

The Accuracy of Food and Drink Cards As A Tool For Estimating Total Nutrients And Calories Intake

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Abstract.

Interview method in exploring foods and drinks intake require estimation tool. Household measuring instruments can be used, as well as of food photographs and three-dimension food models. The purpose of this study was to assess the accuracy of food and drink cards as a tool to estimate the portion of real food and drink. A total of 32 respondents participated in this study. Food records were collected then body weight and height of respondents were measured. In the following day, the respondents estimated the portion of the real foods and drinks compare to the cards. Fifty-one cards are considered accurate from the total 67 cards. Food and drink cards can be used as a tool to estimate nutritional intake and total calories.

1. Introduction

Balanced intake is needed as an energy for daily activities. Total energy requirements are defined as the energy intake needed for the growth or maintenance of a person's body that is determined by age, sex, weight, height, and level of physical activity[1]. Specific conditions, such as pregnancy, breastfeeding, or suffering from a particular disease cause the amount of energy needed increase or decrease than it should. Consumption of food and drink that are less or exceeding the needs can cause malnutrition and increase morbidity. Diabetes mellitus is one of metabolic diseases which can be affected by food intake as a risk factor. It was on top ten non-communicable diseases in Indonesia[2].

Exploring the history of food and drink intake is one of important step in assessing someone's nutritional status. It can be done by various methods, namely the food recall, food records, and food frequency questionnaires. Interviews method require estimation tool. The household measuring tools, as well as photographs and three-dimension (3D) food models can be used[3].

The use of estimation tools can make the result more accurate. The 3D food model is close to the original shape and size, but quite expensive and not travel-friendly. The household measuring instruments have different size and

shape. The use of cards from the food and drink photographs is expected to be an easy method, cheaper, and light to carry.

The results of previous study on food photographs show that this method can be used to estimate foods and drinks intake in rural areas or developing countries[4,5]. Research in Africa shows that food photographs are accurate to be used for children and adults[6]. The difference on food ingredients composition between previous research and Indonesia is interesting and need further research. This study aims to assess the accuracy of food and drink cards for estimating nutrient intake and total calories.

2. Methods

This was an analytic observational study. Thirty-two college students participated and were taken as respondents using simple random techniques. All procedures were approved by the University of Sriwijaya Research Ethics Committee. Respondents signed the approval consent after being informed about this study. They were given a 2-day food record form and were asked to write down the details of foods and drinks consumption for 24 hours on one working day and one day off, as a reference for the type of foods and drinks used later in this study. On the next week, after respondents have collected the food record form, their height and weight were measured. The body mass index was calculated to determine nutritional status.

Photographs of food and drink were taken using a Canon Eos M3 camera with a Canon Fix lens, ISO 250, 50 mm focal length, at an angle of 30°, 55° and 90° to the horizontal. During the photo session, the tripod was fixed in position. A fork and a spoon/ knife were included as reference besides 26 cm or 20 cm white round plate, on a white paper which printed box pattern with a size of 1 cm² per box as a background. The foods with a small amount were placed on a smaller white square plate or without plate. Some products were served in a spoon. The drinks and coconut milk were displayed using standard glasses used daily (250 ml for milk and 300 ml for tea). Photographs then were printed to 125x175-mm size in two different angle that considered as the best for describing the actual appearance. There were 67 photographs of carbohydrate-rich foods, plant-based protein sources, animal-based protein sources, oil/fat sources, fruits, vegetables, and drinks (milk and tea). Size of food presented refer to the size and

3. Results

Demographic characteristics and nutritional status of respondents were presented in table 1. Most of the respondents have normal nutritional status. According to Nutritional Adequacy Rate in Indonesia 2012, the intakes requirements for the age range of 17-18 years were 2125 Kcal of total energy, 59 g of proteins, 71 g of fats and 292 g of carbohydrates for female. Total energy 2675 Kcal, 66 g proteins, 89 g fats, and 368 g carbohydrates considered sufficient value for male [10]. Most of the intakes did not meet 80% recommendation for the total amount of energy or macronutrient content (table 2).

The food photographs varied from raw and cooked dishes. Rice and white bread, in the group of foods which contain carbohydrate, are the only kind of food that ready to eat. Almost

scale contained in the Indonesian food composition table [7,8].

On the following day, respondents were collected to observe cooked-foods and drinks placed on the table, and to estimate the portion of the real foods and drinks compared to the cards. Respondents then checked the portion choices on the sheet provided (1/4, 1/2, 3/4, 1, 2), which stated the comparison food portion of the cards to the foods and drinks that were presented.

All data were analyzed using SPSS 11.5. Nutrition intake was analyzed using Nutrisurvey software and were presented as total calories intake and macronutrients content. The Pearson/Spearman correlation test was used to assess cards accuracy to estimate real-life portion. The interpretation of correlation coefficient stated as very high (0,90–1,00), high (0,70–0,90), moderate (0,50–0,70), low (0,30–0,50), and negligible (0,00–0,30) [9]. The cards that have very high, high, and moderate correlation considered as accurate.

all of foods from animal products were photographed raw, except meatballs. All the plant-based protein sources were raw, and all the vegetables were cooked. The weight of the food served varies, but it was attempted to approach the exchange unit in the exchange food ingredients table. The weight of each vegetable dish was 100 g after boiling and draining.

The real food menu can consist of a single food or a combination of various ingredients. One type of food can be contained in two or three dishes. Processing and containers (for liquid) varies. Respondents observed the real menu on the table, then compare to the reference photographs that displayed in two position as in figure 1.

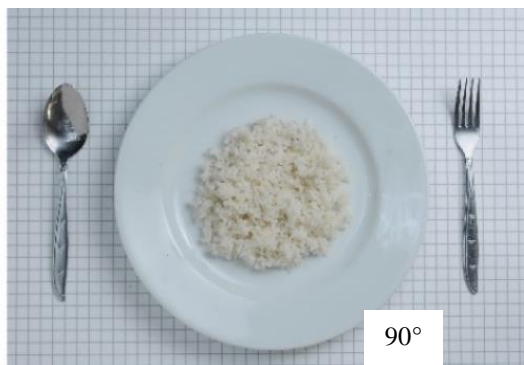
Table 1. Demographic characteristics and nutritional status of respondents.

Characteristics	n	%
Age (years)		
17	11	34,4
18	21	65,6
Sex		

male	13	40,6
female	19	59,4
Nutritional status (kg/m ²)		
underweight	2	6,3
normal	20	62,5
overweight	4	12,5
obese	6	18,8

Tabel2. Nutrients content of food consumption.

Content	Mean	SD	Median	Min-Max
Carbohydrate (g)	156.60	69,16	142,67	72,20-352,50 ^a
Fat (g)	60,73	31,87	52,45	16,35-120,85
Protein (g)	47,14	24,50	38,80	23,50-120,30 ^a
Total calories (Kcal)	1377,45	591,82	1169	560,90-2645,05

^aNon-normal distribution data**Figure 1.** The example of photographs.

The correlation test results from various food and drinks groups can be seen in Tables 3. A total of 51 from 67 cards (76.1%) were considered accurate to estimate nutrients and calories intake in this study.

Tabel3. Correlation of food and drink cards to the real menu.

Food and drink categories	R	p
Carbohydrates		
White bread ^b , noodle (fresh) ^b , macaron oat ^b	0,72–0,84	0,00
Potato ^b , corn ^b , rice (cooked) ^b	0,55–0,68	0,00
Rice vermicelli, sweet potato, cassava	0,05–0,48	>0,05
Plant-based proteins	0,72–0,85	0,00
Red bean ^b , mung bean ^b	0,64–0,65	0,00
Tahu (tofu) ^b , tempeh ^b , peanut ^b Oncom ^b	0,49	0,04
Animal based protein		
Teri (anchovy) ^b , mujair ^b	0,90–0,98	0,00

Gabus ^b , shrimp ^b , chicken mea chickenliver ^b , patin ^b , smoked beef ^b Squid, chicken eggs ^b	0,72–0,82 0,65–0,66	0,00 0,00
Cow liver	0,47	>0,05
Beef, meatballs, sepat	0,11–0,47	>0,05
Oil/fat		
Vegetable oil ^b	0,95	0,00
Coconut milk ^b	0,73	0,00
Margarine ^b , coconut (grated) ^b , mayonnaise ^b	0,64–0,66	0,00
Cheese (grated)	0,16	>0,05
Fruits		
Banana ^b , avocado ^b , water apple ^b , mango snake fruit ^b , pear ^b , watermelon ^b , grapes ^l Orange ^b , apple ^b	0,75–0,83 0,63–0,67	0,00 0,00
Melon, papaya	0,36–0,44	0,01–0,04
Pineapple, kedondong (ambarella)	0,08–0,22	>0,05
Vegetables		
Kangkung (water spinach) ^b , cassa leaves ^b , Chinese cabbage ^b , Eggplant ^b , baby corn unripe jackfruit ^b , cauliflower ^b , carro cucumber ^b , cabbage ^b , mung be sprouts ^b , green bean ^b	0,77–0,84 0,51–0,70	0,00 0,00
Unripe papaya, yardlong bean, gamb (<i>L. acutangula</i>)	0,35–0,42	0,01-0,04
Drinks		
Milk, tea	0,83–0,85	0,00

^b Spearman test

4. Discussion

This study used a single portion size of food or drink in two different angles. The use of two different of shooting angles were intended so that respondents can imagine the actual size of the product. The 55° angle was expected to be close to the human sight when seated[6]. The 30° angle was used to further improve the visualization of small shape food or liquid that placed in a glass.

Utilisation more than one portion photographs with the small and medium portion that approximately close to common portion of food may reduce the estimation errors[6,11]. Nevertheless, most of the card could be used by respondents to estimate real menu

portion. This method can be useful for estimating portion size and can be compared with weighing method[5]. Respondents in this study are college student that have similar education level, so it easier to conduct than previous study[4].

Cook processing of the food could interfere the estimation ability of the respondent. Rice vermicelli on the card is uncooked, so the respondents may find difficulty to imagine a portion of vermicelli after being cooked, which has different shape. Raw food that have extremely different on menu presentation after being cut and skin-peeled such as cassava and sweet potatoes, make this card inaccurate.

The differences in the appearance of the ingredients in the dish seem confusing. Meatballs and oncom cards turned out to be inaccurate in this study. The subject had difficulty to estimate food component on a menu that had been cut into small pieces. The fish which served in fillets may be less common than whole served so that it was difficult to assess. Although the beef and beef liver on the card have been displayed using matchbox as comparator for easier estimation, the respondents still seem difficult to determine the portion of meat if it was cut into pieces in menu.

Cheese on the photo is thought to be inaccurate may be because it was not the usual appearance of cheese that was consumed daily (grated cheese). Unripe papaya is inaccurate in this study allegedly due to the rarity of subjects seeing whole unripe papaya, before being made into any dishes. Long beans in card was displayed in whole form so they may obscure the visualization of subjects who are accustomed to seeing long beans in a truncated form. Melon, pineapple and papaya are fruits that are displayed in large pieces in photos. The appearance of two gambas of different sizes on cards, apparently doesn't make it easier to predict. Kedondong pieces was also inaccurate in this study, this may be due to the rarity of respondents finding kedondong in whole shape nowadays. Photos of the food may be better in a common form and size that is usually eaten.

Certain eating habits and food knowledge may greatly affect this outcome, that was not included in this study. Undiversified shape of food and menu that are not commonly eaten may increase estimation errors. This study also did not assess the respondents' memory about the food they had eaten before, as was done in the real food recall. For further research, food card validation can be carried out at various ages, locations and levels of education. The presentation of the food on the card can be made similar to what is often seen in real life so that visualization is easier.

5. Conclusions

Fifty-one food and drink cards are considered accurate for assessing the real food and drink menu. Further research needs to be carried out,

include other items that have not been assessed or those that are considered not accurate in this study.

6. References

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