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Household food insecurity and undernutrition in children below 5 years living in different geographical areas in East Java, Indonesia

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ABSTRACT

Introduction: Geographical conditions may be linked with food insecurity and growth retardation in young children. This research assessed household food insecurity status and undernutrition in different geographical areas. **Methods:** A cross-sectional study was conducted in four different types of geographical areas: coastal, limestone, agricultural and municipality, which were purposely selected in East Java Province. The samples were households with children aged below 5 years. A total of 736 households that fulfilled the inclusion criteria were recruited. Household food security was assessed using the Household Food Security Supplement Measure (US-HFSSM) adapted for developing countries. Nutritional status of children was determined and classified according to World Health Organization Growth Standard (2006). **Results:** Prevalence and severity of household food insecurity differed significantly among the different geographical areas. Almost half (44.8%) of the households were categorised as "food insecure without hunger". Prevalence of "hunger" was highest in coastal (7.2%) and limestone areas (5.3%). Highest prevalence of stunting was in coastal areas (11.6%), whereas highest prevalence of wasting (6.2%) and underweight (8.9%) were in limestone areas. Prevalence of undernutrition was relatively low among children living in municipalities. The differences in the distribution of undernutrition of young children and household food insecurity status were statistically associated with the types of geographical areas. **Conclusion:** Prevalence of household food insecurity differed according to the types of geographical areas in East Java. Prevalence of household food insecurity and young child undernutrition were greater for households in the coastal and limestone areas, compared to those in the agricultural and municipality areas.

Keywords: Household food insecurity, underweight, wasting, stunting, geographical areas

INTRODUCTION

"Food insecurity exists whenever the availability of nutritionally adequate, safe foods or the ability to acquire personally acceptable foods in socially acceptable ways is limited or uncertain" (FAO, IFAD & WFP, 2015). In developing countries, food insecurity is linked with negative nutrition outcome, such as low birth weight, child's underweight, wasting and stunting. A study of adolescents in Ethiopia showed that food insecurity

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was negatively associated with linear growth among girls (Belachew *et al.*, 2013a). Low dietary diversity as a proxy for food insecurity was positively related with child stunting, according to National Food Consumption Surveys in South Africa (Belachew *et al.,* 2013b). Household food security was found to be positively associated with greater subsequent infant weight gain in a cohort study in Bangladesh (Saha *et al.*, 2009). Economic inequalities at a provincial level in Ecuador, which reflected food insecurity in terms of food purchasing ability, were also positively associated with child's stunting (Larrea & Kawachi, 2005)

In Indonesia, food insecurity remains a major concern despite achievement of economic growth since the economic crisis of 1998 (Yusdja & Soeparno, 2011). Increasing food insecurity among households has been reported as correlating with increase in food insufficiency and decreased dietary intake (Indonesian Ministry of Health, 2013). This condition results in increasing prevalence of undernourished children in both rural and urban areas. Based on the National Research data (Indonesian Ministry of Health, 2013), the prevalence of wasting in East Java increased from 13.7% in 2007 to 14.1% in 2010, while stunting increased from 34.8% to 35.8%. This prevalence of stunting is similar to the national figure of 35.6% (Indonesian Ministry of Health, 2013). Hence, it has been suggested that East Java Province is a miniature Indonesia in terms of child nutritional status.

Physical environmental and geographical conditions, and climate change can affect food availability, which in turn, can affect household food insecurity (Lysenko, Squires & Verheye, 2010; Butler, 2009; Gross, 2013). This study assessed household food insecurity and prevalence of undernutrition among children under 5 years of age living in different geographical areas in East Java Province.

MATERIALS AND METHODS

A cross-sectional study was conducted in four different types of geographical areas: coastal, limestone or dry, lowland agricultural and urban or municipality, which were purposely selected in East Java Province. Coastal areas selected were Pasuruan and Lamongan; limestone areas selected were Gresik and Pamekasan, lowland agricultural areas selected were Ngawi and Banyuwangi Districts; while urban areas were represented by Madiun and Blitar Municipalities. The study samples were households with at least one child aged below 5 years.

The sample size was determined by using multi-stage cluster random sampling. The census block determined by Statistics Indonesia (2010) was used as clusters. Sampling was carried out as follows: three sub-districts were randomly selected from each district, followed by random selection of two villages from each sub-district. There were 8-10 census blocks in each village, in which a census block consisted of 30 households. Two census blocks were randomly selected in each of the selected village. Finally, eight households were randomly selected in every census block. Thus, a total of 96 households was selected in each district or municipality. Out of 768 households initially identified from all the districts/municipalities, a final sample size of 736 household who fulfilled the inclusion criteria were included in the study.

Characteristics of the households were assessed using a questionnaire, and these include food expenditure, source of drinking water, maternal characteristics, household food security and nutritional status of children under 5 years old. Nutritional status of children was determined and classified as underweight, wasting

and stunting, according to weight-for-age z-score (WAZ), weight-for-height z-score (WHZ), and height-for-age z-score (HAZ) respectively (WHO, 2006). The children's weight was measured by using standardised electronic scale to the nearest 0.1 kg (Tanita HS302). Standing height was measured by using a microtoise tape to the nearest 0.1 cm.

Household food security was assessed using the Household Food Security Supplement Measure (US-HFSSM) adapted for developing countries (Bickel *et al.*, 2000). This measure has been shown to provide valid results in several developing countries including Peru (Chaparo & Estrada, 2012), Ecuador (Weigel *et al.*, 2016), Bolivia, Burkina Faso, Philippines (Melgar-Quinonez *et al.*, 2006) and Indonesia (Usfar Fahmida & Februhartanty, 2007).

The US-HFSSM method simplifies the food insecurity scale into small set of categories, each one representing a meaningful range of severity. The questionnaire consists of 18 standardised questions and corresponding scales. Three sequences of screening questions serve as preliminary testing followed by 18 questions as the core scale. Four categories describe the range of food severity: (i) Food secure [FS] for scores <2.32, (ii) Food insecure without hunger [FIWH], when the score is between 2.32 and <4.56; (iii) Food insecure with moderate hunger [FIMH], for scores between 4.56 and <6.53; and (iv) Food insecure with severe hunger [FISH], when the score is ≥6.53 (Bickel *et al.*, 2000).

Appendix 1 shows the questions asked of the household member, particularly the mother. A range of questions depict the severity of food access problems ranging from household that might run out of food, to children not having food a whole day. The mothers' answers were coded into 18 items, with affirmative response (1) given for "often" or "sometimes", while "never" was coded as negative (0). For response to the other questions, affirmative (1) was given for "yes" answers and negative (0) was given for "no". For "how often?" questions, responses, "almost every month" and "some months" were regarded as affirmative (1) and response of "only 1 or 2 months" was deemed as negative response (0) (Appendix 1).

Maternal attributes included mid-upper arm circumference (MUAC), and breastfeeding status. Socio-demographic covariates included total monthly expenditure, food expenditure, and source of drinking water, number of children under 5 years and number of household members.

Breast feeding status is categorised as exclusive breastfeeding for up to 6 months, while predominant breastfeeding is the practice in which only non-milk fluids given in addition to breast milk during the first six months; meanwhile, partial breastfeeding is breastfeeding combined with other milks and/or solid foods (WHO, 1991; Greiner, 2014).

SPSS software version 17.0 (SPSS Inc. Chicago, IL) was used for data entry and statistical analyses. Association between household food security status and child nutritional status (wasting, stunting and underweight) from various geographical areas was determined, with significance set at *p*-value <0.05.

Ethical approval was obtained from Ethical Committee of Faculty of Public Health Universitas Airlangga No. 190-KEPK. Consent was obtained from each subject in writing, after information regarding the purpose of the study was explained to them. The identity of all subjects was kept confidential.

RESULTS

Maternal characteristics

Overall, 14.7% of mothers had MUAC of less than 23.5 cm, indicating low fat deposit. In comparison, only 1.8% of the mothers from the municipalities showed unsatisfactory MUAC (Table 1).

Less than 7.0% of the mothers from all areas practised exclusive breastfeeding for 6 months. The lowest rate of exclusive breastfeeding was reported for the limestone areas (0.5%). Majority of the mothers (73.6%) did not breastfeed their children until two years of age. Mothers in limestone areas were also found to show relatively low prevalence of predominant breastfeeding and partial breastfeeding, whereas comparatively higher prevalence of these breastfeeding practices were reported among mothers in the coastal areas.

Household and environmental characteristics
More than half (55.5%) of the study households consist of nuclear families consisting of 1-4 members. Households that use the well for drinking water were mostly found in agricultural areas (23.6%), while the lowest percentage was in the municipalities (14.9%). The latter had the highest percentage of households (8.8%) that use drinking water supplied by a public water company. Some households, particularly in agricultural areas (2.2%) also used rivers as their drinking water source.

Approximately 64.5% of the households had one person as income earner. Household economic status was determined by using the proxy indicators of monthly total and food expenditures. The average household monthly total expenditure was US$47.71 – 275.14, and monthly food expenditure was US$32.79 – 225.50. Households having the average total and food expenditures were mostly found in municipality areas (8.7%). Majority of the households in the study locations were categorised as having poor economic status, in which the monthly total expenditure was <US$47.71, and monthly food expenditure <US$32.79. Poor economic status was highest in the agricultural areas (18.9%).

Nutritional status of children and household food security status
Using the 2006 WHO Growth Standard (WHO, 2006) the overall prevalence of stunting, wasting and underweight was 39.4%, 18.4%, and 25.0%, respectively (Table 2). The coastal areas had the highest prevalence of stunted children (11.6%). Meanwhile, the limestone area had the highest prevalence of wasting and underweight (6.2% and 8.9%, respectively).

Overall, 34.4% of the households were classified as "FS". However, 44.8% of the households were found as "FIWH", with the limestone areas having the highest proportion (12.9%). Both "moderate hunger (FIMH)" and "severe hunger (FISH)" were reported mostly in households from the coastal 7.2%) and limestone areas (5.3%).

Prevalence of stunting, wasting and underweight were relatively higher in the coastal and limestone areas. Stunting in the coastal and limestone areas was 11.6% and 10.9% respectively, compared to 9.6% in the agricultural areas and 7.3% in the municipalities. Wasting was also relatively higher in the coastal and limestone areas (5.7% and 6.2%, respectively), compared to the agricultural areas and municipalities (3.2% and 3.3%, respectively). Statistically, Table 2 shows that these differences in the distribution of undernutrition of young children and household food insecurity status were statistically associated with the studied geographical areas.

DISCUSSION

The overall high prevalence of underweight (25.0%) and stunting (39.4%) among children under 5 years in the study areas indicate that East Java Province as having a serious public health problem (WHO, 2000). Meanwhile wasting prevalence (overall 18.4%) exceeding the WHO's cut-off point of

Table 1. Maternal and social economic characteristics in various geographical areas

Characteristics	Geographical Area				Total n (%)
	Agriculture n (%)	Coastal n (%)	Limestone n (%)	Municipal n (%)	
Mother's MUAC (n=736)					
<23.5 cm	36 (4.9)	27 (3.7)	32 (4.3)	13 (1.8)	108 (14.7)
≥23.5 cm	156 (21.2)	165 (22.4)	144 (19.6)	163 (22.1)	628 (85.3)
Breastfeeding practice (n=734)					
Breastfeeding for 2 years	81 (11.1)	48 (6.5)	29 (3.9)	36 (4.9)	194 (26.5)
Do not breastfeed for 2 years	111 (15.1)	143 (19.5)	146 (19.9)	140 (19.1)	540 (73.5)
Breastfeeding status (n=734)					
Exclusive breastfeeding for 6 months	24 (3.3)	12 (1.6)	4 (0.5)	6 (0.8)	46 (6.3)
Predominantly breastfeeding	57 (7.8)	36 (4.9)	25 (3.4)	30 (4.1)	148 (20.2)
Partially breastfeeding	111 (15.1)	143 (19.5)	146 (19.9)	140 (19.1)	540 (73.5)
Type of family (n=736)					
Nuclear Family	119 (16.2)	106 (14.4)	92 (12.5)	91 (12.4)	408 (55.4)
Extended Family	73 (9.9)	86 (11.7)	84 (11.4)	85 (11.5)	328 (44.6)
Family member employed (n=736)					
≤1	107 (14.5)	144 (19.6)	115 (15.6)	109 (14.8)	475 (64.5)
2	62 (8.4)	35 (4.8)	46 (6.3)	49 (6.7)	192 (26.1)
≥3	23 (3.1)	13 (1.7)	15 (2.1)	18 (2.4)	69 (9.4)
Source of drinking water (n=736)					
River	16 (2.2)	1 (0.1)	1 (0.1)	1 (0.1)	19 (2.6)
Well	174 (23.6)	132 (17.9)	165 (22.4)	110 (14.9)	581 (78.9)
Public water company	2 (0.3)	25 (3.4)	6 (0.8)	65 (8.8)	98 (13.3)
Others	0 (0.0)	34 (4.6)	4 (0.5)	0 (0.0)	38 (5.2)
Economic status (n=736)[†]					
Poor	139 (18.9)	135 (18.3)	138 (18.8)	112 (15.2)	524 (71.2)
Average	53 (7.2)	57 (7.7)	38 (5.2)	64 (8.7)	212 (28.8)
Monthly expenditure (Mean in US$) (n=736)[‡]					
Low (< US$47.71)	142 (19.3)	101 (13.7)	107 (14.5)	98 (13.3)	448 (60.9)
Average (US$47.71 – 275.14)	50 (6.8)	91 (12.4)	69 (9.4)	78 (10.6)	288 (39.1)
Monthly food expenditure (Mean in US$) (n=736)[§]					
Low (< US$32.79)	131 (17.8)	97 (13.2)	95 (12.9)	100 (13.6)	423 (57.5)
Average (US$32.79 – 225.50)	61 (8.3)	95 (12.9)	81 (11.0)	76 (10.3)	313 (42.5)

[†]Range for economic status classification: poor = <US$1/day, average = US$1-5/day

[‡]Range for monthly total expenditure: low = < US$47.71/month, average = US$47.71–275.14/month

[§]Range for monthly food expenditure: low = <US$32.79/month, average = US$32.79 – 225.5/month.

Table 2. Prevalence of underweight, wasting, stunting among children below 5 years, and household food security status in various geographical areas

Variables	Geographical Area				Total n (%)	p-value
	Agriculture n (%)	Coastal n (%)	Limestone n (%)	Municipal n (%)		
Child's height-for-age z-score (n=731)†						0.008**
Not Stunted (≥ -2 SD)	122 (16.7)	106 (14.5)	94 (12.9)	121 (16.6)	443 (60.6)	
Stunted (< -2 SD)	70 (9.6)	85 (11.6)	80 (10.9)	53 (7.3)	288 (39.4)	
Child's weight-for-height z-score (n=721)†						0.030*
Not Wasted (≥ -2 SD)	167 (23.2)	149 (20.7)	129 (17.9)	143 (19.8)	588 (81.6)	
Wasted (< -2 SD)	23 (3.2)	41 (5.7)	45 (6.2)	24 (3.3)	133 (18.4)	
Child's weight-for-age z-score (n=732)†						0.005**
Not Underweight (≥ -2 SD)	157 (21.4)	134 (18.3)	111 (15.2)	147 (20.1)	549 (75.0)	
Underweight (< -2 SD)	34 (4.6)	57 (7.8)	65 (8.9)	27 (3.7)	183 (25.0)	
Household Food Security Status (n=736)‡						0.000***
Food Secure	71 (9.6)	56 (7.6)	42 (5.7)	85 (11.5)	254 (34.5)	
Food Insecurity without Hunger	93 (12.6)	83 (11.3)	95 (12.9)	59 (8.0)	330 (44.8)	
Food Insecurity with Moderate Hunger	26 (3.5)	43 (5.8)	31 (4.2)	29 (3.9)	129 (17.5)	
Food Insecurity with Severe Hunger	2 (0.3)	10 (1.4)	8 (1.1)	3 (0.4)	23 (3.2)	

†Cut-off point for stunting was height-for-age z-score (HAZ) of < -2 SD; cut-off point for wasting was weight-for-height z-score (WHZ) of < -2 SD; cut-off point for underweight was weight-for-age z-score (WAZ) of < -2 SD.
‡Household Food Security Classification was based on the US-HFSSM; Food secure [FS], when the score <2.32; Food insecure without hunger [FIWH], when the score 2.32≤FIWH<4.56; Food insecure with moderate hunger [FIMH], when the score 4.56≤FIMH<6.53, and Food insecure with severe hunger [FISH], when the score ≥6.53 (Bickel *et al.*, 2000).
*Significant at *p*<0.05; **significant at *p*<0.01; *** significant at *p*<0.001, using chi-square

acute malnutrition (>15.0%), suggests the study areas as having a critical public health problem. The nutritional status of the young children in East Java is worse than the national prevalence of underweight, wasting and stunting rates of 19.6%, 12.1% and 37.2%, respectively (Indonesian Ministry of Health, 2013). These data are useful to alert the regional and national public authorities to address the undernutrition problems in East Java.

In this study, the limestone area has the highest rate of underweight and wasting among the under-five children. The high rates of acute malnutrition in this geographic area might due to low prevalence of breastfeeding, including exclusive, predominant or continued breastfeeding until 2 years. Stunting rate was high in the coastal and limestone areas, with the prevalence of 11.6% and 10.9%, respectively.

Various definitions of hunger have been suggested, including the "state of a strong desire of food where it's lacking" (Barquera *et al.*, 2007). Mutisya *et al.* (2015) described the three indicators of hunger: the prevalence of undernourishment (food deprivation), the prevalence of critical food poverty (income deprivation) and the prevalence of child's underweight. This study found that being food insecure either with or without hunger was reported in all types of geographical areas. Based on the US-HFSSM (Bickel *et al.*, 2000), a total of 65.5% of households was categorised as "food insecure", majority of whom were FIWH. This finding is similar to another study in Indonesia, which identified 77.0% households in urban areas and 84.0% in rural settings as "food insecure" (Usfar *et al.*, 2007).

The total prevalence of food insecure in our study was close to that among low social economic households in Quebec, Canada (62.8%) (Carter *et al.*, 2012). Thus, food insecurity is related to household income status, which was

also reported in a study in Malaysia (Mohamadpour, Sharif & Keysami, 2012). While household income was shown to be a better predictor for dietary adequacy than food expenditure by Booth & Smith (2001), in this study, monthly expenditures appeared easier to compute in rural communities.

This study shows that geographical condition exerts an influence on household food security status and child nutritional status. Similar findings were reported in Western Australia, where geographic location contributes to food availability, and also has impact on food pricing (Pollard *et al.,* 2014). The coastal and limestone areas in East Java are relatively remote and encounter transportation challenges. Thus, households residing in these areas have limited access to food and are vulnerable to food deficits and hunger (Godrich *et al.,* 2017). Most people living in the coastal areas work as fisherman, and are vulnerable to climatic changes. The impact of climate change on food security was delineated among households in coastal areas in Paraty, Brazil (Hanazaki *et al.* 2013), as well as in Bangladesh (Shams & Shohel, 2016). Meanwhile, the limestone area is a dry place and the residents are dependent on rainfall for their livelihoods.

Food and nutrition security have complex linkages with agriculture and the environment (Hwalla, El Labban & Bahn, 2016). Household food insecurity is influenced in part by environmental factors (Carter *et al.*, 2012). Evidence shows that due to land degradation and climate change, rice yields have been decreasing among Malagasy farmers (Gross, 2013), which in turn threatens them to become food insecured.

CONCLUSION

Based on the US-HFSSM modified for developing countries, a high prevalence of household food insecurity was observed among the different types of

geographical areas. Household food insecurity with and without hunger was more prevalent in the coastal and limestone areas. Likewise, the prevalence of child undernutrition was higher in the coastal and limestone areas, compared to the municipalities. Studies on household food security and child nutritional status should take into consideration the potential influence of geographical conditions of the residents.

Authors' contributions

SS, contributed to the design and concept of the study, revised the manuscript and helped in writing the discussion part, responsible for data collection and quality check for data input, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved; SM, contributed to the research methodology, cleaning the data and carrying out the statistical analysis; TM, responsible for sectional scientific management, formulated research question, carried out the analysis, preparation of draft manuscript, and carried out revisions. All authors have given approval to the final manuscript.

Conflict of interest

Authors do not have any conflict of interest in this study.

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Appendix 1. List of food insecurity items adapted in the study

US Food Security Supplement Measure (US-HFSSM)	*Adapted Items in the Questionnaire*
1. Worries that food would run out	1. Mother worries that food would run out
2. Food bought just didn't last	2. Food bought not sufficient
3. Couldn't afford to eat balanced meals	3. Mother couldn't afford to serve a balanced diet
4. Few kinds of low cost food for children	4. Mother couldn't buy low cost food for children
5. Couldn't feed children a balanced meal	5. Mother couldn't feed a balanced meal for children
6. Children were not eating enough	6. Mother says that food to eat is not enough
7. Adult(s) cut or skipped meals	7. Mother or other adults decrease the meals
8. Adult(s) cut or skipped meals, 3+ months	8. Mother or other adults decrease the meals, 3+ months
9. You ate less than felt you should	9. Mother ate less because they run out of money
10. You were hungry but didn't eat	10. Mother felt hungry but didn't eat
11. You lost weight because not enough food	11. Mother lost weight because there was not enough food
12. Adult(s) not eat for a whole day	12. Mother or other adults did not eat for a whole day (except during the fasting month of Ramadhan)
13. Adult(s) not eat for a whole day, 3+ months	13. Mother or other adults did not eat for a whole day, 3+ months
14. Cut size of children's meals	14. Mother cuts size of children meals
15. Children had ever skipped meals	15. Mother gave only one meal a day for children
16. Children skip meals, 3+ months	16. Mother gave only one meal a day for children, 3+ months
17. Children ever hungry	17. Child hungry but mother did not feed
18. Children did not eat for a whole day	18. Children did not eat for a whole day because they ran out of money