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# Comparing intake adequacy and dietary diversity between adolescent schoolgirls with normal nutritional status (NG) and undernutrition (UG) based on BMI-for-age (BAZ) living in urban slums in Central Jakarta

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## ABSTRACT

**Introduction:** Undernutrition among adolescent girls is an important concern due to their rapid growth velocity that requires adequate intake of energy and nutrients. This study compared intake adequacy and dietary diversity between adolescent public schoolgirls from slum areas in Central Jakarta who had normal and poor nutritional status. **Methods:** A total of 220 eligible girls aged 14–18 years were recruited, with an equal proportion in the normal group (NG) [-1 to +1 SD body mass index-for-age z-score (BAZ)], and undernutrition group (UG) (BAZ < -1SD). Dietary intake was assessed using two non-consecutive 24-hour recalls. Dietary diversity scores (DDS) were determined with reference to the intake of 13 food groups with a minimum daily intake of 15 gram/food group. Receiver operating curve analysis was performed to obtain the DDS cut-off. The Mann–Whitney test was performed to compare DDS between the NG and UG. Logistic regression analysis was conducted to examine the likelihood of potential factors in predicting nutritional status outcome. **Results:** Overall, almost half of the girls' daily food intake showed low dietary diversity based on DDS cut-off <5, with no significant difference between NG and UG adolescents. Protein intake inadequacy showed significant unlikelihood of a NG outcome (OR=0.4; 95% CI: 0.2-0.8), while low socioeconomic status (SES) showed a strong likelihood of an UG (OR=2.7; 95% CI: 1.3-5.5) compared to high SES. **Conclusions:** Low dietary intake and DDS were common among adolescent schoolgirls in slum areas in Jakarta. Nutrition interventions promoting appropriate dietary intake among adolescent girls are recommended.

**Keywords**: Adolescent girls, dietary diversity, nutrient adequacy, undernutrition, Jakarta slums

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## INTRODUCTION

Adolescence is a critical period of physical growth and development. Undernutrition among adolescents is a public health concern in Asian countries with prevalence of > 20% underweight (Cappa *et al.*, 2012). In Jakarta, the prevalence of undernutrition in the form of thinness among adolescents was approximately 11.2% in 2010 (MOH Indonesia, 2013), indicating that adolescent undernutrition is at an unsatisfactory level (WHO, 2010).

Undernutrition during adolescence is of significance given that 50% of the adult weight and skeletal mass and 20% of the adult height are gained during this period. As the rapid growth velocity requires adequate intake of energy and nutrients, adolescents become vulnerable to nutrient deficiencies (Stang & Story, 2005). Adolescent girls in low and middle income countries (LMIC) are often reported to have a monotonous cereal based diet consisting of low nutrient-dense foods, resulting in an inadequate intake of energy and nutrients (USAID & SPRING, 2015). As a consequence, poor nutrition during adolescence affects the ability to learn, reduces work productivity, results in a failure to attain potential height and gain optimal bone mass in adulthood, and delays the onset and progression of puberty.

Several factors are known to lead to undernutrition. These include household food insecurity, intra-household allocation of food that does not meet dietary needs, livelihood insecurity, and poor knowledge of nutrition (WHO, 2005). Poor diet quality could be due to a lack of dietary diversity, which indicates consumption of a low variety of food. This condition has been shown to be associated with micronutrient inadequacy among children and adolescents (Korkalo *et al.*, 2017; Zhao *et al.*, 2017). A higher household dietary diversity was reported to be associated with a lower likelihood of child stunting (Lee & Ryu, 2018; Mahmudiono, Sumarmi & Rosenkranz, 2017).

Studies determining dietary diversity among Indonesian adolescents in relation to undernutrition are few. This study was aimed at comparing the dietary intake adequacy and dietary diversity between adolescent schoolgirls with normal and poor nutritional status living in urban slum areas in Central Jakarta, Indonesia.

## MATERIALS AND METHODS

### Study design and subjects

This cross-sectional study was conducted in Central Jakarta. A list of schools was obtained from the Education Office of Central Jakarta, from which five high schools located in slum areas were randomly selected.

*Sample size*

As studies on dietary diversity of Indonesian adolescent girls are lacking, the sample size for this study was computed based on the results reported by Jayawardena *et al.* (2013), that underweight female (BMI≤18.5 kg/m$^2$) had lower mean dietary diversity (5.69±1.52) than those whose nutritional status was normal (BMI >18.5 - ≤22.9kg/m$^2$) (6.52±1.47). Based on 80% power and a 95% confidence interval, a minimum sample size of 220 was estimated with an equal number for each group, that is 110 for the undernutrition group and another 110 for the normal nutritional status group.

The study inclusion criteria for selecting the participants were girls aged 14-18 years, who were post menarche and apparently healthy. A total of 1,073 schoolgirls from the public schools who had met the study criteria were selected, and were invited for anthropometric screening.

*Nutritional status*
Anthropometric measurements were conducted following standard procedures (Gibson, 2005). Height was measured using the ShorrBoard (Weigh and Measure, LLC, USA), and weight was measured using an electronic SECA no. 876 weighing scale (Seca, Germany). The average of two consecutive measurements was used to calculate the body mass index-for-age *z*-score (BAZ) using WHO AnthroPlus software (WHO, 2009). The girls were classified into two groups based nutritional status. These were the normal group (NG) (BAZ: –1SD ≤ BAZ ≤ +1SD) and the undernutrition group (UG) (BAZ < -1SD) (Thomaz, *et al.*, 2010). The 110 schoolgirls whose BAZ status was (BAZ < -1SD) agreed, on a voluntary basis to participate, and were classified to the UG. The other 110 schoolgirls with BAZ status (-1SD ≤ BAZ ≤ +1SD) were placed in the NG.

**Data collection**
All the eligible participants were interviewed by five trained enumerators, to collect data on dietary diversity, food consumption, morbidity (history of diarrhoea and upper respiratory tract infection in the previous one month), physical activity (PA), household food security, working and education status of mother, and household socioeconomic status (SES). The questionnaires on food consumption and dietary diversity were pre-tested on several adolescent girls from a public high school located in the study area. After pretesting, the questionnaires were revised to improve clarity.

*Food consumption*
Dietary intake was assessed using two non-consecutive 24-hour (24-h) food recall periods, comprising one weekday and one day of a weekend. A four-stage multiple-pass interviewing technique was used in the 24-h recall method (Gibson & Ferguson, 2008). The national standardised food photograph book was used for the estimation of portion size (MOH Indonesia, 2014a). The daily nutrient intake was determined using the Indonesian food composition database and calculated by NutriSurvey for Windows, version 2007 (Erhardt, 2007). Energy and protein requirements were calculated by using an estimated energy requirement and protein requirement to specific body weight (FAO, WHO & UNU, 2001; WHO, FAO & UNU, 2007). Fat and carbohydrate adequacy were taken as meeting at least 77% of the Indonesian recommended dietary allowance (RDA) (MOH Decree, 2013). The estimated average requirement was used to evaluate micronutrient adequacy (WHO & FAO, 2006). A dietary intake that was above these requirements was classified as energy and nutrient adequacy.

*Dietary diversity*
A standardised individual dietary diversity questionnaire was used to obtain the dietary diversity score (DDS) (Arimond *et al.*, 2008). The DDS consisted of 13 food groups, namely starchy staples, legumes and nuts, dairy products, organ meats, eggs, small fish eaten with bone, meat ("flesh foods") and animal protein, vitamin A-rich deep yellow/orange/red vegetables, vitamin A-rich deep green leafy vegetables, vitamin A-rich fruits, vitamin C-rich fruits, vitamin C-rich vegetables, and lastly other fruits and vegetables.

*Morbidity (upper respiratory tract infection and diarrhoea)*
Participants with upper respiratory tract infection were identified based on medical diagnosis or reports of fever, sore throat, and cough in the previous one

month. Participants with diarrhoea were identified based on doctor's diagnosis or had experienced passing liquid or loose stools three or more times in the previous one month.

*Physical activity*
A short form of the international PA questionnaire (IPAQ) was used to determine PA during the past seven days (IPAQ, 2005).

*Household food security*
Household food security status was determined by using the food security survey module for children aged ≥ 12 years. The nine questions in the module about food situation at home during the past one month were answered by participants. Response to the questions were assumed to be an indication of the food security status of the children, as perceived by the family (Connell *et al.*, 2004).

*Socioeconomic status*
The SES of the household was determined based on ownership of assets consisting of the sources of drinking water, electricity and cooking fuel, ownership of toilet, type of latrine, final faecal disposal, ownership of a motorcycle, television, air-conditioner, water heater, 12 kg cooking gas cylinder, refrigerator, and car (MOH Indonesia, 2013).

**Data analysis**
The DDS was computed by assigning a score of one (1) for the consumption of at least 15g/day of a food group, and zero (0) score for intake < 15g/day. The total score for the entire food groups ranged from 0-13. The receiver operating characteristic (ROC) curve was plotted to obtain the DDS cut-off corresponding to the nutritional status of the schoolgirls. For this purpose, we contrasted the DDS with the composite score for the intake adequacy of energy and protein. The procedure yielded a DDS of 5 as the cut-off for dietary diversity with the area under the curve (AUC) of 0.65, sensitivity of 60%, and specificity of 64% ($p$= 0.002). This cut-off was also used in examining the relationship between the DDS and nutritional status.

PA was analysed according to the IPAQ guidelines. The subjects were requested to recall the duration of usual their PA in a week. The duration of these activities was then converted into metabolic equivalent (MET) – minutes per week and categorised into high, moderate, and low PA based on the IPAQ guidelines (IPAQ, 2005).

Household food security status was categorised as food-secure or food-insecure, based on the responses to the nine questions in the module. We examined under- and over- reporting of energy intake to check for potential bias in participant's dietary intake (McCrory *et al.*, 2002).

SES was constructed based on 13 variables that were used to indicate the wealth index (MOH Indonesia, 2013). By using principal component analysis (PCA), a reliability analysis was first conducted, yielding ten variables, which were screened providing a Cronbach's alpha of 0.686. The PCA yielded a correlation score of > 0.6 for the SES variables. The scores were then ranked into tertiles, where tertile one was the lowest and tertile three the highest SES.

The independent *t*-test was used to compare the differences in height and body weight between the two nutritional status groups (NG vs UG). The Mann–Whitney test was used to compare the differences in dietary intake and DDS between these two groups. The chi-square test was used to examine the independence between DDS (cut-off < 5 and ≥ 5 food groups) and nutritional status (NG vs UG). Logistic regression analysis was undertaken to assess the relationship between the categorical potential predictive factors: DDS, intake adequacy (energy and protein adequacy), morbidity status (history of diarrhoea and upper respiratory tract infection in the previous one month), household food security status, and SES, in predicting the categorical outcome: normal nutritional status versus undernutrition. The potential predictors were selected according to the conceptual framework of nutritional problems and causal factors during adolescence; dietary inadequacies and infectious diseases are immediate cause of undernutrition in adolescence (WHO, 2005). The results of the logistic regression were expressed as the odds ratio and 95% confidence interval. Statistical analyses were performed using SPSS (version 20). *P* values <0.05 were considered statistically significant.

**Ethical approval**

The study protocol was approved by the Research Ethics Committee of the Medical Faculty of Universitas Indonesia in Jakarta (reference number 206/UN.2.F1/ETIK/2015, dated 16 March 2015). The subjects provided written consent prior to data collection.

## RESULTS

The study was conducted from March to April in 2015. Out of a total of 220 eligible participants who were selected, 25 were excluded from data analysis due to under- or over-reporting of energy intake. The final analysis was performed on 195 participants, consisting of 100 adolescents in the UG and 95 in the NG.

The mean body weight and height were significantly different between the NG and UG. The mean body weight of the NG (49.3±5.1kg) was significantly higher than that of the UG (40.8±4.0kg) (Table 1). However, the mean height of the NG at 1.53±0.06m was significantly less than that of the UG at 1.56±0.06m. This indicates that on average, the UG was thinner but somewhat taller than the NG. In line with this, the proportion of stunting was significantly higher in the NG compared to the UG (24.4% vs 12.0%, respectively; $p$=0.029).

The SES of the UG was worse off than that of the NG, with the former having a significantly higher proportion with low SES (50.0% vs 31.6%, respectively) (Table 1). Overall (i.e. NG and UG), more than half of the adolescent schoolgirls (55.4%) reported having upper respiratory tract infection while a lower proportion (12.3%) had diarrhoea in the previous month. There were no statistically significant differences in the morbidity status between the NG and UG. There was also no significant difference between the two groups in terms of the prevalence of household food insecurity (UG 60.0% vs NG 50.5%), and the proportion of working mothers (UG 25.5% vs 37.6% NG).

The median daily intake of energy, protein, and fat were approximately 1,500 kcal, 49 g, and 62g, respectively; these figures were 72.0%, 83.0% and 87.0%, respectively, of the Indonesian RDA (Table 2). There were no statistically significant differences in the intake of energy, macro- and micro- nutrients between the UG and NG.

Table 3 shows that, overall, <10.0% of the adolescents had adequate energy intake and >60.0% of them attained adequate intake of protein, fat, vitamin A and vitamin $B_6$. Nonetheless, very low proportions of the adolescents had adequate intakes of folate, calcium and zinc. There were no significant differences in energy and nutrient intake adequacy between the UG and NG, except for protein intake adequacy at 83.0% vs 65.3%, respectively.

**Table 1.** Anthropometric measurements, morbidity, household food security, and socioeconomic status of the adolescent schoolgirls according to nutritional status

| | *All (n=195)* | *Nutritional status* | | $p^{\dagger}$ |
|---|---|---|---|---|
| | | *Undernutrition (BAZ<-1SD) (n=100)* | *Normal (-1SD ≤ BAZ ≤ 1SD) (n=95)* | |
| Height, m (mean±SD) | 1.55±0.06 | 1.56±0.06 | 1.53±0.06 | 0.06* |
| Weight, kg (mean±SD) | 44.9±5.8 | 40.8±4.0 | 49.3±5.1 | <0.001*** |
| Stunting (Height-for-age z-score <-2.0) (%) | 17.9 | 12.0 | 24.2 | 0.029* |
| Had upper respiratory tract infection in the previous month (%) | 55.4 | 56.0 | 54.7 | 0.859 |
| Had diarrhoea in the previous month (%) | 12.3 | 10.0 | 14.7 | 0.317 |
| Physical activity level‡ (%) | | | | |
| Low | 33.3 | 32.0 | 34.7 | 0.976 |
| Moderate | 64.6 | 66.0 | 63.2 | |
| High | 2.1 | 2.0 | 2.1 | |
| Household food security status§ (%) | | | | |
| Food secure | 44.6 | 40.0 | 49.5 | 0.184 |
| Food insecure | 55.4 | 60.0 | 50.5 | |
| Adolescent girls with working mother (n=191) (%) | 31.3 | 25.5 | 37.6 | 0.073 |
| Mother educational level (n=191) (%) | | | | |
| Lower education (graduated from junior high school or less) | 26.7 | 26.5 | 26.9 | 0.956 |
| Higher education (attending high school or more) | 73.3 | 73.5 | 73.1 | |
| Socioeconomic status¶ (%) | | | | |
| Low | 41.0 | 50.0 | 31.6 | 0.005** |
| Middle | 24.6 | 24.0 | 25.3 | |
| High | 34.4 | 26.0 | 43.2 | |

†T-test for continuous variables and chi-square test for discrete variable
‡Based on average MET-minutes per week (IPAQ, 2005)
§The sum of affirmative responses to the nine questions in the food security module for children aged ≥12 years (Connell *et al.*, 2004)
¶SES was defined based on tertiles of wealth index score (household ownership of assets) (MOH Indonesia, 2013)
*$p<0.05$, **$p<0.01$, ***$p<0.001$

**Table 2.** Energy and nutrient intake among the adolescent schoolgirls according to nutritional status

| | *All (n=195)* | *Nutritional status* | | $p^{\dagger}$ |
|---|---|---|---|---|
| | | *Undernutrition (BAZ<-1SD) (n=100)* | *Normal (-1SD ≤ BAZ ≤ 1SD) (n=95)* | |
| | Median (IQR‡) | | | |
| Energy (kcal/day) | 1531.3 (1265.3–1865.1) | 1556.6 (1281.2–1853.9) | 1478.7 (1260.9–1883.9) | 0.594 |
| Protein (g/day) | 48.9 (38.3–62.5) | 49.0 (37.8–63.3) | 48.8 (38.7–62.2) | 0.744 |
| Fat (g/day) | 61.9 (47.5–79.1) | 62.3 (50.6–80.8) | 59.6 (46.1–77.6) | 0.455 |
| Carbohydrate (g/day) | 198.4 (158.0–252.5) | 205.2 (162.4–253.2) | 197.5 (153.9–247.9) | 0.385 |
| Vitamin A (µg/day) | 1068.1 (723.6–1627.2) | 1059.3 (739.9–1615.9) | 1082.5 (684.7–1627.2) | 0.823 |
| Thiamine (mg/day) | 0.6 (0.4–0.9) | 0.7 (0.5–0.9) | 0.6 (0.4–0.9) | 0.366 |
| Riboflavin (mg/day) | 0.8 (0.6–1) | 0.8 (0.6–1.0) | 0.8 (0.5–1.0) | 0.359 |
| Niacin (mg/day) | 9.1 (6.9–12.5) | 8.9 (6.4–12.6) | 9.1 (7.1–12.4) | 0.657 |
| Vitamin $B_6$ (mg/day) | 1.2 (0.8–1.8) | 1.2 (0.8–1.7) | 1.1 (0.8–1.8) | 0.539 |
| Folate (µg/day) | 124.0 (83.0–181.0) | 130.0 (88.0–191.0) | 118.0 (77.0–174.0) | 0.080 |
| Vitamin $B_{12}$ (µg/day) | 1.9 (1.3–3.5) | 2.0 (1.4–3.5) | 1.9 (1.2–3.5) | 0.732 |
| Vitamin C (mg/day) | 24.1 (13.1–44.6) | 24.9 (13.8–48.7) | 21.9 (11.2–44.5) | 0.339 |
| Calcium (mg/day) | 294.4 (219.5–421.2) | 307.1 (229.3–420.3) | 281.8 (190.7–426.6) | 0.335 |
| Zinc (mg/day) | 6.5 (5.2–8.2) | 6.3 (5.3–8.3) | 6.6 (5.2–8.1) | 0.114 |
| Iron (mg/day) | 7.7 (5.4–8.2) | 8.0 (6.0–10.2) | 7.2 (4.9–9.9) | 0.971 |

†Mann–Whitney test
‡IQR=Interquartile range

**Table 3.** Percentage of the adolescent schoolgirls according to nutritional status meeting energy and nutrient intake adequacy†

| | Nutritional status | | | |
|---|---|---|---|---|
| | *All (n=195)* | *Undernutrition (BAZ<-1SD) (n=100)* | *Normal (-1SD ≤ BAZ ≤ 1SD) (n=95)* | *p*‡ |
| Energy | 9.7 | 12.0 | 7.4 | 0.276 |
| Protein | 74.4 | 83.0 | 65.3 | 0.005** |
| Fat | 63.1 | 66.0 | 60.0 | 0.386 |
| Carbohydrate | 34.9 | 38.0 | 31.6 | 0.347 |
| Vitamin A | 92.8 | 95.0 | 90.5 | 0.226 |
| Thiamine | 22.6 | 25.0 | 20.0 | 0.404 |
| Riboflavin | 17.4 | 20.0 | 14.7 | 0.333 |
| Niacin | 47.7 | 47.0 | 48.4 | 0.843 |
| Vitamin $B_6$ | 61.0 | 63.0 | 58.9 | 0.562 |
| Folate | 6.2 | 7.0 | 5.3 | 0.614 |
| Vitamin $B_{12}$ | 49.2 | 50.0 | 48.4 | 0.826 |
| Vitamin C | 19.0 | 20.0 | 17.9 | 0.708 |
| Calcium | 0.5 | 1.0 | 0.0 | 0.328 |
| Zinc | 4.6 | 6.0 | 3.2 | 0.344 |

†Energy and protein requirements were calculated by using estimated energy requirement and protein requirement to specific body weight (FAO, WHO & UNU, 2001; WHO, FAO & UNU, 2007). Fat and carbohydrate adequacy were taken as meeting at least 77% of the Indonesian RDA (MOH Decree, 2013). Estimated average requirement was used to evaluate micronutrient adequacy (WHO & FAO, 2006). Dietary intake above these requirements was classified as energy and nutrient adequacy.
‡Chi-square test
**$p<0.01$

Based on a DDS cut-off of <5, almost half of all the girls (46.2%) daily consumed a low diversity of foods, with no significant difference between the NG and UG (Table 4). The food groups consumed by the majority of all the adolescents on a daily basis were starchy staples (100%), flesh foods and animal protein (85.1%), legumes and nuts (55.9%) and egg (54.4%). They consumed a low percentage of fruits, only about one-third reported taking vegetables, on a daily basis. Significant differences were observed for the daily intake of legumes and nuts (NG 42.1% vs UG 69.0%), and vitamin C-rich vegetables (NG 14.7% vs UG 28.0%). Higher intake of legumes and nuts by the UG may explain the finding of significant difference of protein intake adequacy between this group and the NG, as shown in Table 3. Daily consumption of the other food groups did not show significant differences between the NG and UG girls.

The logistic regression analysis showed that among the factors studied, two were found to have significant influence on the nutritional status outcome of the adolescent schoolgirls living in the slum areas of Jakarta. Household SES and protein intake adequacy were significantly associated with the nutritional status of the schoolgirls (Table 5). Protein intake inadequacy was associated with a less likelihood of attaining normal nutritional status (OR=0.4; 95% CI: 0.2-0.8;

**Table 4.** Distribution (%) of dietary diversity scores (DDS) and food groups consumed by the adolescent schoolgirls according to nutritional status

| | *All* | *Nutritional status* | | $p^{\dagger}$ |
|---|---|---|---|---|
| | *(n=195)* | *Undernutrition (BAZ<-1SD) (n=100)* | *Normal (-1SD≤BAZ≤1SD) (n=95)* | |
| Dietary diversity score, median (IQR) | 5.0 (4.0–6.0) | 5.0 (3.0–6.0) | 5.0 (4.0–6.0) | 0.113 |
| DDS <5 (%) | 46.2 | 43.0 | 49.5 | 0.365 |
| DDS ≥5 (%) | 53.8 | 57.0 | 50.5 | |
| Food groups (%) | | | | |
| Starchy staples | 100.0 | 100.0 | 100.0 | 1.000 |
| Legumes and nuts | 55.9 | 69.0 | 42.1 | <0.01** |
| Dairy products | 42.1 | 41.0 | 43.2 | 0.761 |
| Organ meats | 5.1 | 6.0 | 4.2 | 0.572 |
| Eggs | 54.4 | 57.0 | 51.6 | 0.449 |
| Small fish eaten with bone | 4.6 | 3.0 | 6.3 | 0.271 |
| Flesh foods and animal protein | 85.1 | 81.0 | 89.5 | 0.097 |
| Vitamin A-rich deep yellow/orange/red vegetables | 33.8 | 33.0 | 34.7 | 0.798 |
| Vitamin A-rich deep green leafy vegetables | 23.1 | 22.0 | 24.2 | 0.715 |
| Vitamin A-rich fruits | 6.2 | 5.0 | 7.4 | 0.493 |
| Vitamin C-rich vegetables | 21.5 | 28.0 | 14.7 | 0.025* |
| Vitamin C-rich fruits | 15.4 | 58.0 | 63.2 | 0.152 |
| Other fruits and vegetables | 39.5 | 42.0 | 36.8 | 0.463 |

†Chi-square test; Mann–Whitney test for dietary diversity score
*$p<0.05$
**$p<0.01$

**Table 5.** Logistic regression analysis in predicting nutritional status of the adolescent girls (n=195) according to potential factors

| | *Normal nutritional status vs undernutrition*† | | |
|---|---|---|---|
| *Potential factors* | *OR* | *95% CI* | *p* |
| Dietary diversity score (DDS) | | | |
| DDS ≥5 (reference) | | | |
| DDS <5 | 1.1 | 0.6-2.0 | 0.805 |
| Dietary intake | | | |
| Energy intake adequacy (reference) | | | |
| Energy intake inadequacy | 0.7 | 0.3-1.9 | 0.494 |
| Protein intake adequacy (reference) | | | |
| Protein intake inadequacy | 0.4 | 0.2-0.8 | 0.006** |
| Morbidity status | | | |
| Had upper respiratory tract infection | 1.0 | 0.6-1.9 | 0.899 |
| Without upper respiratory tract infection (reference) | | | |
| Had diarrhoea | | | |
| Without diarrhoea (reference) | 0.6 | 0.3-1.6 | 0.328 |
| Household food security | | | |
| Food secure (reference) | | | |
| Food insecure | 1.3 | 0.7-2.4 | 0.405 |
| Socioeconomic status | | | |
| High SES (reference) | | | |
| Middle SES | 1.5 | 0.7-3.2 | 0.323 |
| Low SES | 2.7 | 1.3-5.5 | 0.006** |

†Normal BMI-for-age score or BAZ: (–1SD ≤ BAZ ≤ +1SD) as reference vs undernutrition (BAZ < -1SD)
** $p<0.01$

*p*=0.006). Schoolgirls from households with low SES were 2.7 times more likely to be undernourished than those from households with high SES (OR=2.7; 95% CI: 1.3-5.5; *p*=0.006). The other factors that were studied including DDS, energy intake, morbidity status, and household food security were not found to exert a significant influence on the nutritional status outcome of the adolescent schoolgirls.

## DISCUSSION

Data on dietary intake and dietary diversity among adolescents are limited in Indonesia. Interventions to improve the dietary intake of adolescents are also lacking. The results of this study provide some insights into the quality and variety of food consumed by adolescent schoolgirls from slum areas in Central Jakarta.

On the average, Indonesian adolescents showed a lower DDS (less than five food groups) than some other countries. By comparison, Iranian adolescent girls consumed an average of approximately six food groups (range 5–14 food groups) (Akbari & Azadbakht, 2014). and the mean DDS was 5.76 for urban adolescent schoolgirls in Ethiopia with 76% of them having adequate dietary diversity (Birru, Tariku & Belew, 2018).

The diet of the adolescent schoolgirls in this study was predominantly based on starchy staples. More than half of the girls reported taking animal protein foods and legumes and nuts. A low percentage of them consumed fruit and vegetables on a daily basis, when compared to the finding of the national survey in Indonesia, which reported vegetable consumption among Indonesian adolescents aged 13–18 years at 94.7% (Hermina & Prihartini, 2016). In studies on adolescents conducted in Africa and Canada, low energy and nutrient intake were generally found in adolescents from households with low SES and food insecurity (Kirkpatrick & Tarasuk, 2008; Dapi *et al.*, 2010). In low income households, common barriers to low fruit and vegetable intake were the unavailability and poor access to affordable types of fruit and vegetables, a lack of knowledge about healthy foods, the poor quality of the produce, and budgetary constraints (Huang, Edirisinghe & Burton-Freeman, 2016). A poor knowledge of nutrition among adolescent school girls was reported by a study conducted in 12 districts of Indonesia, which showed that less than half of adolescents aged 10-19 years were aware of health benefits of fruits (43.7%) and vegetables (36.2%) (Sudirman & Jahari, 2012). Therefore, disseminating knowledge of the health benefits of fruits and vegetables is essential. The public sector should enable people to have better access to reduce retail prices so that a wider variety of foods is affordable to all socioeconomic strata in a community (Nair, Augustine & Konapur, 2016).

Several studies have revealed that dietary diversity is consistently associated with micronutrient adequacy in children and adolescents (Korkalo *et al.*, 2017; Zhao *et al.*, 2017). Women of reproductive age in five developing countries reported that dietary diversity consistently predicts micronutrient adequacy (Arimond *et al.*, 2010).

This study showed that the adolescents had low nutrient intake, particularly of vitamin $B_1$, vitamin $B_2$, folate, vitamin C, calcium, and zinc. Macronutrient intake, except for fat, was below the national requirements for Indonesian adolescents aged 14–18 (MOH Indonesia, 2014b). The latest Indonesian dietary survey revealed that the highest proportion of energy inadequacy was among adolescents aged 13–18 (MOH Indonesia, 2014b). This is consistent with the literature regarding dietary intake among adolescents in developing countries, which has highlighted the poor diet quality in this age group (Ochola & Masibo, 2014). Their diets are known to be limited in diversity, particularly in the fruit and vegetable food groups (Zhao *et al.*, 2017). Further, energy and micronutrient intake were found to be inadequate in the majority of adolescents in developing countries (Ochola & Masibo, 2014). These findings indicate that nutrition policies and programmes are important to improve the food intake of adolescents for growth, cognition, and educational achievements (Ochola & Masibo, 2014).

This study found that low household SES had a strong influence on the nutritional status of the adolescents. This is consistent with findings elsewhere in other groups such as that of a study of pregnant women in Kenya, which reported that socioeconomic factors including employment status, household assets, and land ownership influenced dietary diversity in pregnant women (Kiboi, Kimiywe & Chege, 2017).

## CONCLUSION

The diet of adolescent schoolgirls living in slum areas in Jakarta was inadequate in terms of dietary adequacy and diversity. The Indonesian Ministry of Health issued dietary guidelines in the 2014 on principles of a balanced diet. However, these guidelines may not be well disseminated, and key elements of it, including "consume a variety of foods", are not widely known or understood. Interventions directed at promoting good diets through dietary diversification among adolescent schoolgirls, are recommended for schools and the community at large.

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**Authors' contributions**

RR, designed research, carried out data collection, analysed and interpreted the data, and developed manuscript; HK, designed research, interpreted the data and critically reviewed the manuscript; LBS, carried out data collection; LAAW, critically reviewed the manuscript; DHSD, designed research and critically reviewed the manuscript. All authors have seen and approved the final manuscript.

**Conflict of interest**

The authors declare no conflict of interest.

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