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Comparison of maternal nutrition literacy, dietary diversity, and food security among households with and without double burden of malnutrition in Surabaya, Indonesia

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ABSTRACT

Introduction: Double burden of malnutrition in the form of stunted child and overweight/obese mother has been increasing in countries experiencing nutrition transition. This study aimed to compare maternal nutrition, literacy, dietary diversity, and food security of households categorised by nutritional status of mother-child pairs. **Methods:** This cross-sectional study included a total of 685 children under 5 years of age from 14 community health centres (*posyandu)* in a poor urban area of Surabaya, Indonesia. The Lemeshow formula was used to compute sample size. The children and their mothers were categorised into mother-child pairs based on maternal body mass index (BMI) and height-for-age *z-score* for the child: non-overweight mother-non-stunted child (NM), non-overweight mother and stunted child (SC), overweight/obese mother and non-stunted child (OWT), stunted child and overweight/obese mother (SCOWT). Nutrition literacy was determined using questionnaires, dietary diversity was estimated using household dietary diversity scores, and food security was determined using the Household Food Insecurity Access Scale (HFIAS). **Results:** The prevalence of households with SCOWT double burden of malnutrition was 21.2%, OWT 37.7%, SC 15.3% and 25.8% were normal (NM). There were significant differences in maternal nutrition literacy, dietary diversity and household food security status. Households with NM pairs were shown to be most food secure followed by OWT, SC and lastly, the SCOWT pairs. **Conclusion:** Households with double burden of malnutrition have relatively lower nutrition literacy, dietary diversity, and food security. This study indicates the importance of developing nutritional strategies to enable low-income households to make healthy food choices.

Keywords: Nutrition literacy, dietary diversity, food security, double burden of malnutrition, Indonesia

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INTRODUCTION

Over two decades ago, Popkin (1994) postulated the growing problem of nutrition transition as part of a complex interrelation of demographic and epidemiologic transition. In his recent publication, Popkin (2015) argued that the underlying cause for rapid nutrition transition in low and middle income countries (LMICs) is related to changes in agricultural systems, advancement of technologies and mechanisation that decrease physical activity, urbanisation, and tremendous growth of the modern food system. As a result, nutrition transition is believed to be the driving force for the global epidemic of overweight and obesity (Popkin, 2012) and double burden of malnutrition (Doak *et al.*, 2005). Secondary data analysis from Brazil, China, Indonesia, the United States, and Vietnam revealed households with double burden of malnutrition in the form of stunted child under 5 years of age and overweight mother (SCOWT) were more likely to occur in an urban setting and within a high-income population (Doak *et al.*, 2005). A recent review revealed nearly all developing countries were facing the problem of double burden of malnutrition, and the increase in per capita income was associated with the increase in the overweight/underweight ratio (Abdullah, 2015).

With the fourth largest population in the world, Indonesia is believed to be experiencing the double burden of malnutrition (Oddo *et al.*, 2012; Sekiyama *et al.*, 2015). A study in rural Indonesia reported that the prevalence of SCOWT was 11% in 2012 (Oddo *et al.*, 2012), while in 2015, SCOWT prevalence was 30.6% in rural areas (Sekiyama *et al.*, 2015). Understanding specific features of SCOWT among populations undergoing nutrition transition might help explain approaches to achieve good nutrition at this critical time in children's lives.

SCOWT households tend to be characterised by consumption of foods with higher fat and protein content compared to underweight and normal weight households (Doak *et al.*, 2002). Though easily distinguished from the "underweight only" households, the double burden of malnutrition (SCOWT) was relatively difficult to distinguish from the "overweight only households" (OWT) (Doak *et al.*, 2005). Boutizou (2015) reported that low dietary diversity was associated with an increased likelihood of double burden of malnutrition. High consumption of animal-based foods was associated with a decrease of likelihood of SCOWT in rural Indonesia (Sekiyama *et al.*, 2015).

We hypothesised that SCOWT households lacked the necessary knowledge for choosing healthy foods, leading to poor dietary diversity. This inability could be driven by a low level of knowledge in nutrition, and not merely caused by limited access to healthy foods. Bandura (2004) argued that knowledge of health benefits provides the necessary precondition for change. Knowledge in nutrition could be measured as nutrition literacy described as the degree to which individuals have the capacity to obtain, process, and understand basic nutrition information and services needed to make appropriate nutrition-related decisions (Gibbs *et al.*, 2016). In the tenets of the Social Cognitive Theory (SCT), Bandura (2004) argued that cognitive precondition in the form of knowledge was not enough for people to overcome the impediments to adopt new lifestyle habits and retain them without additional self-influence and personal-efficacy.

MATERIALS AND METHODS

This cross-sectional study was conducted in the second largest city in Indonesia,

Surabaya. This site was chosen according to the criteria of having more than 15% prevalence of children under 5 years old suffering from underweight, based on the monthly child growth monitoring data in the community-driven integrated health post, or in Indonesian language, "*Pos Pelayanan Terpadu*" or "*posyandu*" (Mahmudiono, 2007). We defined the double burden of malnutrition as the coexistence of stunted child under five and overweight/obesity mother in the same household (SCOWT).

A minimum sample size of 662 participants was computed based on maximising detection for SCOWT households, 82.5% statistical power with a 5% margin of error, a general assumption of 50% response distribution, using 1.5 design effect from the clustering of *posyandu*. In anticipation of 5% non-response rate, we targeted 700 mother-child pairs.

We employed a systematic cluster sampling method involving 14 *posyandu* in an urban poor population of Surabaya, Indonesia. Seven *posyandu* were randomly selected from each of two sub-districts with high prevalence of underweight children (more than 15% based on the report of Surabaya District Health Office). During the *posyandu* meetings, mothers were informed about the study and invited to participate by signing an informed consent. Inclusion criteria included agreement to participate and having a child aged under 5 years. In each of the 14 *posyandu*, 50 households with eligible pairs of mothers and under-five children were selected for this study. After cleaning the data to remove extreme values and missing data, a total of 685 mother-child pairs were included in the final study sample.

Weight and height of the mother as well as the child were taken at the *posyandu*. A stadiometer SECA 213 (Seca GmbH & Co. Kg, Germany) was used to measure height, and a Camry EB6571 digital scale (Guangdong, China) was used to the nearest 0.01 kg to measure weight. Measurements were conducted twice if the reading from the first and second measurements was less than 0.5 cm difference for height and 0.05 kg for weight. A third measurement was carried out if the first and second measurements had more than the above-mentioned difference. The age of the child was determined from the health-monitoring card/registry in the *posyandu*. Background information of the households was recorded. The World Health Organization (WHO) child growth standard 2006 was used as a reference for determining the child nutrition status based on the index of height-for-age *z*-score (HAZ) (WHO, 2016). According to that standard, a child is categorised as stunted if the HAZ is below -2 standard deviations. The conventional cut-off points for determining maternal overweight (BMI of 25.00 kg/m^2 to 29.99 kg/m^2) and obesity (BMI >30.00 kg/m^2) were employed (Gibbs *et al.*, 2016).

Based on the BMI and height-for-age measurements of the mothers and children respectively, the eligible mother-child pairs were categorised as follows: non-overweight mother-non-stunted child (NM) pair, non-overweight mother and stunted child (SC) pair, overweight/obese mother and non-stunted child (OWT) pair, and stunted child and overweight/obese mother (SCOWT) pair.

Nutrition literacy was measured in five domains: relationship between nutrition and health, knowledge of macronutrients, skill in food measures, numeracy and label reading, and skills in grouping food in categories (Gibbs *et al.*, 2016). Only three domains of nutrition literacy were used in this study; the three domains were: macronutrients, household food measures, and food groups. The macronutrients domain had 6-item, close-ended questions

modified from the original questionnaire (Cronbach's α=0.497). The 6-item questionnaire in the household food measure domain was adapted to reflect the common household measurements used in Indonesia (Cronbach's α=-0.344). The food groups domain was also adapted from the original American "MyPlate" to the Indonesian version of MyPlate known in Indonesian language as "*Piring Makanku*" (Cronbach's α=0.564). The major difference between MyPlate and "*Piring Makanku*" was that in Indonesian "*Piring Makanku*" water is substituted for milk (Kemenkes, 2014).

Dietary diversity was assessed according to the Food and Agriculture Organization of the United Nations guidelines to measure the household and individual dietary diversity (FAO, 2011). Mothers were asked to recall food intake during the past 24 hours by answering a series of questions about each of 16 food groups. In keeping with the FAO guidelines, the 16 food groups were aggregated into 12 food groups, and the answers were used to create the household's dietary diversity score (HDDS). The 12 food groups listed in the final HDDS were cereals (including rice and noodles), tubers/roots, vegetables, fruits, fish (including fresh water fish, dried fish, and seafood), meat and poultry, eggs, nuts and seeds, dairy products, spices, oils and fats, and sweets. Scores for the 12 food-group categories ranged from 0 to 12 (Cronbach's α=0.281).

Food security was assessed using nine items from the household food insecurity access scale (HFIAS) questionnaire (Coates *et al.*, 2007). Originally, the score for the HFIAS ranged from 0 through 27 with a lower score indicating food security. In this study, we performed principle component analysis (PCA) to derive the measure of food security from the set of nine HFIAS questions. We used Varimax rotation with the Kaizer Normalization method for rotation of the data, and set factors with an eigenvalue of greater than 1.0 to be included as measures of food security. Table 3 shows the PCA results for the nine-items set of HFIAS questions.

Test of normality was conducted on the studied variables and for those not normally distributed, the Kruskal-Wallis test with post hoc analysis with Bonferroni correction was used. Significance was set at $p<0.05$ for Kruskal-Wallis and $p<0.0083$ for Bonferroni correction. Descriptive statistics and Chi-square tests were used to describe the demographic characteristics of the sample. The measurement of food security status was derived from principle component analysis (PCA) with Varimax rotation. Statistical analysis was performed using SPSS Statistics version 23 (IBM Corporation, Philadelphia, USA).

This study was conducted according to the guidelines outlined in the Declaration of Helsinki, and all procedures involving human subjects/patients were obtained from the Institutional Review Board (IRB) of Kansas State University, USA (reference or proposal number: 7646). In Indonesia, approval for the study was granted by the Surabaya City Review Board (Bakesbangpol No: 1366/LIT/2015). Written informed consent was obtained from the mothers. Respondents were told they could withdraw their participation in the study at any time without consequences.

RESULTS

Description of the sample

This study found that 21.2% of the sample experienced double burden of malnutrition in the form of SCOWT living in the same household. The prevalence of OWT was 37.7%, while that for SC was 15.3%. Just over one fourth (25.8%) of the households had mothers with normal BMI and normal child height-for-age *z*-score (NM).

Significant differences were found between the mother-child nutritional status categories and several demographic characteristics, such as maternal education, total number of children living in the same household, father's occupation, household income and monthly food expenditure (Table 1). However, no significant difference was observed for child's gender, maternal general literacy, family type, number of children under 5 years of age in the household and maternal occupation across the different mother-child categories.

The percentage of mothers who did not attend high school education was the highest among OWT pairs (24.1%), followed by SCOWT pairs (16.3%), as compared to the NM pairs (14.1%). Households with SCOWT pairs also had a higher percentage of 3 to 4 children living at home (7.9%) than the NM pairs (4.5%). The percentage of fathers with a steady occupation, as government employees, or in the private sector as tradesmen was relatively higher among NM pair households (17.8%) than the SCOWT pair households (9.6%). In terms of total monthly income, the percentage of households earning more than Indonesian Rupiahs (IDR) 2,500,000 (USD 165) was higher among NM pairs (9.7%) and OWT pairs (10.2%) than SCOWT pairs (4.3%) and SC pairs (2.1%). The monthly food expenditure among households was significantly different among the groups of households. The majority of respondents (77.4%) reported monthly food expenditure was around IDR 500,000 to IDR 1,500,000 (USD 33 to USD 99).

Nutrition literacy, dietary diversity, food insecurity

Nutrition literacy results are shown in Table 2. The SCOWT households were among the lowest for maternal literacy and dietary diversity scores. They were the worst-off in terms of food insecurity rank.

The follow-up post hoc analysis revealed that maternal nutrition literacy between households with SCOWT pairs was significantly lower than households with NM pairs as well as OWT pairs (Table 3).

Dietary diversity result showed a modest score for all the categories; however, post hoc analyses indicated that NM significantly outperformed the other three categories (Table 3). NM households were shown to be the most food secure followed by the OWT pairs, SC pairs and lastly, the SCOWT pairs.

Two factors emerged in this study as household food security measures. The first factor was related to possible disruption of "food quality," and the second factor emphasised concerns about lack of "food quantity" in the household for the preceding last 4 weeks. Table 3 shows there was significant difference in food security measures in terms of both "food quality" ($p<0.001$) and "food quantity" ($p=0.019$) among the four pair categories based on the Kruskal-Wallis test. In the post hoc analysis with Bonferroni correction, the "food quality" measure in the SCOWT pairs was significantly higher than the NM pairs, SC pairs, as well as OWT pairs. In the "food quantity" measure, the SCOWT pairs were significantly lower than the SC pairs.

DISCUSSION

There were significant differences in maternal nutrition literacy, dietary diversity, and PCA-derived food security measures (quality of food and quantity of food) among the households with and without double burden malnutrition. Maternal nutrition literacy and lack of food quality were distinctly different in the SCOWT and OWT households only.

Table 1. Demographic background of mother-child pairs (*n*=685)

Variable	*NM pairs*[†]		*SC pairs*[‡]		*OWT pairs*[§]		*SCOWT pairs*[¶]		*p-value*
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	
Child's gender									0.065
Male	87	12.7	60	8.8	115	16.8	81	11.8	
Female	90	13.1	45	6.6	143	20.9	64	9.3	
Mother's general literacy									0.059
Illiterate	8	1.2	12	1.8	23	3.4	14	2.0	
Partially literate	18	2.6	15	2.2	33	4.8	28	4.1	
Literate	151	22.0	78	11.4	202	29.5	103	15.0	
Maternal education									0.000***
No schooling	4	0.6	9	1.3	14	2.0	11	1.6	
Primary	58	8.5	57	8.3	93	13.6	74	10.8	
Secondary	34	5.0	19	2.8	58	8.5	27	3.9	
High-school	64	9.3	19	2.8	78	11.4	26	3.8	
College	17	2.5	1	0.1	15	15.0	7	1.0	
Family type									0.410
Nuclear family	112	16.4	61	8.9	159	23.2	89	13.0	
Extended family	65	9.5	44	6.4	99	14.5	56	8.2	
Number of children at home									0.006**
1-2 children	141	20.6	77	11.2	177	25.8	87	12.7	
3-4 children	31	4.5	25	3.6	77	11.2	54	7.9	
>4 children	5	0.7	3	0.4	4	0.6	4	0.6	
Number of children under 5 years old in the household									0.969
1 child	159	23.2	97	14.2	232	33.9	129	18.8	
2 children	17	2.5	8	1.2	25	3.6	15	2.2	
3 children	1	0.1	0	0.0	1	0.1	1	0.1	
Maternal occupation									0.465
Housewife without maid	135	19.7	86	12.6	187	27.3	112	16.4	
Housewife with maid	2	0.3	4	0.6	11	1.6	9	1.3	
Government officer (PNS/BUMN/Army/ Police)	1	0.1	0	0.0	2	0.3	0	0.0	
Private sector	13	1.9	3	0.4	20	2.9	6	0.9	
Trade and entrepreneur	15	2.2	8	1.2	19	2.8	9	1.3	
Labour/miscellaneous services	11	1.6	4	0.6	19	2.8	9	1.3	
Paternal occupation									<0.001***
Government employee (PNS/BUMN/Army/ Police)	28	4.3	1	0.2	30	4.6	4	0.6	
Private sector	60	9.2	26	4.0	72	11.1	34	5.2	
Trade and entrepreneur	28	4.3	20	3.1	38	5.8	25	3.8	
Labour	35	5.4	36	5.5	81	12.5	45	6.9	
Other	20	3.1	17	2.6	24	3.7	26	3.9	
Household's monthly income									0.007**
<IDR 1,000,000 (<$100)	25	3.7	18	2.6	50	7.3	32	4.7	
IDR 1,000,000 – 1,500,000 ($100 – 150)	47	6.9	44	6.4	77	11.2	50	7.3	
>IDR 1,500,000 – 2,000,000 (>$150 – 200)	28	4.1	17	2.5	34	5.0	21	3.1	
>IDR 2,000,000 – 2,500,000 (>$200 – 250)	11	1.6	12	1.8	27	3.9	13	1.9	
>IDR 2,500,000 – 3,000,000 (>$250 – 300)	30	4.4	8	1.2	23	3.4	19	2.8	
>IDR 3,000,000 (>$300)	36	5.3	6	0.9	47	6.8	10	1.5	
Household's monthly food expenditure									0.049*
<IDR 500,000 (<$50)	16	2.3	13	1.9	17	2.5	6	0.9	
IDR 500,000 – 1,000,000 ($50 – 100)	71	10.4	54	7.9	118	17.2	68	9.9	
>IDR 1,000,000 – 1,500,000 (>$100 – 150)	51	7.4	28	4.1	90	13.1	51	7.4	
>IDR 1,500,000 – 2,000,000 (>$150 – 200)	14	2.0	5	0.7	16	2.3	10	1.5	
>IDR 2,000,000 – 2,500,000 (>$200 – 250)	13	1.9	4	0.6	7	1.0	5	0.7	
>IDR 2,500,000 (>$250)	12	1.8	1	0.1	10	1.5	5	0.7	

[†]NM pairs=Pairs with nutritional status of both mother (Body Mass Index or BMI between 18.5 to 25.0) and child (Height-for-age *z*-score/HAZ between -2 to + 2) was normal.
[‡]SC pairs=Pairs with stunted child (HAZ less than -2) and normal mother (BMI between 18.5 to 25.0).
[§]OWT pairs=Pairs with overweight/obese mother (BMI>25.0) and normal child (HAZ between -2 to + 2).
[¶]SCOWT pairs=Pairs with stunted child (HAZ less than -2) and overweight/obese mother (BMI>25.0).
Values were significantly different from households with normal mother-child pairs: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. *P* was obtained with X^2 tests.

Table 2. Descriptive statistics of household's categories based on mother-child pairs in relation to nutrition literacy, dietary diversity, and food insecurity

Variable	*Median*	*IQR*	*Skewness (SE)*	*Kurtosis (SE)*
Nutrition literacy score				
NM pairs	19	3.5	-0.630 (0.183)	0.822 (0.363)
SC pairs	18	4.0	-1.256 (0.236)	2.933 (0.467)
OWT pairs	18	3.0	-0.442 (0.152)	0.284 (0.302)
SCOWT pairs	17	4.0	-0.746 (0.201)	2.154 (0.400)
Dietary diversity score				
NM pairs	7	2.0	-0.013 (0.183)	0.362 (0.363)
SC pairs	6	2.0	0.545 (0.236)	0.663 (0.467)
OWT pairs	7	1.0	2.222 (0.152)	14.104 (0.302)
SCOWT pairs	6	2.0	0.107 (0.201)	-0.152 (0.400)
The HFIAS score				
NM pairs	1	6.0	1.361 (0.183)	0.815 (0.363)
SC pairs	4	9.0	0.939 (0.236)	-0.002 (0.467)
OWT pairs	2	7.0	1.311 (0.152)	0.961 (0.302)
SCOWT pairs	5	9.0	0.818 (0.201)	-0.129 (0.400)

IQR=Inter Quartile Range; SE=Standard Error; HFIAS=Household Food Insecurity Access Scale.

These results negate previous arguments that suggested households with double burden malnutrition (SCOWT) was not a distinct entity and merely a statistical artefact (Dieffenbach and Stein, 2012). Whether SCOWT households were biologically distinct, aligning with the Developmental Origins of Health and Disease (DOHaD) (Sata, 2016), for example, is yet to be confirmed.

Previous evidence showed that SCOWT prevalence was highly dependent on the prevalence of maternal overweight (Dieffenbach & Stein, 2012). Although the prevalence of OWT households was higher than other household categories, our study found that the prevalence of SCOWT was not dependent or having a multi-collinearity with the prevalence of OWT pairs. Maternal nutrition literacy among SCOWT households was significantly lower, while the PCA-derived measure of "food quality," representing a household's lack in "preferred" foods, was significantly different from OWT households. The SCOWT households were reported to have a significantly higher lack of "food quality" but not "food quantity" in comparison to the OWT households. A study in Guatemala had also shown that double burden malnutrition was most prevalent among households with per capita consumption in the middle quintile (Lee *et al.*, 2012).

The observed maternal nutrition literacy that was lower among SCOWT households indicated that mothers who are responsible for the household's grocery shopping, were not equipped to make healthy food choices. In order to assess nutrition literacy, only three domains of nutrition literacy were used in this study due to the socio-cultural differences with the original five domains (Gibbs *et al.*, 2016). There was no significant difference between the lack of "food quantity" between households with SCOWT and OWT pairs, but a significant difference in the lack of "food quantity" was found between SCOWT and SC households. The SCOWT households believed they were "food secure" although they had limitations in terms of access to preferred foods. These findings indicate the importance of nutritional and behavioural strategies

Table 3. Nutrition literacy, dietary diversity, food security, and nutritional status of mother-child pairs

Mother-child pairs	*Nutrition literacy*			*Dietary diversity*			*FS1*[†]			*FS2*[‡]		
	Mean rank	*p*	*Eta-squared*	*Mean rank*	*p*	*Eta-squared*	*Mean rank*	*p*	*Eta-squared*	*Mean rank*	*p*	*Eta-squared*
Kruskal-Wallis test		<0.001**	0.046		0.000**	0.030		<0.001**	0.045		0.019*	0.015
NM Pairs	391.89			388.34			313.19			332.89		
SC Pairs	290.49			298.05			343.71			381.91		
OWT Pairs	361.32			349.05			318.85			352.18		
SCOWT Pairs	288.75			307.87			419.27			308.40		
Post hoc analysis												
SCOWT-NM		<0.001***	0.065		0.000***	0.042		<0.001***	0.073		0.182	0.006
SCOWT	135.33			141.05			188.14			153.51		
NM	182.94			178.25			138.64			167.17		
SCOWT-SC		0.849	0.000		0.691	<0.001		0.002***	0.038		0.007***	0.029
SCOWT	124.76			127.00			137.30			115.14		
SC	126.52			123.42			109.20			139.80		
SCOWT-OWT		<0.001***	0.031		0.032	0.011		<0.001***	0.062		0.033	0.011
SCOWT	174.66			185.82			239.82			185.75		
OWT	217.37			211.09			180.74			211.13		
NM-SC		<0.001***	0.062		0.000***	0.049		0.200	0.006		0.028	0.017
NM	157.05			155.07			136.34			132.99		
SC	115.30			118.62			148.81			154.42		
NM-OWT		0.099	0.006		0.049	0.010		0.746	0.000		0.270	0.003
NM	229.91			233.02			215.22			209.73		
OWT	209.83			207.69			219.06			222.80		
SC-OWT		0.001***	0.028		0.017	0.016		0.248	0.004		0.164	0.005
SC	154.67			162.00			191.70			193.69		
OWT	193.12			190.14			178.05			177.24		

[†]FS1=Food quality as a measure of food security derived from principle component analysis.
[‡]FS2=Food intake as a measure of food security derived from principle component analysis.
685 among 700 households with non-missing variables were used for the Kruskal-Wallis test and sub-sequent post hoc analysis.
Values were significantly different for Kruskal-Wallis test: *p<0.05, **p<0.001.
Values were significantly different for post hoc analysis with Bonferroni Correction: ***

to enable mothers on a limited budget to make healthy food choices.

Post hoc analysis revealed that the difference in dietary diversity was significant between households with SCOWT pairs compared to NM pairs, but there was no significant difference in dietary diversity between SCOWT and OWT or SC pairs. These results are similar to the findings of a previous study in Indonesia (Sekiyama *et al.*, 2015).

The percentage of households earning more than IDR 2,500,000 ($165 USD) was higher among OWT pairs (10.2%) than SCOWT pairs (4.3%) and SC pairs (2.1%). In terms of monthly income, the discrepancy between SCOWT households and OWT households was wider than between SCOWT and SC households. These results are in line with the suggested aetiology of the double burden of malnutrition (Jehn & Brewis, 2009). Increases in household income is likely to lead to increased intake of energy-dense food, and not by nutrient-dense foods (Dieffenbach & Stein, 2012; Jehn & Brewis, 2009). Providing adequate nutrients to assist a child's rapid growth during the first 1,000 days of life should be emphasised (Victora & Rivera, 2014).

Our findings highlight the importance of food system in term of food security and dietary diversity related to double burden of malnutrition. Previous research showed that SCOWT households did not meet dietary diversity as well as daily energy needs due to insufficient food availability and high costs of food (Shamah-Levy *et al.*, 2017). Stunting in children is a result of long term nutritional insufficiency, owing to a lack of consumption of highly nutritious food required for the normal growth. Besides, children in food insecure households are likely to be exposed to less sanitary environment that might increase their infection risks (Caulfield *et al.*, 2006).

Even though Corace & Garber (2014) and Hall *et al.* (2016) reported disparities between nutrition knowledge and behaviour outcomes, nutrition literacy should be accompanied by enhancing self-efficacy, positive outcome expectations and building support systems (Bandura, 2004). A previous study in Indonesia revealed that interventions to enhance mother's self-efficacy could improve mother's positive behaviour towards feeding practices (Salarkia, 2016).

There are limitations encountered in this study. As a cross-sectional study, causal inference for the difference in features of households with double burden malnutrition in terms of maternal nutrition literacy, dietary diversity, and food security could not be made. Low levels of internal consistency were observed for all of the three domains of nutrition literacy and dietary diversity indicated by Cronbach's $\alpha<0.65$. Even though the questionnaires used in the study were previously validated in other peer-reviewed publications, adaptation to the local context in Indonesia might affect their validity. The use of *posyandu* as the basis for recruitment might limit the representation of children who were not registered in *posyandu*.

CONCLUSION

Compared to households without double burden of malnutrition, the SCOWT households had significantly lower maternal nutrition literacy and food security. The study results emphasised the importance of developing behavioural strategies to enable households subsisting on limited resources to make healthy food choices.

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Authors' contributions

TM was responsible for overall and/or sectional scientific management, formulating research question, making concept and design of the study, preparation of draft manuscript, doing revisions. He also 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. RR was responsible for substantial contributions in design and conception of the study, and was involved in manuscript preparation, providing critique, revision of the manuscript, and supervises the study. TSN carried out training for the enumerator and surveyor, input data and analysis of nutrition literacy data. DRA responsible for analysis data on food security, writing the method section and interpretation of the food security data. QR was responsible for revision of the manuscript and help data analysis for dietary diversity data. HM lead the data collection, coordinate the community health workers, setting up ground work for data collection. All authors have given approval of the final manuscript.

Conflict of interest and funding disclosure

We have no conflicts of interest to report for this study entitled *"Comparison of Maternal Nutrition Literacy, Dietary Diversity, and Food Security among Households with and without Double Burden of Malnutrition in Surabaya, Indonesia"*.

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