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The Influence of Nutritionist-Based Food Service Delivery System on Food and Nutrient Quality of School Lunch Program in Primary Schools in Indonesia

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Summary It is well-established that school feeding program (SFP) has been provided significant nutritional and health beneficial effects to student namely. SFP or school meal services program without nutritionist have lack of food delivery system, nutrient quality and health promotion. Thus, the aim of this study was to analyze the influence of nutritionist-based food service delivery system on food and nutrient quality of school lunch program in primary school. Methods: This study used cross-sectional design in two primary school in Indonesia that use different models of SFP (on-site (public-owned-public-managed) kitchen, off-site (ready-to-eat foods will be taken to school, preparation, cooking and sprinkling processes are carried out outside the school (catering)). Comparison analysis was done by using *t*-test independent. Results: We found that food service on-site model with nutritionist (Al Muslim) in school meal service, menu quality and hygiene sanitation better than Al Hidayah primary school (catering without nutritionist). The adequacy of nutrients particularly protein, calcium and iron in Al Hidayah students was significantly different than Al Muslim student (*p*-value<0.05). Conclusion: Primary school need to collaborate with nutritionist to plan the menu and food service system to achieve optimal nutritional status.

Key Words food service delivery, nutrient quality, school lunch program, nutritionist

Health, education and increased purchasing power of families/communities have three main pillars in realizing quality and competitive human resources (1). Increasing obesity prevalence nationally in Riskesdas 2013 for children aged 5–12 y was 18.8% compared to Riskesdas 2010 which was only 10.7% in boys and 7.7% in girls (2, 3).

In middle and low income countries, school feeding is the food provision of food on site. In short term, school feeding aims to alleviate hunger especially for households with very low income, and increase enrollment of children into schools. In the longer term, it aims to improve the nutritional status, attendance, cognitive development, academic achievement, and retention of school children (4–7). In Indonesia, the government followed up the Presidential Instruction (INPRES) No. 1/2010 which mandates the provision of supplementary food must given for primary school especially in disadvantaged, isolated, remote, border areas, on small islands, and/or outermost, and in rural areas (8). This is in line with Health Act No. 36 of 2009 concerning nutritional intake must be in accordance with individual needs to prevent the risk of over nutrition or under nutrition.

Sinaga (9), was designed food delivery model in primary schools for poor family students with an average energy content on the sample menu of 439 kcal, 10 g

of protein, 266.8 µg RE vitamin A, and 1.97 mg iron at a cost of 3,000 idr/portion. Consumption of nutrient intake increased significantly after being given a sepinggan menu breakfast. This model is also expected to be applicable to families with middle and upper socioeconomic levels and above. Of course this is inseparable from the participation of the school, parents of students, students and the surrounding community.

Nurdiani (10) showed score of Healthy Eating Index (HEI) was higher than the school without school meal services. This indicates that the nutrient quality in school meal service is better. Both of school meal services standards still have lack of facilities, and lack of hygiene sanitation. Besides that, other schools lack of food delivery and menu planning because they don't have nutritionist. In Indonesia, school feeding provide food on-site (public-owned-public-managed) kitchen, off-site (ready-to-eat foods will be taken to school, preparation, cooking and sprinkling processes are carried out outside the school (catering)) (11, 14) and take home food.

School meal service program is expected to improve health promotion. Children can apply healthy food consumption and apply good eating habits in the family through school feeding and nutrition education provided. Nutritionists expected to have a good effect to provided meal service and nutrition education (11, 12). But in Indonesia, just few schools use nutritionist to made menu plan. They even care about nutritional

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needs of the student include food allergy and their favourite food.

Research on the importance of the role of a nutritionist in feeding at school does not yet exist. Based on this description, a study was conducted the influence of nutritionist-based food service delivery system on Food and nutrient quality of school lunch program in primary schools in Indonesia.

METHODS

The method of sampling is done by purposive sampling. Inclusion criteria are students who get food at school. The subject is allocated into 2 (two) groups. School groups accompanied with nutritionists ($n=43$) consisting of 22 men and 21 women and groups who were not accompanied by nutritionists, consisting of 24 men and 18 women ($n=42$).

The primary data collected in this study are subject data and data regarding the management of the food delivery system. Variable included gender, age, food consumption, body weight, height, and body mass index (BMI)/aged. Management data on food delivery systems include inputs, processes and outputs in food delivery activities. Subject data were obtained through interviews with children using questionnaire, food consumption obtained through two days \times 24 h food recall, nutritional status (Body mass index (BMI)/aged) obtained by weighing body weight and measuring subject height then assessed based on WHO standard Z-score. The management data of the food delivery system is obtained through direct observation and interviews with managers and food handlers in each school.

Subject characteristics data were analyzed using descriptive statistics. To see the existence of differences in nutritional status of BMI/U, intake, level of adequacy, and density of nutrient intake of subjects between school groups accompanied by nutritionists and school groups who were not accompanied by nutritionists were carried out using a *t*-test independent.

RESULTS

Participant characteristics shown in Table 1

Sample in this study of SDI Al Muslim is primary school students with 43 people consisting of 21 women (48.8%) and 22 men (51.2%) and 42 students SDIT Al Hidayah consisting of 24 women (57.1%) and 18 men (42.9%). The sample age was grouped into two groups in both primary schools. The sample of students aged 9–10 y in SDI Al Muslim is 19 people (44.2%) and those aged 11–12 y are 24 people (55.8%). Examples in SDIT Al Hidayah aged 9–10 y were 36 people (85.7%) and those aged 11–12 y were 6 people (14.3%).

Analysis of food service system in schools

SDI Al Muslim applies a food delivery model by preparing food at school locations and foodstuffs from locations around the school. It according in Taiwan schools that use this model have their own school-owned (public-owned-public-managed) kitchen (13). SDIT Al Hidayah applies a food preparation model outside of school with food handlers from outside the school

Table 1. Participant characteristics based on school meal service.

Variable	SDI Al Muslim	SDIT Al Hidayah
	n (%)	n (%)
Age		
9–10 y	19 (44.2)	36 (85.7)
11–12 y	24 (55.8)	6 (14.3)
Sex		
Male	22 (51.2)	24 (57.1)
Female	21 (48.8)	18 (42.9)
Nutritional Status (BMI/aged) Z- Score		
Wasting	1 (2.3)	—
Normal	25 (58.1)	19 (45.2)
Overweight	10 (23.3)	12 (28.6)
Obesity	7 (16.3)	11 (26.2)

(catering). Schools with this model do not yet have their own kitchen, ready-to-eat foods will be taken to school (14). All the preparation, cooking and sprinkling processes are carried out outside the school (catering, off-site) (11).

School meal service in SDI Al Muslim has a good standard based on Kemenkes RI (2015), namely adequate personnel and the presence of a nutritionist can managed food service system management especially planning menu based on age, gender, culture, food allergy, and food cost; hygiene sanitation, regulation related with food service management. SDIT Al Hidayah used catering as commercial food service (off-site). This catering has weakness because they don't have standard for food service management, absence of nutritionist, household facilities, lack of hygiene sanitation.

Quality menu

According to Drewnowski (15), the density of energy and food nutrients can be used as a guide in choosing foods that contain enough energy and nutrients according to the needs of each individual so that it can be developed into an instrument that aims to identify and identify total energy and nutrient composition from a food. Food quality is high if the DED score is lower and NRF 9.3 score is higher and vice versa (16). NRF 9.3 Score was based on 9 nutrients (protein, fiber, vitamin A, C, and E, calcium, iron, potassium and magnesium) and also 3 nutrient limit (saturated fat, sodium and added sugar). This score based on 100 kcal and serving size based on 100 g.

Food quality category according to Drewnowski (15), snack/snack food groups are included in quintile 1 (score <1) while food sources of animal protein include meat, poultry, and fish and plant foods included in category 2 quintile (score 1–10) Drewnowski (16) explained that types of snack foods especially those containing

Table 2. Comparison of nutritional content on lunch menus in SDI Al Muslim and SDIT Al Hidayah based on 30% NAR (Nutritional adequacy rate) and standard lunch in Japan.

Intake	SDI Al Muslim	SDIT Al Hidayah	NAR in Indonesia	NAR in Japan
Energy	537.1 kcal	451.9 kcal	595 kcal	736.7 kcal
Protein	15.1 g	17.2 g	16.5 g	27.3 g
Iron	17.3 mg	11.8 mg	4.3 mg	3.7 mg
Calcium	56.9 mg	322.1 mg	340 mg	400 mg
Vitamin A	168.0 µg RE	371.9 µg RE	170 µg RE	223.3 µg RE
Vitamin C	10.3 mg	20.8 mg	14.5 mg	26.7 mg
Fiber	4.30 mg	2.76 mg	8.4 mg	5.8 mg

Table 3. Differences in the level of adequacy in two models of food service system.

Variable	SDI Al Muslim (n=43)	SDIT Al Hidayah (n=42)
Energy	74.8±21.2*	87.9±25.8*
Protein	139.5±51.3	153.1±50.5
Calcium	22.2±13.2*	36.1±20.6*
Iron	30.3±12.2*	55.3±54.7*
Vitamin A	68.7±36.7	68.4±46.6
Vitamin C	5.5±9.0	4.2±7.1

* *p* value<0.05; Significant.

high sugar are categorized as low-dense nutrient food. Low energy density score and high nutrient density score in the food group and the right portion of food can have a significant influence on the intake/intake of nutrients both in an individual.

Table 2 showed that the nutritional content of energy, protein, iron, vitamin A and vitamin C in SDI Al Muslim has fulfilled 25–30% of the daily needs of students' lunches. According to NAR in Indonesia (2014), the daily energy adequacy rate for children aged 7–9 y is 1850 kcal and 10–12 y olds are 2050 kcal. 49 g protein for children aged 7–9 y and 58 g for children aged 10–12 y. The calcium contained in the lunch menu in SDI Al Muslim based on NAR in Indonesia and in Japan is still not fulfilled. Foods high in calcium can be added to the menu that is served such as fish and sea food sources, bread, nuts, green vegetables, milk and the results of processing like cheese (27).

Differences in nutritional adequacy levels in two food delivery models

Adequacy level of energy nutrition (Table 3), SDI Al Muslim 74.82±21.18 and SDIT Al Hidayah 87.9±25.8, level of calcium sufficiency SDI Al Muslim 22.2±13.22 and SDIT Al Hidayah 36.1±20.6 and iron adequacy level SDI Al Muslim 30.25±12.15 and SDIT Al Hidayah 55.3±54.7. The level of adequacy of the three nutrients differed significantly in both food delivery models. Pertiwi et al. (2014) study on school children in Indonesia that the average level of energy sufficiency on average for school-age children 7–12 y as a whole is

69.5% energy, 115.5% protein, 48.6% vitamin A, vitamin C 32.7%, calcium 45.3%, and iron 103.8%. Most of the children in SDI Al Muslim have a level of macro nutrient intake in the category of severe deficits (<70% RDA) of 41.9% while calcium and iron are included in the category of deficits <77% NAR of 100.0%.

DISCUSSION

The prevalence of obesity in children aged 6–12 y is lower in girls (13.4%) compared to boys (16.8%) because girls more often limit their eating for reasons of appearance. The role of teachers and parents is very important in overcoming obesity in school children. Children assume that teachers and parents, especially mothers, are good models to become role models for a child.

Table 1 showed that nutritional status of Al Muslim students based on IMT/U (WHO, 2007) is included in the normal category (0.52±1.33) while in Al Hidayah students are included in the overweight category (1.08±1.43). Nutritional status in these two schools is significantly different (*p*<0.05), this can be caused because SDI Al Muslim is a school with a food delivery model accompanied by a nutritionist while SDIT Al Hidayah does not have a nutritionist.

Food service management in SDI Al Muslim is better than SDIT Al Hidayah because they have a nutritionist. The role of a nutritionist is related to competence in organizing food in the form of supervision in terms of designing menus according to the needs and nutritional status of consumers, overseeing food production that meets nutritional adequacy, estimating the cost of receiving power, arranging food standards for students and employees (31). In addition, the importance of food security in a food delivery activity is also one of the roles of a nutritionist because a nutritionist needs to ensure that a dish served is safe for consumption by students and employees who are in school.

Moffat T and Thrasher D (18) conducted research on lunch feeding in schools in France and Japan. These two countries have similarities in terms of school lunches that involve the role of nutritionists not only in terms of determining the menu that is adjusted for nutritional standards for each age and sex but also related to nutrition education. Woo (12) research that examined the

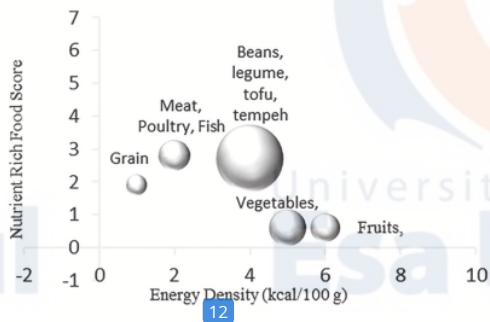


Fig. 1. Median skor Nutrient Rich Food Index (NRF 9.3) dan Dietary Energy Density (DED) SDI Al Muslim.

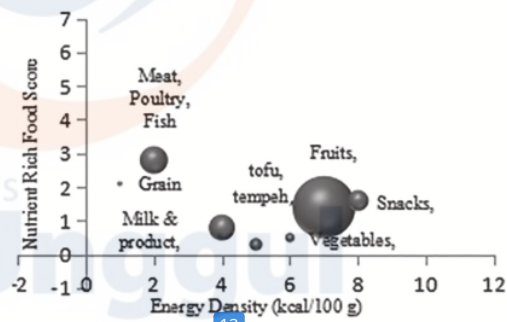


Fig. 2. Median skor Nutrient Rich Food Index (NRF 9.3) dan Dietary Energy Density (DED) SDI Al Hidayah.

feeding system in schools and schools based on nutrition education in Korea showed that feeding in these schools aimed to improve student health, promote traditional food and implement food intake for students to be better. This illustrates that the existence of a nutritionist in SDI Al Muslim has reflected the role of a nutritionist in accordance with his competence but nutrition education related to food administration has not been carried out routinely only at the beginning of the semester while SDIT Al Hidayah has not involved the role of a nutritionist.

The use of local food on the lunch menu served at SDIT Al Muslim is also good enough so that students are expected to know and like it and can apply the lunch menu at home. In Japan since 2008, the school that organizes meals at school has enacted the Shokuiku so that students can get to know local products and be able to know the importance of the food they consume (19).

The role of students in washing their eating utensils in SDI Al Muslim is expected not only in terms of improving hygiene and sanitation but students in schools that have food administration can be taught to take lunch to their friends alternately. School lunch and promotion of nutritional education in Japan apply students to take responsibility for serving food and cleaning eating utensils alternately (20).

Previous research has shown that feeding in schools can increase fruit and vegetable consumption (21). WHO recommends that consumption of fruits and vegetables 5 servings per day (400 g) for all age groups but in fact currently the WHO finds that consumption of fruits and vegetables in Southeast Asia is only 182 g/d in children aged 5–14 y (22).

Based on Figs. 1, 2, it can be seen that the larger the size in the figure shows the number/diversity of types of food consumed by students in both schools. Food nutrient density scores can be used to identify nutrient density or diversity in food consumed by individuals or a population (23).

Drewnowski (16) states that the category of food nutrient density scores and the median NRF score of 9.3 in milk and dairy products have a median score in quintile 4, which is a score of 21–30, which is classified

as a food group with good nutritional quality. In this study, the nutrient density of milk and its processed types reached a score of 43. Milk consumption in children and adolescents can increase bone mass density and prevent fracture (24).

Most of the food served in both schools is of good quality, but when viewed from food groups in SDIT Al Hidayah, it is more diverse than SDI Al Muslim. Drewnowski (25) shows that the energy density and food nutrients consumed can create quality dishes at affordable prices, and a limited budget but can meet the nutritional needs of an individual. If the concept of nutrient density in food and nutrition education is applied it will be a good basis in balanced nutrition guidelines. In addition, the nutrient density score of food can also be used as a guideline in selecting a food that is suitable for nutritional needs according to age and the presence or absence of restrictions, against certain nutrients so that it can improve nutritional status and public health status (26).

When associated with food nutrient density, diversification of food groups is good in both schools but in determining menu quality must be able to meet the rules of nutrient content in accordance with nutritional adequacy rate (NAR), adhering to a diversification principle which is one of nutritional guidelines in Indonesia and meets portion standards.

According to Nozue (28), low calcium intake can be increased by the consumption of milk at lunch. The nutritional content of energy, protein, iron, calcium, vitamin A and vitamin C in SDIT Al Hidayah already meets 25–30% NAR (27). The low fiber consumption in SDIT Al Hidayah should be met through increased consumption of fruits and vegetables.

According to Soekirman (29), the principle of diversification is based on one of nutritional guidelines in Indonesia, the diversity of food in a daily meal consumed, must at least come from one type of food source of energy, one type of food source of building materials and one food source of regulatory substances. The menu given to SDI Al Muslim students is in accordance with the principle of diversification but SDIT Al Hidayah still does not adhere to this principle because in one

menu it has not originated from the three sources of nutrient (Table 2).

The standard portion given for carbohydrate-based food in both schools is suitable 100–150 g/portion, animal source foods are suitable 50 g/portion, but vegetable, fruit and vegetable sources of food are not suitable especially in SDIT Al Hidayah because in some menus they are not provide these foods every day. The standard portion in SDI Al Muslim in general is in accordance with portion standards but in SDIT Al Hidayah it is still not appropriate.

Based on the nutritional fact, food diversity and food portion standards given in both schools, it can be concluded that the quality of the lunch menu in SDI Al Muslim is better and meets the balanced menu rules while SDIT Al Hidayah still does not meet the balanced menu rules so it needs to be improved. The lunch menu should consist of a complete menu.

Table 3 showed protein adequacy level exceeded 120% of NAR in both schools. The menus planning can be improved based on gender, age of students, and principles of balanced nutrition. Foods high in calcium can be added to the menu, which is served as fish and sea food, bread, nuts, green vegetables, milk and the results of processing like cheese (27). Low calcium intake can be increased by the consumption of milk at lunch (29). Beside added in lunch, calcium can added in snack.

According to Gibson (30) in the Ministry of Health (2014), high heme iron intake can be obtained from meat, offal, fish and poultry. Non-heme iron sources are soybeans, beans, green vegetables and seaweed. In addition, there is a need for information to students regarding phytic acid, oxalic acid and fiber which have a negative effect on iron absorption (27).

The level of adequacy of students comes from daily food consumption both from family meals and food served at each school and snack foods. Snacking habits of elementary school students can also contribute to daily consumption and nutritional adequacy of students. Snack habits include the number of types of snacks and frequency of snacks.

CONCLUSION

The menu quality in SDI Al Muslim is good but the menu planning at SDIT Al Hidayah still needs to be improved to make it more diverse, fulfill the nutritional content, according to the needs of students and meet the principles of balanced nutrition. There are significant differences in nutritional status, energy, protein, calcium and iron intake, levels of protein, calcium and iron adequacy in both schools. Organizing food service management in school meal program or SFP should require collaboration not only from the school but also a nutritionist in the preparation of menus for school children, nutrition education for food handlers as well as students as well as the participation of students in the food delivery activities.

Disclosure of state of COI

No conflicts of interest to be declared.

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