The Role of Built Environment on Under-Five Malnutrition in Indonesia

Kencana Sari
The Center of Public Health Research and Development
The National Institute of Health Research and Development, Indonesian Ministry of Health
Jakarta, Indonesia
kencana.sw@gmail.com

Nurillah Amaliah., Bunga Ch. Rosha., Anies Irawati
The Center of Public Health Intervention Technology
The National Institute of Health Research and Development, Indonesian Ministry of Health
Jakarta, Indonesia

Abstract— Thirty five percent of under-five deaths are associated with undernutrition. In fact, there were more than one hundred million underweight children, 171 million stunting children, 13 million low birth weight children. In many developing and poor countries, malnutrition is still a burden. The built environment is factors that affect the nutritional status. Yet, the data and information on the relationship between the built environment and the undernutrition is still limited. The analysis aims to obtain the relationship between the built environments with nutritional problems on under-five children.

Method

This is a secondary data analysis. Data on the prevalence of malnutrition on under-five children is obtained from a national survey Basic Health Research (Riskesdas) 2013 that covers 82,666 children throughout 34 provinces in Indonesia. Data of the built environmental was derived from a national survey Village Potential Statistics 2011, which covers all villages in Indonesia, 70,390 villages. Ecological analysis and regression were conducted to examine the relationship between prevalence of malnutrition and various built environment variables. The unit of analysis is province.

Results

The prevalence of underweight (z-score <-2) was 19.6 per cent in 2013 and stunting (z-score <-2) was 37.2 per cent on under-five children in 2013. The correlation analysis suggested that variable of a waste temporary shelter (WTS) in village (r= 0.70), four-wheel car passable roads in villages (r = 0.59), a restaurant/food vendor in village (r = -0.52), and a minimarket in village (r = -0.59) had the most strongly and significantly correlated with the prevalence of underweight (z-score <-2SD). While variable of four-wheel car passable roads in villages (r = -0.60), a waste temporary shelter in village (r = -0.74), a minimarket in village (r = -0.56) were the most strongly and significantly correlated with the prevalence of stunting (z -score <-3SD). To eliminate underweight and stunting in the longer term, interventions need to address those variables and other underlying causes of undernutrition, such as poverty, infrastructure, and unhealthy environment.

Index Terms: **built environment, malnutrition, underweight, stunting, community nutrition**

I. Introduction

Thirty five percent of under-five deaths are associated with undernutrition [1]. In fact, there were more than one hundred million underweight children, 171 million stunting children, 13 million low birth weight children [2]. In many developing and poor countries, malnutrition is still a burden. In Indonesia, the malnutrition problems occur in all age groups. In children, undernutrition is a major problem.

The prevalence of underweight (z-score <-2) and stunting (z-score <-2)was around 17.9 percent and 35.6 percent, respectively [3]. Undernutrition contributes to early life maternal and child mortality, and delays on physical or cognitive growth and development. Increased numbers and prevalence rates of undernutrition influence nutritional status of a human being [4].

Undernutrition was well understood, but many policy makers and health providers still assume it is the only malnutrition issue in Indonesia [5]. The prevalence of child undernutrition is declining but child stunting is not [3], [6], which is part of the risk for noncommunicable diseases [7]. In Indonesia, a health policy related to environment explains that the central government, local government, and society ensures the availability of a healthy environment and does not pose a risk bad for health. The scope of environment may include neighborhood, workplaces, recreation areas, as well as places and public facilities. However, the definition of a healthy environment (in those policy) is still limited in an environment free from elements that caused the health problems that include liquid waste, solid waste, waste gas, other form of waste, the animals carrying diseases, hazardous chemicals, noise exceeding the threshold, ionizing and non-ionizing radiation, contaminated water and contaminated food [8]. All the approaches listed are an approach of how the community not to be sick, not an approach of how the community be healthy. In other words, the approaches taken were more about treatment not prevention.

The unhealthy environment, lack of ready access to water and poor environmental sanitation, are important underlying causes of malnutrition [4]. The role of environment on health are not limited to water and sanitation, but cover all dimension biologically, economically, physically, socially healthy [9].

Food at home is affected by food availability in the community environment level in term of the number, type, location and access of the food outlets [10]. This are related to the role of other sectors (public works, agriculture, education, social welfare, industry/trade, public information, finance) [9] on the implementation of the specific program and the role of

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the health sector in sensitive program as mentioned in the Scaling up Nutrition program [11].

Sustainable food security, food safety, healthy lifestyle and nutrition policy need to be established to tackle malnutrition problem.[10],[13]. A multi-sectorals approaches were claimed can help reduce undernutrition by accelerating action on determinants of undernutrition, including specific programs in other sectors, and increasing policy coherence through government-wide attention to unintended negative consequence on nutrition policies in other sectors [11].

Built environment related to undernutrition has not been thoroughly considered as one factor correlate to malnutrition control and prevention that. The health sector had not been notice. This is supported by the fact that the data and information on the relationship between the built environment and the undernutrition is still limited. This analysis aims to obtain the relationship between the built environments with undernutrition on under-five children.

II. Methodology

This is a secondary data analysis. Data on the prevalence of malnutrition on under-five children is obtained from a national survey Basic Health Research (Riskesdas) 2013 that covers 82,666 children throughout 33 provinces in Indonesia. While data of the built environmental was derived from a national survey Village Potential Census (Podes) 2011, which covers all villages in Indonesia, 70,390 villages in 33 provinces.

The built environment in is a form of physical and economic environment that might affect people's health, a factor that affects nutritional status including through food availability and access [13], food security and agriculture, influences consumption or eating pattern [10]. All variables in this analysis refer to the pillars of double burden malnutrition nutrition policy framework (food security, food safety, healthy lifestyle, and nutrition) [9], concentrating on the undernutrition problem. Variables related to food security are road, irrigation, restaurants, market, and minimarket. Variables related to food safety are clean water, the availability of waste temporary shelter. Variables related to nutrition are public hospitals that have lactation clinic.

Riskesdas 2013 is a cross sectional survey design conducted by The Institute of Health Research and Development, Ministry of Health every five years since 2007/2008. Sample selection is done by probability proportional to size (PPS) and stratified systematic random sampling at the household level. Riskesdas data collection was conducted by interview by trained personnel using a structured questionnaire.

The weight of children under five weighed on digital scales that had a precision of 0.1 kg, length or height was measured using a measuring tool length / height with a precision of 0.1 cm. To assess the nutritional status of children under five, the number of weight and height of each child under five is converted into a standardized value (z-score) using WHO standard anthropometry toddlers 2005. Children under five are categorized as underweight if the value z-score weight / age <-2SD and stunting if the value of z-score of height / age <-3SD. Riskesdas has obtained ethical approval from the Health Research Ethics Committee (KNEPK) [14].

Village potential Census (Podes) 2011.is conducted regularly every three years by Statistics Indonesia. The time reference for each data refers to the period of enumeration that is April 2011. Podes 2011 implemented as a census of the entire regency/city, districts, and the lowest governmental administrative region equivalent to village all over Indonesia. Data collection of Podes 2011 carried out through direct interviews by trained personnel with relevant respondents in the enumeration area. The instruments of Podes 2011 consists of 3 (three) types of questionnaires according to the levels of enumeration areas, namely: regency/city, district, and village levels [15].

Statistical analysis

Initial assessment of the ecological associations between prevalence of malnutrition and various built environment was obtained using simple Pearson's correlation coefficients. All the prevalence of malnutrition and various built environment variables are normally distributed. Simple linear regression analyses were then performed with underweight and stunting as dependent variables and various built environment indicators as independent variables. The analysis was performed using SPSS package. The unit of analysis is province.

III. Results

Information summarizing all of the participating provinces, including the undernutrition prevalence, the food security related variables, the food safety related variables, and nutrition related variable, had already been published [16], [17]. The prevalence of underweight (z-score <-2) was 19.6 per cent in 2013 and stunting (z-score <-2) was 37.2 per cent on under-five children in 2013. Table 1 shows the prevalence of malnutrition by age group that nutritional problems occur in all age groups.

Table 1. Malnutrition Prevalence By Age Group In Indonesia, 2013

Malnutrition	Age groups						
	New born	< 5 yo	5-12 yo	13-15 yo	16-18 yo	19-59 yo	60+
Stunting	20.2	37.2	30.7	35.1	31.4		
underweight	10.2	12.1	11.2	11.1	9.4	9.3	10.9

Source: Basic Health Research (Riskesdas) 2013

Table 2. Correlation Coefficients Between Built Environment And Undernutrition In Indonesia, 2013				
	Underweight		Stunting	
	Pearson correlation coefficient, *r*	*p*	Pearson correlation coefficient, *r*	*p*
Food Security				
• Village with irrigation (%)	-0.24	0.178	-0.12	0.496
• Village roads which passable by four-wheeled car (%)	-0.59	<0.001	-0.60	<0.001
• Market availability in village (%)	-0.49	0.004	-0.50	0.003
• Villages with minimarket (%)	-0.59	0.000	-0.56	0.001
• Villages with a restaurant / food vendor (%)	-0.52	0.002	-0.47	0.006
Food Safety				
• Households with a source of drinking water a distance of 100 meters or more (%)	0.40	0.020	0.14	0.420
• Villages that have WTS (%)	-0.70	0.000	-0.74	0.000
Nutrition				
• Percentage of public hospitals have lactation clinic	-0.44	0.010	-0.29	0.095

Newborns are 20.2 percent who have a short body length of birth (<48cm) and 10.2 percent of low birth weight. Therefore, it is not surprising that children under five are stunted 37.2 percent of children under five. The prevalence of stunting as settled with increasing age group, as well as underweight, its prevalence is not much different between age groups.

Table 2 presents the Pearson correlation values between built environment and undernutrition. The correlation analysis suggested that variable of a waste temporary shelter in village (r= 0.70), four-wheel car passable roads in villages (r = 0.59), a restaurant/food vendor in village (r = -0.52), and a minimarket in village (r = -0.59) had the most strongly and significantly correlated with the prevalence of underweight (z-score <-2SD).

The variable of market in village (r = -0.49), public hospitals with lactation clinic (r = -0.44), households with drinking water source distance ≥ 100 m (r = 0.40) had a significant relationship with underweight. While variable of four-wheel car passable roads in villages (r = -0.60), a waste temporary shelter in village (r = -0.74), a minimarket in village (r = -0.56) were the most strongly and significantly correlated with the prevalence of stunting (z -score <-3SD). Variable of a restaurant/food vendor in village (r = -0.47), and market in village (r = -0.50) had a significant relationship with stunting. The fitted linear relationships between underweight and stunting and the percentage of village that have waste temporary shelter are depicted in Fig. 1-2.

The simple linear regression identified the same group as statistically significantly associated with the prevalence of undernutrition (Table 3). The analysis was calculated to predict undernutrition based on percentage of some variables, one of them is the percentage of villages that have waste temporary shelter in a province. A significant regression equation was found ($p<0.001$), with an R^2 of 0.484 and 0.545 for underweight and stunting, respectively. The predicted prevalence of underweight in a province is equal to 27.7+(-0.515) (village that have waste temporary shelter) percent when village that have waste temporary shelter is measured in percent. The percentage of undernutrition decreased 0.515 for each percent increase of village that have waste temporary shelter. Also, we can say that 48% of the variation on underweight prevalence is explained by the percentage of villages that have waste temporary shelter.

Table 3. Relationship between built environment and undernutrition in Indonesia, 2013

		Underweight					Stunting			
	R^2	Constant	B	SE B	β	R2	Constant	B	SE B	β
Food Security										
• Village with irrigation (%)	0.058	23.4	-0.052	0.038	-0.24	0.015	19.2	-0.023	0.033	-0.12
• Village roads which passable by four-wheeled car (%)	0.353	30.4	-0.140	0.034	-0.59*	0.365	26.1	-0.123	0.029	-0.60*
• Market availability in village (%)	0.236	25.9	-0.130	0.042	-0.48**	0.250	22.2	-0.115	0.036	-0.50**
• Villages with minimarket (%)	0.346	24.0	-0.172	0.043	-0.59*	0.308	20.3	-0.140	0.038	-0.55*
• Villages with a restaurant / diner (%)	0.272	23.9	-0.172	0.051	-0.52**	0.021	20.1	-0.133	0.045	-0.47
Food Safety										
• Households with a source of drinking water a distance of 100 meters or more (%)	0.162	18.2	0.403	0.165	0.40**	0.021	17.3	0.126	0.154	0.14
• Villages that have WTS (%)	0.484	27.7	-0.515	0.097	-0.70*	0.545	23.9	-0.473	0.079	0.74*
Nutrition										
• Percentage of public hospitals have lactation clinic	0.195	25.6	-0.121	0.044	-0.44*	0.087	20.6	-0.070	0.041	-0.29

*p <0.001 ** p<0.005

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IV. Discussion

The variables in food security variable groups (irrigation, road, market, minimarket, restaurant) basically are to reflect access to food in the area [9], [18] because food security is one of the main underlying causes of malnutrition[4]. A study revealed in populations with sufficient food, education about complementary feeding Increased height-for-age z-score by 0.25 (95% CI 0.01-0.49), whereas provision of food supplements (with or without education) in populations with insufficient food increased the height-for-age z-score by 0.41 (0.05-0.76) [19].

Results showed that the availability of roads which passable by four-wheeled car, market, and minimarket in village correlated negatively and significantly to both underweight and stunting. The availability of roads through the village is one of factors affecting the sustainable food security [9]. The road infrastructure is essential for almost all factors of life. The availability of proper road would improve access to food, clothing, housing, and health care is no exception. Often there are variations in food prices across the region with other regions. Presence or absence of road infrastructure is one of the causes of price variations between regions. A decent road will increase the chances of access to food at a price that is more stable, so the needs of a variety of foods in the household will be fulfilled.

The Indonesian government was already aware that the provisions of adequate infrastructure to all corners of the country (roads, bridges, airports, electricity, water, etc.) become one of the major challenges. Therefore the government will speed up the construction, transportation facilities and infrastructure that is integrated between sea, land and air to facilitate the flow of goods, services, people and capital as one of the main targets of the National Medium Term Development Plan 2015-2019 [20].

There is a significant negative relationship between the proportion of villages have a market, minimarket and the prevalence of undernutrition. The increasing numbers of villages that have a market or minimarkets were correlated to lower prevalence of underweight and stunting. A study have recorded that increases numbers and prevalence rates of undernutrition associated with food purchasing power, food availability, and the sustainability of both [13].

Increase market access and opportunities is one of best practice principles in agriculture and nutrition interventions programs [21]. Increase market access can increase the opportunity for the community to more vary supply food as addition to indigenous food. Food at home is affected by food availability provide by other outlets. The more stores the more chances food available at home because the location and price are more accessible. With additional number of store the market monopoly can be avoided as a study suggested that the food cost in supermarkets was not found to be higher in the low-income neighborhood, though it was much higher in the variety stores that predominate in the low-income neighborhood [22]. The government will develop the capacity to trade with one of them minimizing the variation in prices of essential goods through the development and / or revitalization/ rehabilitation market 5000 folk/ traditional markets during 2015-2019 [20].

The correlation analysis (Pearson) indicates that there is a negative relationship between the percentage of villages that have waste temporary shelter (WTS) and the incidence of children underweight ($r = -0.70$; $p < 0.001$) and stunting ($r = -0.74$; $p < 0.001$). Waste should be managed correctly because waste is closely related to communicable diseases. An absent of waste management can harm peoples health. A latest

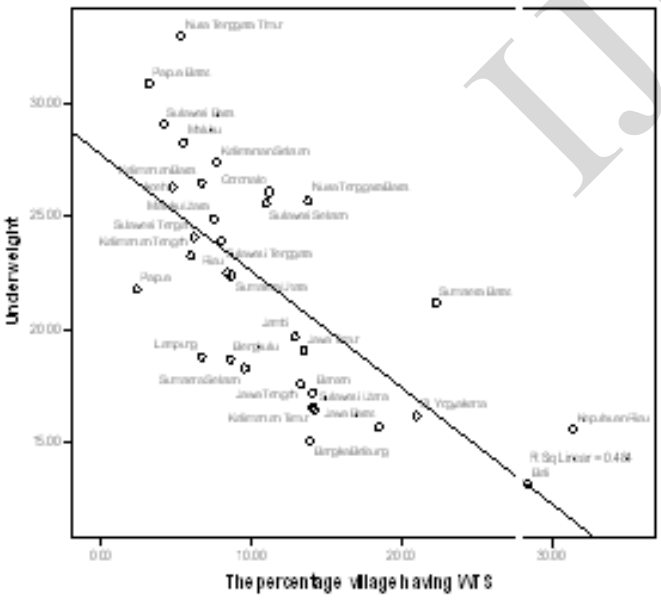


Figure 1. Ecological association between underweight and the percentage of village having waste temporary shelter

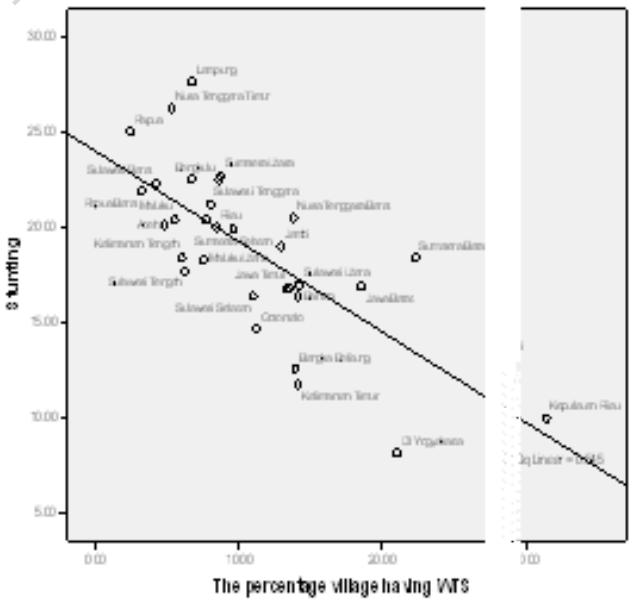


Figure 2: Ecological association between stunting and the percentage of village having waste temporary shelter

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studies revealed that there were the preponderance of toxic chemicals such as Pb, Cd, As and Hg in dump sites that have the risk of entering food chain and groundwater supplies, and these can give rise to endemic malnutrition and may also increase susceptibility to mutagenic substances, thereby increasing the incidence of cancer in developing countries[23].

Meanwhile the variable of restaurant available in village, households with a source of drinking water a distance of 100 meters or more, and public hospitals have lactation clinic were only associated with underweight incidence. These might be because those entire variables would reflect a short term direct effect to underweight rather than to stunting.

V. Conclusion

The correlation analysis suggested that variable of a waste temporary shelter (WTS) in village, four-wheel car passable roads in villages, a restaurant/food vendor in village, and a minimarket in village had the most strongly and significantly correlated with the prevalence of underweight. While variable of four-wheel car passable roads in villages, a waste temporary shelter in village, and a minimarket in village were the most strongly and significantly correlated with the prevalence of stunting. To eliminate underweight and stunting in the longer term, interventions need to address those variables and other underlying causes of undernutrition, such as poverty, infrastructure, and unhealthy environment.

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