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Validation Household Dietary Diversity Score (HDDS) to Identify Food Insecure Households in Industrial Area

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Abstract: Majority of poor households in industrial areas work as factory labors. They were at risk to food insecurity due to low income. Quantitatively, food insecurity determining based on energy adequacy level (<70%). One of the qualitative method that developed by Food and Agriculture Organization (FAO) is Household Dietary Diversity Score (HDDS). This instrument has not been tested in Indonesia as an alternative method to identify household food insecurity, especially in industrial area. This study aimed to validate the HDDS to identify food insecure households in the industrial area. Cross sectional study was conducted in Wanaherang village, Gunung Putri sub district, Bogor district on May until October 2013. The result showed that 83.5% of total household consumed more than six foods group, but most of them has a low energy adequacy level (±70% RDA). Quantitative validation using energy adequacy level as a gold standard. Sensitivity analysis showed HDDS sensitive 22.03% to identify food insecure households. Specificity analysis showed HDDS specific 90.91% to identify food secure households. HDDS was modified by food categories based on nutritional function, namely source of carbohydrates, fat, animal protein, vegetable protein, vitamin and mineral and others. Sensitivity analysis showed HDDS modification was sensitive 86.44% to identify food insecure households. Specificity analysis showed HDDS modification was specific 50.00% to identify food secure households. High sensitivity implies that HDDS modification was able to identify food insecure households.

Key words: Food insecure, HDDS, industry, sensitivity, specificity

INTRODUCTION

Food security is directly related to food consumption, both in quality and quantity. Food consumption is determined by the food availability and access. National food availability does not ensure food security at the regional, household, even individual level (Saliem, 2006). This can be happen due to limited public access to food, both physically and economically.

In urban areas, especially in industrial areas, most of fathers (head of households) work as a labor and has a low income. Most of them are poor households. But, their access to food relatively higher, so they should be able to choose food which is more diverse than rural areas. However, the high availability of fast food caused increasing in these food consumption, because it is easy to get and affordable in price. These conditions will degrade the quality of food consumption (less nutritious foods).

To support household food security, households food consumption should be adequate in quantity and quality. The quantity indicated by energy and protein adequacy level. The quality of household food consumption could be assessed by dietary diversity score, known as Household Dietary Diversity Score (HDDS). This simple instrument was developed by Food and Agriculture Organization (FAO).

Energy adequacy levels has been used as a reference in measuring households food security. A household was grouped into food secure if energy adequacy level equivalent to or more than 70% and food insecure if energy adequacy level less than 70%. This calculation requires longer time, both in data collecting and data processing. A simple method for measure households food security is needed. So, this study aims to validate the HDDS to identify food insecure households in industrial area.

MATERIALS AND METHODS

Study design and setting: A cross sectional study was conducted in industrial area in Wanaherang, Gunung Putri Sub District, Bogor District, West Java, Indonesia for five months, from May until October 2013. The location was taken purposively and considered representative the industrial ecosystem.

Sample: The population in this study was poor households in Wanaherang. Inclusion criterions for this study were: (1) participants were poor households; (2) household members were usually eating at home and (3) the head of household was industry labor. The sample in this research were 105 households based on proportion of poor households in Bogor District on 2012 (45.37%) calculated by Lemeshow's formula (Lemeshow *et al*., 1990).

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Data collection: The collected data in this research were household characteristics and dietary intake during past 24 h using a questionnaire. Household characteristics consist of household size, age, education level, occupation and the head of househod's income per month. Household dietary intake collected from recall past 24 h by directly interviewed to housewife who determine the food menu in household.

Data analysis: Data were analyzed by using Microsoft Office Excel 2007 and SPSS version 16.0 for Windows. Only the households with household member who usually est at home and the energy intake more than 500 kcal/capita/day and less than 5000 kcal/capita/day will be analyze in this research (Wiesmann *et al*., 2009). Households that include in these criteria were 103 households.

Univariate analysis was used to assess household characteristics. Dietary intake was analyzed by quantitative and qualitative method. Quantitative method conducted by calculating household's energy and protein intake based on Indonesian Food Composition Table. Determination of recommended energy and protein allowances refers to the Recommended Dietary Allowances (RDA) based on a National Food and Nutrition Meeting 2012 (WNPG 2012) in Jakarta. Energy and protein adequacy level were calculated by comparing household's energy and protein intake to recommended energy and protein allowances. Energy and protein adequacy classified based on Indonesian Health Department (1996) i.e., severe deficit (<70%), moderate deficit (70-79%), low deficit (80-89%), normal (90-119%) and excessive (≥120%).

Qualitative method conducted by using Household Dietary Diversity Score (HDDS). There were 16 food groups in HDDS questionaire. To get HDDS score, all of food were eaten by the household from 16 food groups should be grouped into 12 food groups, i.e., (1) cereals, (2) tubers, (3) vegetables, (4) fruits, (5) meat, (6) eggs, (7) fishes and others seafood, (8) legumes and nuts, (9) milk and milk products, (10) oils and fats, (11) sugar and (12) spices and beverages. Score 1 were given if the household consumed one various of food in food groups and score 0 were given if household was not consumed one various of food in food groups that had been determined by FAO. Dietary diversity based on HDDS categorized into three categories, i.e low if consumption was ≥3 various of food, moderate if consumption was 4-5 various of food and high if consumption was ≥6 various of food (Swindale and Bilinsky, 2005).

Qualitatively, food consumption would be known in diversity if consumption was less than six various of food (Kennedy *et al*., 2011). Quantitatively, food insecurity households would be known if energy consumption of households were less than 70%. Energy adequacy level was often used to determine food insecurity households (food insecurity if <70%). Validation analysis was conducted to assess HDDS as an alternative method to determine food insecurity household. Validation is used energy adequacy level as a gold standard. Validation conducted using sensitivity and specificity analysis. Sensitivity analysis to assess HDDS's ability to identify food insecurity households in poor households, also classified by the proxy indicator (gold standard) as food-insecure. Specificity analysis to assess HDDS's ability to identify food security households in poor households, also classified by the proxy indicator (gold standard) as food-secure. Cross tabulation to determine sensitivity and specificity analyzed based on Daniel Maxwell (1999) and IFPRI (2008).

RESULTS AND DISCUSSION

Household characteristic: The analysis of household characteristics including household size, age, educational level, occupation and the head household's income per month (Table 1).

Descriptive analysis showed that the majority of households (88.3%) were small households with the average of four members per household. According to Oliyini (2014), household size has a correlation with household income. In high-income household, number of household members tend to be small. This is closely correlate with the results that most of the households belong to a small size and high income (>IDR 1,800,000).

Most of fathers (68%) belong to the group of middle adulthood. While most of the housewives (50.5%) belong to early adulthood. Middle adulthood is the age of the head of households to be productive and be able to work actively and productively for daily needs of the households (Oliyini, 2014).

Most of fathers (71.8%) were high school graduated. Housewive's education balance between junior and senior high school (±44%). According to Hardinsyah (2007) level of formal education reflects a person's ability to understand the various aspects of knowledge, including knowledge of nutrition. The education level of the head of household is directly or indirectly determine household economic status. In addition, housewives education in addition to the main capital in the household economy also play a role in regulation of household diet. Heads of households are mostly working as factory labors (94.2%). Most of the mothers are housewives (83.5%).

Household dietary diversity: HDDS scores indicated households dietary diversity were high, as many as 83.5% of households consume more than six various of food (Table 2). These results are different from Oliyini (2014) who reported that the HDDS score lower in poor

Table 1: Household characteristics

	----- Household -----		Mean±SD
Variables	n	%	
Household size			3.56±0.775
Small (≤4 persons)	91	88.3	
Middle (5-7 persons)	12	11.7	
Large (≥8 persons)	0	0.0	
Total	103	100.0	
Father's age			33.20±6.228
Adolescent (10-18 year)	0	0.0	
Early adult (19-29 year)	32	31.1	
Middle adult (30-49 year)	70	68.0	
End Adult (50-64 year)	0	0.0	
Elderly (≥65 year)	1	1.0	
Total	103	100.0	
Mother's age			30.21±6.276
Adolescent (10-18 year)	0	0.0	
Early adult (19-29 year)	52	50.5	
Middle adult (30-49 year)	50	48.5	
Last Adult (50-64 year)	0	0.0	
Elderly (≥65 year)	1	1.0	
Total	103	100.0	
Father's education			-
Not school	0	0.0	
Elementary school	4	3.9	
Junior high school	22	21.4	
Senior high school	74	71.8	
University	3	2.9	
Total	103	100.0	
Mother's education			-
Not school	0	0.0	
Elementary school	10	9.7	
Junior high school	46	44.7	
Senior high school	45	43.7	
University	2	1.9	
Total	103	100.0	
Father's occupation			-
Labor	97	94.2	
Businessman	2	1.9	
Services expert	2	1.9	
Others	2	1.9	
Total	103	100.0	
Mother's occupation			-
Labor	16	15.5	
Business woman	1	1.0	
Housewife	86	83.5	
Total	103	100.0	
Head of household's income			-
<IDR 300,000	0	0.0	
IDR 300,000-IDR 800,000	3	2.9	
IDR 801,000-IDR 1,300,000	0	0.0	
IDR 1,301,000-IDR 1,800,000	14	13.6	
>IDR 1,800,000	86	83.5	
Total	103	100.0	

households (2.55±0.07). HDDS score based on the food groups that consumed at home, although in very small amounts of food (Swindale and Bilinsky, 2005). Higher households income also became one of determinant factors of dietary diversity. If households income became higher, food access of those households also increase. This result agrees with Rashid *et al.* (2011) who stated that household income is a main factor to determine household dietary diversity in Bangladesh.

Energy and protein adequacy of households: Intake, recommended allowances and adequacy level of energy and protein of households are presented in Table 3.

Table 2: Proportion of households based on HDDS score

	---------- Households ----------	
HDDS score	n	%
Low (≤3 food)	4	3.9
Medium (4-5 food)	13	12.6
High (≥6 food)	86	83.5
Total	103	100.0

Table 3: Intake, recommended allowances and adequacy level of energy and protein of households

Variable	Mean±SD
Energy intake (kcal/capita/day)	1287±571
Protein intake (g/capita/day)	40±22
Recommended energy allowances (kcal/capita/day)	1861±198
Recommended protein allowances (g/capita/day)	47±5
Energy adequacy level (%)	70±38
Protein adequacy level (%)	85±57

Table 4: Cross tabulation for sensitivity and specificity analysis between HDDS and energy adequacy level

	------ Energy Adequacy Level ------		
HDDS	Low (<70%)	High (≥70%)	Total
Low (0-5)	13	4	17
High (6-12)	46	40	86
Total	59	44	103

The average of household's energy and protein intake were 1287 kcal/capita/day and 40 g/capita/day. The average of recommended energy and protein allowances were 1861 kcal/capita/day and 47 g/capita/h. The average level of energy and protein adequacy of household were 70 and 85%. The average of household energy intake is still low when compared with recommended energy allowances. While the average household protein intake is good enough.

Sensitivity and specificity: HDDS validation conducted quantitatively by calculating the sensitivity and specificity with energy adequacy level as a gold standard. Cut off used are less than 70% (food insecure) and equivalent to or more than 70% (food secure). The cut off for HDDS score are 0-5 (low) and 6-12 (high). This validation is belongs to type of validation criteria (Abramson, 1990). Cross tabulation for sensitivity and specificity analysis are presented in Table 4.

Sensitivity analysis showed that HDDS is sensitive for 22.03% to identify food insecure households. Specificity analysis showed that HDDS is specific for 90.91% to identify food secure households. Low sensitivity value implies that HDDS was not able to identify food insecure households according to household food insecurity were identified based on the energy adequacy level. So, it is important to modified HDDS score to improve the value of sensitivity. This is related to Daniel Maxwell (1999) who stated that highly sensitivity is needed to identify food insecure household.

Modification of HDDS: Modifications of the food groups and HDDS score were constructed based on source of nutrient that required by humans. According to Ruel

Table 5: Food categories of HDDS modification

Food Categories based on source of nutrient	HDDS Food Groups (16 food groups)	Score	Max. Score
Sources of carbohydrate	Cereals White roots and tubers Sweets	0 = not consumed 1 = consumed 1 food groups 2 = consumed ≥2 food groups	2
Sources of fat	Oils and fats	0 = not consumed 1 = consumed 1 various of food 2 = consumed ≥2 various of food	2
Sources of animal protein	Meats Organ meat Eggs Fishes and seafood Milk and milk products	0 = not consumed 1 = consumed 1 food groups 2 = consumed ≥2 food groups	2
Sources of vegetable protein	Legumes and nuts	0 = not consumed 1 = consumed 1 various of food 2 = consumed ≥2 various of food	2
Sources of vitamin and mineral	Vitamin a rich vegetables and tubers Dark green leafy vegetables Other vegetables Vitamin A rich fruits Other fruits	0 = not consumed 1 = consumed 1 food groups 2 = consumed ≥2 food groups	2
Others	Spices, condiments, beverages	0 = not consumed 1 = consumed 1 various of food 2 = consumed ≥2 various of food	2
Total			12

Table 6: Proportion of households based on HDDS score modification

	---------- Household ----------	
HDDS score	n	%
Low (≤5 food groups)	10	9.7
Moderate (6-8 food groups)	63	61.2
High (≥9 food groups)	30	29.1
Total	103	100.0

Table 7: Cross tabulation for sensitivity and specificity analysis between HDDS modification and energy adequacy level

	------ Energy adequacy level ------		
HDDS	Low (<70%)	High (≥70%)	Total
Low (0-8)	51	22	73
High (9-12)	8	22	30
Total	59	44	103

(2002) food grouped based on their nutrient function or main nutrient contain in those food. Sixteen food groups in questionnaire are aggregated into six categories based on the source of nutrients i.e., source of carbohydrate, fat, animal protein, vegetable protein, vitamins and minerals and others (Table 5).

The range of HDDS modification scores is 0-12. In scoring the sources of carbohydrates, animal protein and sources of vitamin and mineral category, it conducted by giving 0 if the household did not consume any food groups in each category, score 1 if household consume one food group in each category and score 2 if household consumed two and more than two food groups in each category. In scoring the sources of fat, vegetable protein and others groups, it conducted by giving 0 if the household did not consume any food groups in each category, score 1 if household consume one various of food in each category and score 2 if household consumed two and more than two food groups in each category. Maximum score for each category is 2 so that the maximum of total score is 12. The weight score for each category is considered equivalent because this is a qualitative instrument that does not calculate the contribution of nutrients quantitatively, but focused at the number of food groups consumed. More food groups were consumed, it means diversity also increased. This is different with the previous score of HDDS that does not calculate the contribution of nutrients.

Dietary diversity based on HDDS score modifications are grouped into three categories: low (score ≤5), moderate (score 6-8) and high (score ≥9). The households dietary diversity is low when they consume at least one various of food in each main category (exclude others category). The households dietary diversity is moderate when they consume at least one various of food in each category (include others category). Consume at least two various of food from the four categories and a various of food from the other categories showed that the household dietary diversity is high.

Dietary diversity analysis using HDDS modification indicates that households dietary diversity is moderate i.e., as many as 61.2% of households consume six to eight various of food (Table 6). Sensitivity and specificity analysis also conducted to HDDS modification (Table 7). Sensitivity analysis showed HDDS modification sensitive 86.44% to identify food insecure households. Specificity analysis showed HDDS modification specific 50.00% to identify food secure households. High sensitivity implies that HDDS modification was able to identify food insecure households.

Conclusion: High sensitivity value implies that the HDDS modification can be used as an alternative method or indicator to identify food insecure households in industrial areas.

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