nutritional Status; Adolescent*

BACKGROUND

Adolescence is a vulnerable period with nutritional status problems, such as malnutrition, including low body weight, overweight, stunting, and micronutrient deficiencies [1, 2]. Overweight and obesity in adolescents can increase the risk of heart disease, atherosclerosis, diabetes mellitus, orthopedic disorders, mental health disorders, and cognitive function [2].

Globally, the prevalence of overweight in adolescents aged 15-19 is 10%, and 2-3% of them are obese. Meanwhile, 88% are underweight in which 29% are girls and 59% are boys [3]. Over 340 million children aged 5-19 years were overweight and obese in 2016 [4]. Overweight or obesity adolescents are public health problems that require immediate attention and it may worsen their health, causing infectious disease [5–7].

According to Basic Health Research in 2018, the proportion of overweight and obese people aged 18 years and over in Indonesia has increased. East Kalimantan, Borneo is in the top three proportions of obese adults aged 18 years and over. Meanwhile, the prevalence of obesity and overweight in the Samarinda area in adolescents aged 13-15 years is 9.03% and 10.42%, respectively. Additionally, the prevalence of obesity and overweight for 16-18 years is 5.50% and 8.17%, respectively. Meanwhile, the prevalence of underweight and fragile nutritional status in Samarinda is 8.34% and 4.66% in 13-15 years and 10.98% and 3.36% in 16-18 years [8].

[1] Faculty of Public Health, Universitas Mulawarman
Jalan Kesehatan, Gunung Kelua, Samarinda, East Kalimantan 75119, Indonesia
[2] Department of Cardiothoracic Surgery, Maastricht University Medical Center+, P. Debyelaan 25, PO Box 5800, 6202 AZ Maastrict, the Netherlands
[*]**Correspondence** : E-mail: ratih@fkm.unmul.ac.id, Phone +62-85161558202

Sleep duration, sleep quality, and sleep problems can lead to obesity and overweight. Sleep duration can increase the risk of cardiovascular disease, type 2 diabetes, mental health, hypertension and affect academic performance [9–12]. In addition, adolescent nutritional status is related to short sleep duration, which has the highest risk of obesity or overweight, increased fasting glucose levels, and an unhealthy immune profile [13].

Several studies state an association between short sleep duration and the nutritional status of high school adolescents, which stated that during a pandemic period, adolescents sleep only 4-6 hours in one day [13–15]. The amount of sleep duration is not aligned with the suggestion of the Ministry of Health of the Republic of Indonesia in 2018, which stated that the total sleep duration for adolescents should be 8-9 hours a day.

Another research on the sleep duration in high school students discover that more female students (75.6%) are having a shorter sleep duration compared to male students (69.6%) [16]. The same result is also found in high school students in Brazil, as well as with a sense of sleepiness was excessive [17]. Nonethless, short sleep duration has a relationship with obesity in adolescents [18].

Apart from sleep duration, meta-analytical studies confirm that skipping breakfast also increases the risk of obesity or overweight [19]. Health behaviors such as the duration of sleep and breakfast consumption in adolescents are associated with chronic disease [13]. Breakfast plays a role in fulfilling nutritional intakes. However, adolescents still skip breakfast [20]. Adolescents who skip breakfast tend to have a poor quality diet and have a higher BMI or have more weight than adolescents who do not skip breakfast. [21, 22]. Another study suggests a positive correlation between skipping breakfast and obesity [23].

In Samarinda , 912 junior high and high school students are obese [24], and 249 high school adolescents have a low BMI [25]. There was also an increase in body weight during the COVID-19 pandemic [26]. In addition, changes in sleep duration in adolescents during the COVID-19 pandemic and their breakfast bevavior affect their nutritional status [27, 28]. If those problems do not get enough attention, it will lead to an increasing number of adolescents with high BMI during the COVID-19 pandemic. The result from this study are expeted to be used as a reference for further study about the problems and can be another source of knowledge for society. The aim of this study was to identify and predict the relationship between adolescent nutritional status and sleep duration and breakfast routines during the COVID-19 pandemic. This study conducted during COVID-19 pandemic at Samarinda , West Kalimantan, Borneo, Indonesia.

MATERIALS AND METHODS

This study was an observational study with a cross-sectional survey conducted in Samarinda in West Kalimantan in March 2021. The population for this study was 2.943 high school students,. Schools were selected based on the ease of access for researchers to reach.. The sample was calculated using the Lemeshow formula [29]. The randomized and stratified random sampling technique was used based on geographic location, age, and socio-economic status [30]. The independent variables were sleep duration and breakfast routine, and the dependent variable was nutritional status. Based on self-reports, data on nutritional status, sleep duration, and breakfast routines were collected. Sleep duration was obtained from calculating bed and wake up time during the week. Meanwhile, the breakfast routine is obtained by calculating the time of breakfast during the week and the number of days of breakfast. BMI was calculated by age to determine nutritional status. The instrument used was an online questionnaire that was previously tested for its reliability. The sleep duration question was used to determine the average amount of sleep duration for teenagers in one week, breakfast routine questions were used to see what breakfast time teenagers had breakfast. However, the nutritional status question was asked to see the nutritional status of adolescents based on the z value of BMI. Informed consent was obtained by providing a descriptive at the beginning of the questionnaire and providing questions regarding willingness to fill out the online questionnaire. The study protocol was approved by the ethics committee in Mulawarman University, Samarinda, Indonesia.

Univariate data analysis was used to see the distribution and frequency. The bivariate analysis used was the Spearman test and the chi-square test to find confounding variables. Multivariate analysis was conducted to see whether there was a relationship between sleep duration and breakfast routine on nutritional status. Data analysis using quantitative analysis, namely linear, quadratic, cubic, and logistic regression analysis. If Sig (2-sided) < 0.05 then H0 is rejected and Sig (2-sided) > 0.05 then H0 is accepted. This analysis predicted sleep duration and breakfast routine based on nutritional status. A logistic regression test was used to predict the relationship between breakfast routine variables and nutritional status variables by adjusting the four models. The linear test was used to see a straight-line relationship between sleep duration and the z value of BMI as seen from the significant fixed coefficient. Meanwhile, quadratic and cubic tests were used to see the

relationship between sleep duration and the z value of BMI, which was seen from the significant fixed effects results. Linear, quadratic, and cubic tests were adapted to the four models. For all tests, a two-tailed p-value < 0.05 was considered statistically significant.

RESULTS

Table 1. Characteristic of Adolescents

Variables	Nutritional Status				N (%)	*p*-value
	Poor (%)	Good (%)	Over (%)	Obese (%)		
Sleep Duration						
<8 Hours	28 (12,5)	158 (70,5)	27 (12,1)	11 (4,9)	224 (100)	
8-9 Hours	8 (12,5)	43 (68,3)	9 (14,3)	3 (4,8)	63 (100)	0,459
>9 hours	5 (9,4)	32 (60,4)	13 (24,5)	3 (5,7)	53 (100)	
Breakfast Routine						
Not Routine	26 (12,9)	131 (65,2)	32 (15,9)	12 (6)	201 (100)	0,420
Routine	15 (10,8)	102 (73,4)	17 (12,2)	5 (3,6)	139 (100)	
Age						
15	1 (6,3)	9 (56,3)	6 (37,5)	0	16 (100)	
16	19 (11,5)	122 (73,9)	18 (10,9)	6 (3,6)	165 (100)	
17	12 (9,6)	85 (68)	20 (16)	8 (6,4)	125 (100)	0,586
18	7 (22,6)	16 (51,6)	5 (16,1)	3 (9,7)	31 (100)	
19	2 (66,7)	1 (33,3)	0	0	3 (100)	
Sex						
Female	20 (9,3)	165 (76,7)	22 (10,2)	8 (3,7)	215 (100)	**<0,001**
Male	21 (16,8)	68 (54,4)	27 (21,6)	9 (7,2)	125 (100)	
School						
PUBLIC HS 11	14 (11,8)	81 (68,1)	19 (16)	5 (4,2)	119 (100)	0,146
PUBLIC HS 1	5 (5,2)	75 (78,1)	12 (12,5)	4 (4,2)	96 (100)	
Variables	Nutritional Status				N (%)	*p*-value
	Poor (%)	Good (%)	Over (%)	Obese (%)		
PRIVATE HS Setia Marga	9 (16,1)	35 (62,5)	7 (12,5)	5 (8,9)	56 (100)	
PRIVATE HS Islam	3 (11,5)	17 (65,4)	6 (23,1)	0	26 (100)	0,146
ISLAMIC HS Granada	10 (23,3)	25 (58,1)	5 (11,6)	3 (7)	43 (100)	
Grade						
X (Ten)	20 (11)	129 (71,3)	25 (13,8)	7 (3,9)	181 (100)	
XI (Eleven)	16 (11,6)	92 (66,7)	22 (15,9)	8 (5,8)	138 (100)	0,498
XII (Twelve)	5 (23,8)	12 (57,1)	2 (9,5)	2 (9,5)	21 (100)	
Tribe						
Kutai	3 (13)	15 (65,2)	4 (17,4)	1 (4,3)	23 (100)	
Banjar	13 (13)	70 (70)	14 (14)	3 (3)	100 (100)	
Dayak	0	2 (40)	2 (40)	1 (20)	5 (100)	
Jawa	13 (11,9)	66 (60,6)	22 (20,2)	8 (7,3)	109 (100)	0,197
Bugis/ Makassar	8 (15,1)	39 (73,6)	3 (5,7)	3 (5,7)	53 (100)	
Others	4 (8)	41 (82)	4 (8)	1 (2)	50 (100)	
Fathers' Occupation						
Government/ private employees	17 (11)	105 (68,2)	23 (14,9)	9 (5,8)	154 (100)	
Army/ Police	0	4 (80)	0	1 (20)	5 (100)	
Laborer	4 (18,2)	17 (77,3)	0	1 (4,5)	22 (100)	0,565
Unemployment	5 (13,5)	21 (56,8)	8 (21,6)	3 (8,1)	37 (100)	
Others	2 (16,7)	9 (75)	1 (8,3)	0	12 (100)	
Mothers' Occupation						
Government/ private employees	9 (12,3)	43 (58,9)	16 (21,9)	5 (6,8)	73 (100)	
Entrepreneur /trader	6 (19,4)	21 (67,7)	4 (12,9)	0	31 (100)	
Army/ Police	0	0	0	1 (100)	1 (100)	**<0,001**
Laborer	1 (100)	0	0	0	1 (100)	
Housemakers/ Unemployment	24 (10,4)	168 (73)	28 (12,2)	10 (4,3)	230 (100)	
Others	1 (25)	1 (25)	1 (25)	1 (25)	4 (100)	

The *p*-value of the nutritional status and age variables was based on the Spearman test.
In addition to the Spearman test, the value was obtained from the chi-square test.
The comparison results were obtained from the *p*-value > 0.05.
Values in bold are significant values.

A total of 340 respondents were obtained from the four public and one private high school in Samarinda. The demographic characteristics of the respondents are depicted in Table 1. The majority of respondents were 16 and 17 years (48.5% and 36.8%, respectively) and predominantly female (63.2%). More than half of the respondents were in class X (ten), as many as 181 (53.2%). Of 340 participants, 63.2% attended public school, and 109 of the respondents (32.1%) were Javanese. Meanwhile, as of parents' occupations, a government/private employee (45.3%) and housewife (67.6%) were the most common for father and mother, respectively.

The group with the highest number of good nutritional status was 16 years. In addition, the number of poor nutrition (undernutrition, overnutrition, and obesity) was only 43 respondents. There are 28 respondents aged 17 years who have more nutritional status and obesity, which makes this age has the highest number compared to other ages. The good nutritional status was predominantly female, while the malnutrition was predominantly male. In addition, respondents whose father is a goverment/private employee have the best nutritional status, amounting to 105 respondents. At the same time, they also have the highest number of over nutritional status compared to other fathers' occupations, which are 23. Based on the mother's occupation, respondents with a housewife mother have the best nutritional status compared to working mothers.

Based on table 1, the most respondents slept for <8 hours, which amounted to 224 (65.8%). The results of the cross-tabulation showed as many as 158 adolescents had good nutritional status and sleep duration < 8 hours. In addition, respondents with sleep duration < 8 hours had the highest good nutritional status compared to other sleep durations. And, most respondents (59.1%) did not have breakfast regularly. In addition, as many as 131 respondents who do not routinely have breakfast have good nutritional status, while only 26 respondents have poor nutritional status and do not routinely eat breakfast.

Table 2. Sleep Duration and Body Mass Index

	BMI Z Score		
	Linear	Quadratic	Cubic
Model 1	0,701	0,135	**0,045**
Model 2	0,655	0,134	**0,042**
Model 3	0,553	0,124	0,053
Model 4	0,966	0,355	**0,020**

Model 1: Age, gender, occupation of mother
Model 2: Age, gender, occupation of father
Model 3: Age, gender, father's occupation, mother's occupation
Model 4: Age, gender, ethnic, school
The value of each model is obtained from linear, quadratic, and cubic tests. The comparison is obtained from the p-value < (
Values in bold are significant values.

Table 3. Breakfast Routine and BMI-for-age

Breakfast Routine	BMI-for-age
	p-value
Model 1	**0,044**
Model 2	0,061
Model 3	**0,047**
Model 4	**0,024**

Model 1: Age, gender, occupation of mother
Model 2: Age, gender, occupation of father
Model 3: Age, gender, father's occupation, mother's occupation
Model 4: Age, gender, ethnic, school
The value of each model is obtained from linear, quadratic, and cubic tests. The comparison is obtained from the p-value < (
Values in bold are significant values.

Results of the chi-square test showed that gender (<0,001) and mother's occupation (<0,001) were significant. Meanwhile, other variables were not significant. For the cubic test results displayed in table 2, the significance values obtained in model 1, model 2, and model 4 were 0.045, 0.042, and 0.020, which showed significant results with the Z score BMI. However, for model 3, the results were insignificant with the Z BMI value because the significance value obtained was 0.052. The logistic regression statistical test results in table 3 showed the significance value (p-value) in each model of 0.044, 0.061, 0.047, and 0.024. Because p < 0.05, this means that model 1, model 3, and model 4 showed a significant value, while model 2 did not show a significant value.

The results of the cubic test were presented in the figure 1 where it can be seen that the line begins to rise at a sleep duration of fewer than 8 hours, then falls back to 8 to 9 hours of sleep duration and again experiences a high increase when sleep duration was 10 hours. These results showed an increase in the Z score BMI when sleep duration was less than 8 hours and a significant increase was more than 10 hours.
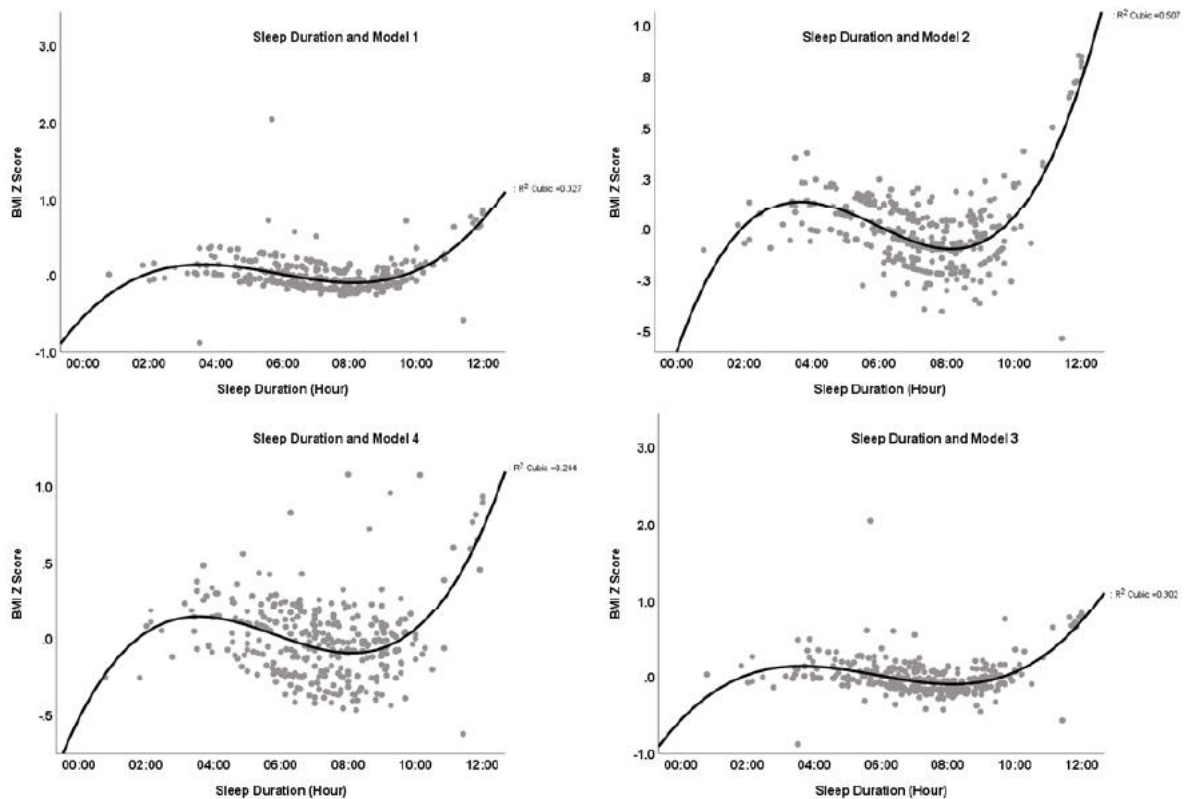
Figure 1. Sleep Duration and Z-Score BMI Each Model

DISCUSSION

This study's main results indicate a relationship between sleep duration and breakfast routine on the nutritional status of adolescents during the COVID-19 pandemic. However, the relationship found between sleep duration and BMI Z value based on the Multicentre Growth Reference Study (MGRS) for sleep duration [31]. In addition, there is also a relationship between gender and mother's occupation with the nutritional status of adolescents.

In term of age, Salmela-Aro (2011) categorized adolescents into three, namely, early adolescents (11-13 years), middle adolescents (14-17 years), and late adolescents (17-19 years) [32]. Therefore, based on the results of this study, 90% of adolescents were included in the category of middle adolescents, and 10% were late adolescents. Drastic growth and development occur at that age, so the need for energy, vitamins, protein, and minerals increase significantly [20]

In the current study, the prevalence of overweight and obesity was 22.6% in adolescents aged 17-19 years. These results are very high compared to the results of previous studies, which found the prevalence of overweight and obesity in adolescents is 2.3% [33]. In the same age group, the prevalence of malnutrition was 13.2%, while the study by Roba et al. (2016) reports that 29.5% of adolescents have poor nutritional status [34]. These different results may be caused by different socio-economic backgrounds or ethnic differences in dietary behaviour [34, 35]. Strict diet patterns and over snack consumption can also make their nutritional intake unfulfilled and result in malnutrition [36]. While the reason why adolescents with overweight or obesity caused too much consuming fat and carbohydrate food and lack in physical activity [36].

Nutritional issues in adolescents might started during infant period and they also suffer from malnutrition during infant periods. Furthermore, the adolescent environment influences their nutritional status [37]. Nutritional issues in adolescents, such as undernutrition or obesity, can also be induced by an imbalanced adolescent nutritional intake [38]. Food consumption and weight gain in the 10 - 19 years age group are rising during the COVID-19 pandemic, potentially affecting their nutritional condition [39]. One can assume that this might be caused by a shift in behavior related to weight increase in the school-age group during the ongoing pandemic [40].

The respondents in this study were predominantly female, with the sex ratio between female and male being 2:1. Adolescents experience different sexual maturity between girls and boys, influencing their

nutritional needs [20]. Adolescent sexual maturity is related to hormonal changes, body composition, weight, and linear growth [20]. Gender determines a person's nutritional needs, where male adolescents have higher nutritional needs due to their higher physical activity than female adolescents [41]. Nutritional status in adolescents was found to have a association with gender on this study. This finding is in line with the results of a study conducted by Darling et al. (2020), which found a relationship between adolescent girls with a reduced risk of being underweight, but a high risk of being overweight [42]. Meanwhile, adolescent boys are associated with low body weight [42]. The difference between girls and boys is because girls have about twice as much fat as boys. After all, girls are prone to fat accumulation [43]. Research conducted by Maltoni et al. (2021) stated weight gain in adolescent boys during the COVID-19 pandemic [44].

Women from young to old, married or unmarried, have children or do not have children at this time have the ambition to work, so it is not uncommon to find a mother who has a dual role in a family [45]. However, during the COVID-19 pandemic, many mothers between the ages of 25 and 44 lost their jobs due to demands to care for their families [46]. This study found a relationship between a mother's work and adolescent nutritional status. However, the results of this study were different from previous studies, which reported no relationship between the mother's work and the nutritional status of students [47]. Adolescents with mothers who have employment status as homemakers are the most likely to have good adolescent nutritional status based on this study. Because homemakers have time to meet their children more often, mothers can pay more attention to their children's health [47].

This study found no significant association between father's occupation and adolescent nutritional status. This may be due to the status of mothers who are mostly housewives and the finding of a relationship between mother's occupation status and adolescent nutritional status, so that father's occupation does not show significant results. Meanwhile, a previous study states a significant relationship between fathers' work and adolescent nutritional status [48]. The type of father's occupation affects his income in which will affect the amount and food selection at home [48]. Income that only comes from one parent can hinder overweight in adolescents [49]. Family with low income might have some difficulties to provide and choose nutritious and diverse foods [50].

Sleep duration usually refers to the total amount of sleep gained, either during episodes of nocturnal sleep or over 24 hours [51]. Sleep is defined as a behavioral state characterized by rest, reduced environmental awareness, and immobility [52]. Different sleep times result from different lifestyles and jobs for each individual [52]. When sleep is of insufficient duration, it can disturb consciousness during the day and cause excessive experience sleepiness [52]. Adolescents often experience insufficient sleep duration can be caused by the adolescents deliberately reducing the duration of their sleep for other activities, such as attending parties, working, studying at night for exams [53]. Lack of sleep duration can cause individuals to experience hallucinations, mood swings, fatigue, irritability, impaired perception & orientation, and declining attention [52].

Based on this study, most adolescents had a total sleep duration of less than 8 hours, so this finding was in line with the results of the study by Sinha et al. (2020), which reported that the amount of sleep duration for adolescents during the COVID-19 pandemic is only 4-6 hours in a day [54]. It can be caused by adolescents who deliberately reduce their sleep duration, such as doing activities at night, studying, partying, or working [53]. These results did not meet the sleep needs of adolescents recommended by the Indonesian Ministry of Health in 2018, which is 8-9 hours of sleep duration in one day.

Previous research on sleep duration during the COVID-19 pandemic conducted in five cities (Seoul, Stockholm, London, Los Angeles, and New York) found that the average sleep duration of respondents is less than 8 hours [55]. This short sleep duration is due to increased stress during the COVID-19 pandemic [56]. During the COVID-19 pandemic, many adolescents experienced stress, making it hard for them to sleep at night. Stress and sleep quantity can also reduce sleep duration because during the COVID-19 pandemic, they rarely sleep at night, even though their sleep duration is only about 6 to 8 hours [57].

In addition, poor health can cause adolescents to sleep less than eight hours. Evidence by Panel et al. (2015) states that adolescent sleep duration of fewer than seven hours tends to have poor and low health and low physical and mental quality [58]. Likewise, Guo et al. (2021) state that an unhealthy lifestyle occurred during the COVID-19 pandemic among students at a high level of education [59]. Health problems such as obesity in adolescents, hypertension, diabetes, and cardiovascular disease can cause sleep duration shorter than eight hours [60]. Individuals who lack sleep can affect their long and medium-term performance (58). Short sleep duration can affect changes in sleep quality during the COVID-19 pandemic [61].

Research on sleep duration in America states that, on average, an adolescent sleep for 7.3 hours in one day [62]. This result is similar to the studies conducted in European and North American states, where the average adolescent sleep duration ranges from 7 to 9 hours on school days [63]. In addition, these results are also supported by research conducted in Africa, Asia, Central and South America, the Middle East, the Caribbean, and Oceania, which found that the sleep duration in 16-year-old adolescents is 7 hours [64].

This study found that 15.6% of adolescents had a sleep duration of more than 9 hours, while research conducted by AL-Haifi (2016) found that 24.85% of adolescents have more than 9 hours sleep duration, others found that almost 90% of adolescents have more than 7 hours sleep duration in one day [65, 66]. Adolescents with longer sleep duration can increase the risk of coronary heart disease and affect their mental health [67, 68].

This study showed that only 18.5% of adolescents met the adequacy of sleep duration, namely for 8-9 hours, while the majority (81.5%) did not meet the adequacy of sleep duration. As a comparison, previous research showed that 82.7% of adolescents met the adequacy of their sleep duration, while 17.2% did not meet the adequacy of their sleep duration [69]. Because other study were conducted before the COVID-19 pandemic while this study was conducted during the pandemic, so that makes results are different. Another reason is adolescents having a tough time maintaining and initiating sleep [70].

The bivariate analysis results showed no significant relationship between sleep duration and adolescent nutritional status during the COVID-19 pandemic. It is in line with the results of a previous study, which stated that there was no association between BMI and sleep duration in adolescence [71]. A study by Schneider et al. (2020) also found that there is no association between BMI and sleep duration in adolescent boys [72]. These results show that short sleep duration does not affect their nutritional status [73].

Sleep duration and nutritional status are not related because when adolescents stay up late, they do not always consume food or drink; it could also be that they are busy doing school assignments [73]. In addition, factors that directly affect nutritional status are food intake and infection, while sleep duration is an indirect factor affecting nutritional status [74]. The absence of this relationship can also be explained that sleep duration is not an independent factor. It can also be caused by other factors such as genetic factors and environmental factors [75].

The results of the cubic test analysis in this study found that adolescents whose sleep duration was more than 9 hours experienced a high increase in their BMI Z value, which was inversely proportional to the findings of Grandner et al. (2015) [76]. They found that a short sleep duration of less or equal to four hours is associated with high BMI Z values. This difference is because a non-linear relationship was found in the current study, while Grandner et al. (2015) found a linear relationship [76]. Lack of sleep duration is associated with unhealthy eating habits, such as more significant portions, increased hunger, increased appetite in high-calorie foods, and increased intake of sugary foods and drinks [77]. Children who experience sleep deprivation and lack healthy food have a high BMI z value [77].

Research from Italy states that adolescents with low or average weight tend to have longer sleep durations compared to adolescents who are overweight and obese [78]. The results of this study are in line with the results of this study, in which 70% of adolescents with low or normal nutritional status had a total sleep duration of more than nine hours compared to adolescents with overweight and obese status. Covariates effect such as lifestyle, diet, and physical activity on BMI can influence these outcomes, as can sample size, age group differences, and geographic and ethnic variations [79].

For breakfast, can be characterised as the first meal before or starting the activity two hours after waking up, usually, less than 10 am, with a calorie content of about 20% to 35% of the total daily energy adequacy [19]. This study found that 59.1% of adolescents did not regularly eat breakfast. These results align with Hermanto et al.'s (2020) research, which found that 70.4% of adolescents rarely eat breakfast [70]. Skipping breakfast is often done by adolescents and can reduce their nutrient intake [20].

Adolescents skip breakfast because there is no food available in their homes [22]. Husain & Ashkanani (2020) reported that during the COVID-19 pandemic, breakfast is often missed. Staying up late makes someone snack in the middle of the night, and excessive sleep is the reason for skipping breakfast [80]. Other reasons adolescents skip breakfast are lack of appetite, no time, difficult to make a food, and religious reasons [81]. These results are inversely proportional to the research conducted by Sidor & Rzymski (2020), who stated that 65.5% of respondents had breakfast every day [82].

A total of 131 adolescents who did not regularly take breakfast has good nutritional status, while adolescents who regularly eat breakfast with good nutritional status are 102 respondents. Based on this study,

adolescents who did not regularly eat breakfast tend to have good nutritional status during the COVID-19 pandemic. It can be due to other factors related to good nutritional status, such as physical activity. Adolescents who are physically active during the COVID-19 pandemic tend to have normal nutritional status [83]. In addition, the intake of energy, carbohydrates, and protein also affects the nutritional status of adolescents [84]. Therefore, there is a possibility that adolescents have good nutritional status but do not regularly eat breakfast.

The bivariate analysis results in this study showed no correlation between breakfast routine and nutritional status. A previous study by Kurniawan (2020) show no relationship between breakfast routines and nutritional status [85]. A typical breakfast cannot determine a person's nutritional status because the total energy requirement obtained from breakfast food is only 25% [38]. So, a balance breakfast menu is needed to fulfill the daily nutritional intake [86]. Previous studies demonstrated that there is no association between breakfast habits and the nutritional status in high school students [85, 87]. Food quality and quantity such as large portions, nutritional value, and food varieties affect a person's nutritional status rather than solely breakfast behavior [88].

This study found a linear relationship between breakfast routine and nutritional status in adolescents. Nutritional status is a balance between nutrient intake from food and the nutritional needs needed for body metabolism [2]. Data analysis using logistic regression tests found an association between breakfast routines and nutritional status in adolescents. This finding aligns with Amalia & Adriani (2019), which found an association between breakfast routines and nutritional status [89]. Research conducted on European and Brazilian adolescents found that skipping breakfast leads to obesity in adolescents [90]. Similarly, a study in Bangladesh and India demonstrated that skipping breakfast significantly correlates with being overweight [91]. However, research from Zagreb, Croatia, states that adolescent girls who eat breakfast have a higher incidence of obesity [92].

Adolescents who skip breakfast tend to have increased blood sugar levels, fatigue, declined concentration, and experience a decrease in physical and mental conditions [93]. Breakfast can improve cognitive performance, as the adolescents will not be disturbed by hunger and affect memory [94]. A previous study have reported that skipping breakfast is associated with an increased risk of obesity by 1.75 times than eating breakfast regularly [19].

During the COVID-19 pandemic, adolescents increase their breakfast and unhealthy food/drinks consumption, resulting in weight gain that affects their nutritional status [95]. Beside excessive breakfast, skipping breakfast can also increase the energy intake obtained when adolescents consume snacks to replace breakfast [96]. Another explanation is that adolescents who skip breakfast during the COVID-19 pandemic are caused by waking up at night, leading to snacking in the middle of the night and also excessive sleep the next day, which can lead to overweight and obesity [80]. Another study conducted in South Korea stated that in general breakfast consumption in adolescent during the pandemic COVID-19 is higher than before the pandemic. During the pandemic period, adolescents have a lot of free time to eat at home, the ban on going out causes adolescents to have a lot of time to eating or snacking at home [97]. Also, a study showed that during a pandemic there are some people who skip breakfast, which can affect their quality of life [98].

CONCLUSION

In a nutshell, there was an association between sleep duration and breakfast routine with adolescent nutritional status. The findings indicated that many adolescents had less than 8 hours of sleep duration and a lack of breakfast routines. However, more than half of adolescents had good nutritional status. Adolescents are advised to get enough sleep duration as recommended and to have breakfast every day and maintain it during the COVID-19 pandemic.

ACKNOWLEDGMENT

REFERENCES

1. Das JK, Salam RA, Thornburg KL, Prentice AM, Campisi S, Lassi ZS, Koletzko B, Bhutta ZA (2017) Nutrition in adolescents: physiology, metabolism, and nutritional needs. Ann N Y Acad Sci 1393:21–33
2. Par'i HM, Wiyono S, Harjatmo TP (2017) Penilaian Status Gizi.
3. Mulu Birru G, Eshete Tadesse S, Hassen Abate K, Mekonnen TC, Genetu Chane M (2021) Malnutrition in

School-Going Adolescents in Dessie Town, South Wollo, Ethiopia. J. Nutr. Metab. 2021:

4. WHO (2020) Fact Sheet : Obesity and Overweight. In: World Heal. Organ.

5. Baniissa W, Radwan H, Rossiter R, Fakhry R, Al-Yateem N, Al-Shujairi A, Hasan S, Macridis S, Farghaly AA, Naing L (2020) Prevalence and determinants of overweight/obesity among school-aged adolescents in the United Arab Emirates: a cross-sectional study of private and public schools. BMJ Open 10:e038667

6. Phan HD, Nguyen TNP, Bui PL, Pham TT, Doan TV, Nguyen DT, Van Minh H (2020) Overweight and obesity among Vietnamese school-aged children: National prevalence estimates based on the World Health Organization and International Obesity Task Force definition. PLoS One 15:e0240459

7. Abarca-Gómez L, Abdeen ZA, Hamid ZA, Abu-Rmeileh NM, Acosta-Cazares B, Acuin C, Adams RJ, Aekplakorn W, Afsana K, Aguilar-Salinas CA (2017) Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128· 9 million children, adolescents, and adults. Lancet 390:2627–2642

8. Kementrian Kesehatan RI (2018) Laporan RISKESDAS Provinsi Kalimantan Timur 2018. Jakarta

9. Jike M, Itani O, Watanabe N, Buysse DJ, Kaneita Y (2018) Long sleep duration and health outcomes: A systematic review, meta-analysis and meta-regression. Sleep Med Rev 39:25–36

10. Karimy M, Parvizi F, Rouhani MR, Griffiths MD, Armoon B, Fattah Moghaddam L (2020) The association between internet addiction, sleep quality, and health-related quality of life among Iranian medical students. J Addict Dis 1–9

11. Marelli S, Castelnuovo A, Somma A, Castronovo V, Mombelli S, Bottoni D, Leitner C, Fossati A, Ferini-Strambi L (2020) Impact of COVID-19 lockdown on sleep quality in university students and administration staff. J Neurol 1–8

12. Roshifanni S (2016) Risiko Hipertensi Pada Orang Dengan Pola Tidur Buruk. J Berk Epidemiol 4:408–419

13. Villa-González E, Huertas-Delgado FJ, Chillón P, Ramírez-Vélez R, Barranco-Ruiz Y (2019) Associations between active commuting to school, sleep duration, and breakfast consumption in Ecuadorian young people. BMC Public Health 19:85

14. Theorell-Haglöw J, Lindberg E (2016) Sleep Duration and Obesity in Adults: What Are the Connections? Curr Obes Rep 5:333–343

15. Zikrahadi H (2019) HUBUNGAN ASUPAN KARBOHIDRAT, ASUPAN SERAT DAN DURASI TIDUR DENGAN STATUS GIZI REMAJA DI SMA NEGERI 06 KOTA PADANG TAHUN 2018.

16. Wheaton AG, Jones SE, Cooper AC, Croft JB (2018) Short sleep duration among middle school and high school students—United States, 2015. Morb Mortal Wkly Rep 67:85

17. Alves FR, de Souza EA, de França Ferreira LG, Neto J de OV, de Bruin VMS, de Bruin PFC (2020) Sleep duration and daytime sleepiness in a large sample of Brazilian high school adolescents. Sleep Med 66:207–215

18. Sunwoo J-S, Yang KI, Kim JH, Koo DL, Kim D, Hong SB (2020) Sleep duration rather than sleep timing is associated with obesity in adolescents. Sleep Med 68:184–189

19. Ma X, Chen Q, Pu Y, Guo M, Jiang Z, Huang W, Long Y, Xu Y (2020) Skipping breakfast is associated with overweight and obesity: A systematic review and meta-analysis. Obes Res Clin Pract 14:1–8

20. Brown JE (2016) Nutrition through the life cycle. Cengage Learning, Boston

21. FATHIN FA (2018) HUBUNGAN KONTRIBUSI ENERGI SARAPAN DAN MAKANAN JAJANAN DENGAN STATUS GIZI PADA REMAJA PUTRI DI SMK NEGERI 1 SUKOHARJO. Skripsi S1 Ilmu Gizi FIK UMS

22. Smith KJ, Breslin MC, McNaughton SA, Gall SL, Blizzard L, Venn AJ (2017) Skipping breakfast among Australian children and adolescents; findings from the 2011–12 National Nutrition and Physical Activity Survey. Aust N Z J Public Health 41:572–578

23. Ardeshirlarijani E, Namazi N, Jabbari M, Zeinali M, Gerami H, Jalili RB, Larijani B, Azadbakht L (2019) The link between breakfast skipping and overweigh/obesity in children and adolescents: a meta-analysis of observational studies. J Diabetes Metab Disord 18:657–664

24. Nugroho PS, Hikmah AUR (2020) Kebiasaan Konsumsi Junk Food dan Frekuensi Makan Terhadap Obesitas. J DUNIA KESMAS 9:185–191

25. Badrah S, Noviasty R, Susanti R (2020) Screening of Eating Disorders Risk with Scoff Tool on Adolescents in Samarinda City. J La Medihealtico 1:26–31

26. Noviasty R, Susanti R (2020) Perubahan Kebiasaan Makan Mahasiswa Peminatan Gizi Selama Masa

Pandemi Covid 19. J. Kesehat. Masy. Mulawarman 2:

27. Leone MJ, Sigman M, Golombek DA (2020) Effects of lockdown on human sleep and chronotype during the COVID-19 pandemic. Curr Biol 30:R930–R931

28. Susanti CBJ (2019) Pengaruh kebiasaan melewatkan sarapan terhadap tingkat obesitas pada remaja SMA 7 Surakarta.

29. Iyer R, Hosmer DW, Lemeshow S (1991) Applied Logistic Regression. Stat. https://doi.org/10.2307/2348743

30. Wisnuwardani RW, De Henauw S, Androutsos O, Forsner M, Gottrand F, Huybrechts I, Knaze V, Kersting M, Le Donne C, Marcos A (2019) Estimated dietary intake of polyphenols in European adolescents: the HELENA study. Eur J Nutr 58:2345–2363

31. Bhan MK, Norum KR (2004) The WHO multicentre growth reference study (MGRS): Rationale, planning, and implementation. Food Nutr. Bull. 25:

32. Salmela-Aro K (2011) Stages of Adolescence. In: Brown BB, Prinstein MJBT-E of A (eds). Academic Press, San Diego, pp 360–368

33. Teji K, Dessie Y, Assebe T, Abdo M (2016) Anaemia and nutritional status of adolescent girls in Babile District, Eastern Ethiopia. Pan Afr. Med. J. 24:

34. Roba KT, Abdo M, Wakayo T (2016) Nutritional status and its associated factors among school adolescent girls in Adama City, Central Ethiopia.

35. Hadush G, Seid O, Wuneh AG (2021) Assessment of nutritional status and associated factors among adolescent girls in Afar, Northeastern Ethiopia: a cross-sectional study. J Heal Popul Nutr 40:1–14

36. Veronika AP, Puspitawati T, Fitriani A (2021) Associations between nutrition knowledge, protein-energy intake and nutritional status of adolescents. J Public health Res 10:2239

37. Lampus C, Manampiring A (2016) Profil status gizi pada remaja di Kabupaten Bolaang Mongondow Utara. eBiomedik 4:

38. Kurniawan AN (2020) HUBUNGAN ANTARA KEBIASAAN SARAPAN DAN AKTIVITAS FISIK TERHADAP STATUS GIZI REMAJA. J. Tata Boga 9:

39. Stavridou A, Kapsali E, Panagouli E, Thirios A, Polychronis K, Bacopoulou F, Psaltopoulou T, Tsolia M, Sergentanis TN, Tsitsika A (2021) Obesity in Children and Adolescents during COVID-19 Pandemic. Children 8:135

40. Kim ES, Kwon Y, Choe YH, Kim MJ (2021) COVID-19-related school closing aggravate obesity and glucose intolerance in pediatric patients with obesity. Sci Rep 11:5494

41. Badi'ah A (2019) Hubungan kebiasaan sarapan dan durasi tidur dengan kegemukan pada remaja di SMP Islam Al-Azhar 29 Semarang. UIN Walisongo

42. Darling AM, Sunguya B, Ismail A, Manu A, Canavan C, Assefa N, Sie A, Fawzi W, Sudfeld C, Guwattude D (2020) Gender differences in nutritional status, diet and physical activity among adolescents in eight countries in sub-Saharan Africa. Trop Med Int Heal 25:33–43

43. Khasanah D, Endang Nur W, Rusdin Rauf STP (2016) hubungan aktivitas fisik dengan status gizi remaja putri di pondok pesantren ta'mirul islam surakarta.

44. Maltoni G, Zioutas M, Deiana G, Biserni GB, Pession A, Zucchini S (2021) Adolescent males suffered from reduced physical activity and increased BMI during COVID-19 pandemic. Nutr Metab Cardiovasc Dis. https://doi.org/https://doi.org/10.1016/j.numecd.2021.03.018

45. Sulistyorini E, Rahayu T (2017) Hubungan pekerjaan ibu balita terhadap status gizi balita di posyandu prima sejahtera Desa Pandean Kecamatan Ngemplak Kabupaten Boyolali Tahun 2009. J. Kebidanan Indones. 1:

46. Parolin Z (2020) Unemployment and child health during COVID-19 in the USA. Lancet Public Heal 5:e521–e522

47. Hutauruk KNSP (2017) HUBUNGAN ANTARA KARAKTERISTIK IBU (PENDIDIKAN, PEKERJAAN, PENGETAHUAN TENTANG GIZI) DENGAN STATUS GIZI SISWA SDN SAWAHAN I SURABAYA. J. Pendidik. Olahraga dan Kesehat. 5:

48. Handari SRT, Loka T (2017) Hubungan Aktivitas Fisik dan Kebiasaan Konsumsi Fast Food dengan Status Gizi Lebih Remaja SMA Labschool Kebayoran Baru Jakarta Selatan Tahun 2016. J Kedokt dan Kesehat 13:153–162

49. Mizuta A, Fujiwara T, Ojima T (2016) Association between economic status and body mass index among adolescents: a community-based cross-sectional study in Japan. BMC Obes 3:47

50. Rompas KF (2016) Hubungan antara sosial ekonomi keluarga dengan status gizi pada pelajar di SMP wilayah Kecamatan Malalayang 1 Kota Manado. PHARMACON 5:

51. Kline C (2013) Sleep Duration BT - Encyclopedia of Behavioral Medicine. In: Gellman MD, Turner JR (eds). Springer New York, New York, NY, pp 1808–1810

52. Pollak C, Thorpy MJ, Yager J (2010) The encyclopedia of sleep and sleep disorders, 3th ed. InfoBase publishing, New York

53. Carskadon MA (2002) Adolescent sleep patterns: Biological, social, and psychological influences. Cambridge University Press

54. Sinha M, Pande B, Sinha R (2020) Impact of COVID-19 lockdown on sleep-wake schedule and associated lifestyle related behavior: A national survey. J. Public health Res. 9:

55. Robbins R, Affouf M, Weaver MD, Czeisler MÉ, Barger LK, Quan SF, Czeisler CA (2021) Correction: Estimated Sleep Duration Before and During the COVID-19 Pandemic in Major Metropolitan Areas on Different Continents: Observational Study of Smartphone App Data. J Med Internet Res 23:e28057

56. Rezaei N, Grandner MA (2021) Changes in sleep duration, timing, and variability during the COVID-19 pandemic: Large-scale Fitbit data from 6 major US cities. Sleep Heal.

57. Yuksel D, McKee GB, Perrin PB, Alzueta E, Caffarra S, Ramos-Usuga D, Arango-Lasprilla JC, Baker FC (2021) Sleeping when the world locks down: Correlates of sleep health during the COVID-19 pandemic across 59 countries. Sleep Heal 7:134–142

58. Panel CC, Watson NF, Badr MS, Belenky G, Bliwise DL, Buxton OM, Buysse D, Dinges DF, Gangwisch J, Grandner MA (2015) Joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society on the recommended amount of sleep for a healthy adult: methodology and discussion. Sleep 38:1161–1183

59. de Souza MR, Neves MEA, Souza A de M, Muraro AP, Pereira RA, Ferreira MG, Rodrigues PRM (2020) Skipping breakfast is associated with the presence of cardiometabolic risk factors in adolescents: Study of Cardiovascular Risks in Adolescents – ERICA. Br J Nutr 1–9

60. Iwama M, Wilson S, Durant C, Alford C, Hank D, Hicks J, Smith-Windsor J, Franklin J, Boswell J, Thai J (2015) An occupational therapist's guide to sleep and sleep problems. Jessica Kingsley Publishers, London

61. Genta FD, Rodrigues Neto GB, Velletri Sunfeld JP, Porto JF, Xavier AD, Moreno CRC, Lorenzi-Filho G, Genta PR (2021) COVID-19 pandemic impact on sleep habits, chronotype and health-related quality of life among high school students: A longitudinal study. J Clin Sleep Med jcsm-9196

62. Johansson AEE, Petrisko MA, Chasens ER (2016) Adolescent Sleep and the Impact of Technology Use Before Sleep on Daytime Function. J Pediatr Nurs 31:498–504

63. Gariepy G, Danna S, Gobiņa I, Rasmussen M, de Matos MG, Tynjälä J, Janssen I, Kalman M, Villeruša A, Husarova D (2020) How are adolescents sleeping? Adolescent sleep patterns and sociodemographic differences in 24 European and North American countries. J Adolesc Heal 66:S81–S88

64. Kuula L, Gradisar M, Martinmäki K, Richardson C, Bonnar D, Bartel K, Lang C, Leinonen L, Pesonen AK (2019) Using big data to explore worldwide trends in objective sleep in the transition to adulthood. Sleep Med 62:69–76

65. Al-Haifi AA, AlMajed HT, Al-Hazzaa HM, Musaiger AO, Arab MA, Hasan RA (2016) Relative contribution of obesity, sedentary behaviors and dietary habits to sleep duration among Kuwaiti adolescents. Glob J Health Sci 8:107

66. Litsfeldt S, Ward TM, Hagell P, Garmy P (2020) Association between sleep duration, obesity, and school failure among adolescents. J Sch Nurs 1059840520901335

67. Liu B-P, Wang X-T, Liu Z-Z, Wang Z-Y, An D, Wei Y-X, Jia C-X, Liu X (2020) Depressive symptoms are associated with short and long sleep duration: A longitudinal study of Chinese adolescents. J Affect Disord 263:267–273

68. Wang D, Li W, Cui X, Meng Y, Zhou M, Xiao L, Ma J, Yi G, Chen W (2016) Sleep duration and risk of coronary heart disease: A systematic review and meta-analysis of prospective cohort studies. Int J Cardiol 219:231–239

69. Cheng L, Pohlabeln H, Ahrens W, et al (2021) Cross-sectional and longitudinal associations between sleep duration, sleep quality, and bone stiffness in European children and adolescents. Osteoporos Int 32:853–863

70. Hermanto RA, Kandarina BJI, Latifah L (2020) Hubungan Antara Status Anemia, Tingkat Aktivitas Fisik,

Kebiasaan Sarapan Dan Depresi Pada Remaja Putri Di Kota Yogyakarta. Media Gizi Mikro Indones 11:141–152

71. Sokol RL, Grummon AH, Lytle LA (2020) Sleep duration and body mass: direction of the associations from adolescence to young adulthood. Int J Obes 44:852–856

72. Schneider AC, Zhang D, Xiao Q (2020) Adolescent sleep characteristics and body-mass index in the Family Life, Activity, Sun, Health, and Eating (FLASHE) Study. Sci Rep 10:1–10

73. Rachmadianti D, Puspita ID (2020) Korelasi Antara Asupan Protein, Serat dan Durasi Tidur Dengan Status Gizi Remaja. J Ris GIZI 8:85–89

74. Saputri W (2018) Hubungan Aktivitas Fisik Dan Durasi Tidur Dengan Status Gizi Pada Remaja Di SMP N 2 Klego Boyolali.

75. Utami NP, Purba MB, Huriyati E (2017) Hubungan durasi tidur terhadap asupan energi dan obesitas pada remaja SMP di Kota Yogyakarta.

76. Grandner MA, Schopfer EA, Sands-Lincoln M, Jackson N, Malhotra A (2015) Relationship between sleep duration and body mass index depends on age. Obesity 23:2491–2498

77. Gohil A, Hannon TS (2018) Poor sleep and obesity: concurrent epidemics in adolescent youth. Front Endocrinol (Lausanne) 9:364

78. Ferranti R, Marventano S, Castellano S, Giogianni G, Nolfo F, Rametta S, Matalone M, Mistretta A (2016) Sleep quality and duration is related with diet and obesity in young adolescent living in Sicily, Southern Italy. Sleep Sci 9:117–122

79. Maharjan N, Karki PK, Adhikari B, Bhaila A, Shrestha H (2020) Association between sleep duration, sleep quality and body mass index in medical students. J Chitwan Med Coll 10:34–38

80. Husain W, Ashkanani F (2020) Does COVID-19 change dietary habits and lifestyle behaviours in Kuwait: a community-based cross-sectional study. Environ Health Prev Med 25:61

81. Otuneye AT, Ahmed PA, Abdulkarim AA, Aluko OO, Shatima DR (2017) Relationship between dietary habits and nutritional status among adolescents in Abuja municipal area council of Nigeria. Niger J Paediatr 44:128–135

82. Sidor A, Rzymski P (2020) Dietary Choices and Habits during COVID-19 Lockdown: Experience from Poland. Nutrients 12:1657

83. Rukmana E, Permatasari T, Emilia E (2020) The Association Between Physical Activity with Nutritional Status of Adolescents During the COVID-19 Pandemic in Medan City. J Dunia Gizi 3:88–93

84. Rachmayani SA, Kuswari M, Melani V (2018) Hubungan Asupan Zat Gizi dan Status Gizi Remaja Putri di SMK Ciawi Bogor. Indones J Hum Nutr 5:125–130

85. Irdiana W, Nindya TS (2017) Hubungan kebiasaan sarapan dan asupan zat gizi dengan status gizi siswi SMAN 3 Surabaya. Amerta Nutr 1:227–235

86. Noviasty R, Afiah N, Susanti R, Suja'i MNM, Pakkerai AD, Cahyantari U, Wirasti N (2020) Komposisi Menu Sarapan dan Status Gizi Pelajar Boarding School SMP Muhammadiyah 5 Samarinda. Ghidza J Gizi dan Kesehat 4:1–10

87. Fayet-Moore F, McConnell A, Tuck K, Petocz P (2017) Breakfast and breakfast cereal choice and its impact on nutrient and sugar intakes and anthropometric measures among a nationally representative sample of Australian children and adolescents. Nutrients 9:1045

88. Yanuarti R (2019) HUBUNGAN KEBIASAAN SARAPAN PAGI, ASUPAN ENERGI, DAN KEBIASAAN OLAHRAGA DENGAN KEJADIAN KEGEMUKAN PADA SISWA KELAS XI SMAN 3 CIMAHI.

89. Amalia SMK, Adriani M (2019) Hubungan antara Kebiasaan sarapan dengan Status Gizi pada siswa SMP Negeri 5 Banyuwangi. Amerta Nutr 3:212–217

90. Forkert ECO, Moraes ACF De, Carvalho HB, et al (2019) Skipping breakfast is associated with adiposity markers especially when sleep time is adequate in adolescents. Sci Rep 9:6380

91. Khan A, Khan S, Burton N (2019) Missing breakfast is associated with overweight and obesity in Bangladeshi adolescents. Acta Paediatr 108:178–179

92. Sila S, Ilić A, Mišigoj-Duraković M, Sorić M, Radman I, Šatalić Z (2019) Obesity in adolescents who skip breakfast is not associated with physical activity. Nutrients 11:2511

93. Rohmah MH, Rohmawati N, Sulistiyani S (2020) Hubungan kebiasaan sarapan dan jajan dengan status gizi remaja di Sekolah Menengah Pertama Negeri 14 Jember. Ilmu Gizi Indones 4:39–50

94. Benitez D (2005) The Importance of Breakfast in Children and Adolescents. Unpubl. M S Diss. Submitt.

to Fam. Consum. Sci.

95. Androutsos O, Perperidi M, Georgiou C, Chouliaras G (2021) Lifestyle Changes and Determinants of Children's and Adolescents' Body Weight Increase during the First COVID-19 Lockdown in Greece: The COV-EAT Study. Nutrients 13:930

96. Enriquez-Martinez OG, Martins MCT, Pereira TSS, Pacheco SOS, Pacheco FJ, Lopez K V, Huancahuire-Vega S, Silva DA, Mora-Urda AI, Rodriguez-Vásquez M (2021) Diet and lifestyle changes during the COVID-19 pandemic in Ibero-American countries: Argentina, Brazil, Mexico, Peru, and Spain. Front. Nutr. 8:

97. Kim SY, Yoo DM, Min C, Choi HG (2021) Changes in Dietary Habits and Exercise Pattern of Korean Adolescents from Prior to during the COVID-19 Pandemic. Nutrients 13:3314

98. de Melo Souza TC, Oliveira LA, Daniel MM, Ferreira LG, Della Lucia CM, Liboredo JC, Anastácio LR Lifestyle and eating habits before and during COVID-19 quarantine in Brazil. Public Health Nutr 1–29