ENVIRONMENTAL FACTORS AND THEIR IMPACT ON THE RISK OF INFECTIOUS DISEASES IN UNDER-FIVES TO COUNTING INCIDENTS IN SOLOCK DISTRICT: A GSEM ANALYSIS

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ABSTRACT

Purpose: This study aims to identify environmental factors that contribute to the risk of viral infections in toddlers, specifically concerning the occurrence of stunting in Solok Regency.

Method: The present investigation employs a quantitative research approach, utilising a cross-sectional study design.

Results and conclusion: The stunting rate in Solok Regency is 82%, with a significant proportion of cases being caused by infectious disorders, particularly diarrheal diseases, accounting for 57.5%. The current state of environmental factors is characterised by a deficiency in the provision of sanitary latrines at a rate of 31%, effective wastewater treatment at 23.5%, and proficient waste management at 35.5%.

Research implications: The present study examines the association between viral illnesses in toddlers and the risk of stunting across different environmental factors.

Originality/value: The GSEM analysis revealed that infectious diseases directly contributed to the occurrence of stunting, while parenting, diet, and environment were identified as indirect factors influencing stunting incidence.

Keywords: GSEM Analysis, Toddler Infection, Stunting, Environmental Factors.

RESUMO

Objetivo: Este estudo visa identificar fatores ambientais que contribuem para o risco de infeções virais em crianças pequenas, especificamente no que diz respeito à ocorrência de nanismo na Regência Solok.

Método: A presente investigação utiliza uma abordagem de pesquisa quantitativa, utilizando um projeto de estudo transversal.

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Resultados e conclusión: A taxa de raquitismo na Regência Solok é de 82%, com uma proporção significativa de casos sendo causados por distúrbios infecciosos, particularmente doenças diarreicas, respondendo por 57,5%. O estado atual dos fatores ambientais caracteriza-se por uma deficiência no fornecimento de latrinas sanitárias a uma taxa de 31%, tratamento eficaz de águas residuais a 23,5% e gestão proficiente de resíduos a 35,5%.

Implicações da pesquisa: O presente estudo examina a associação entre doenças virais em crianças e o risco de nanismo em diferentes fatores ambientais.

Originalidade/valor: A análise GSEM revelou que as doenças infecciosas contribuíram diretamente para a ocorrência de nanismo, enquanto a criação de filhos, dieta e ambiente foram identificados como fatores indiretos que influenciam a incidência de nanismo.


FACTORES AMBIENTALES Y SU IMPACTO EN EL RIESGO DE ENFERMEDADES INFECCIOSAS EN MENORES DE CINCO AÑOS PARA CONTAR INCIDENTES EN EL DISTRITO DE SOLOCK: UN ANÁLISIS DE GSEM

RESUMEN

Propósito: Este estudio tiene como objetivo identificar los factores ambientales que contribuyen al riesgo de infecciones virales en niños pequeños, específicamente con respecto a la ocurrencia de retraso del crecimiento en Solok Regency.

Método: La presente investigación emplea un enfoque de investigación cuantitativa, utilizando un diseño de estudio transversal.

Resultados y conclusión: La tasa de retraso del crecimiento en la regencia de Solok es del 82%, con una proporción significativa de casos causados por trastornos infecciosos, particularmente enfermedades diarreicas, que representan el 57,5%. El estado actual de los factores ambientales se caracteriza por una deficiencia en el suministro de letrinas sanitarias a una tasa del 31%, un tratamiento eficaz de las aguas residuales al 23,5% y una gestión eficiente de los desechos al 35,5%.

Implicaciones de la investigación: El presente estudio examina la asociación entre las enfermedades virales en los niños pequeños y el riesgo de retraso del crecimiento en diferentes factores ambientales.

Originalidad/valor: El análisis del GSEM reveló que las enfermedades infecciosas contribuyeron directamente a la aparición del retraso del crecimiento, mientras que la crianza de los hijos, la dieta y el medio ambiente se identificaron como factores indirectos que influyen en la incidencia del retraso del crecimiento.

Palabras clave: Análisis GSEM, Infección Infantil, Retraso Del Crecimiento, Factores Ambientales.

1 INTRODUCTION

Toddlers are susceptible to nutritional deficiencies and diseases, leading to the development of stunted growth in children (Gerungan, Malonda, and Rombot, 2013; Chairunnisa, 2017). Stunting is a persistent nutritional issue observed in young children, characterized by a reduced height in comparison to their peers. their age (World Health
Organization, 2013; Ministry of Health RI, 2018; WHO, 2018). Stunted toddlers are associated with slower motor development and lower intelligence levels, besides that they also have lower ratings on locomotor, hand and eye coordination, hearing, speaking, and performance when compared to normal children. Low cognitive levels and impaired growth in stunted toddlers are factors that can cause loss of productivity as adults. Stunted adults have a low level of work productivity and lower wages when compared to other people adults who are not stunted (Zilda and Sudiarti, 2013).

Toddlers with stunting are more susceptible to disease and as adults are at risk for degenerative diseases such as obesity, glucose tolerance, coronary heart disease, hypertension, osteoporosis, decreased performance and productivity (Kuhlmann, 2000; World Health Organization, 2013; WHO, 2018; Kusumawati, Rahardjo and Sari, 2015). Postnatal growth retardation has a potential relationship to current body weight and blood pressure. Blood pressure in adults has a negative relationship with birth weight and blood pressure in childhood has a relationship with the size of the baby at birth (Zilda and Sudiarti, 2013).

The incidence of stunting in toddlers is a global problem. In 2017 22.2% or around 150.8 million toddlers in the world were stunted. more than half of the stunted toddlers in the world come from Asia (55%). Out of the total of 83.6 million children under the age of five that are stunted across Asia, South Asia had the highest percentage at 58.7%, while Central Asia had the lowest percentage at 0.9%. (World Health Organization, 2013; Indonesian Ministry of Health, 2018).

Stunting, which refers to impaired growth and development in children due to chronic undernutrition, is a significant public health issue in Brazil. Several studies have examined the factors associated with stunting and its long-term consequences. One study conducted by Hallal et al. (2013) investigated the nutritional status of indigenous children in Brazil. The study found that stunting and underweight were closely related to unfavorable socioeconomic and environmental conditions, poor nutrient intake, and recurrent infectious diseases. The authors attributed the high rates of undernutrition among indigenous peoples to factors such as increased participation in the market economy, reduced access to natural resources, sedentarization, and poor sanitary conditions.

Another study by Sawaya & Roberts (2003) explored the relationship between stunting and future risk of obesity. The study highlighted the increasing prevalence of obesity in Brazil, particularly among the poor population. The authors emphasized the importance of understanding the long-lasting effects of early undernutrition, as stunting can lead to lower

energy expenditure, higher susceptibility to high-fat diets, and impaired regulation of food intake, all of which contribute to the development of obesity.

Grillo et al. (2016) conducted a study to investigate the association between stunting in early childhood and metabolic syndrome components in adulthood. The study found that stunting in the second year of life was inversely associated with triglycerides and waist circumference in men. These findings suggest that stunting may have long-term effects on metabolic health.

Furthermore, a study by Gubert et al. (2016) examined the relationship between household food insecurity (HFI) and stunting in Brazilian children. The study found that HFI was associated with stunting and the occurrence of common childhood illnesses. This highlights the importance of addressing food insecurity as a means to prevent stunting and improve child health outcomes. In conclusion, stunting is a complex issue influenced by socioeconomic, environmental, and nutritional factors. It is associated with an increased risk of obesity and metabolic health problems in later life. Addressing the underlying causes of stunting, such as poverty, inadequate nutrient intake, and poor sanitation, is crucial for improving child health and well-being in Brazil.

According to data gathered by the World Health Organisation (WHO), Indonesia ranks third in terms of the highest frequency of stunting among children under the age of five in the Southeast Asia/South-East Asia Regional (SEAR) area. In Indonesia, the average prevalence of stunting among children under the age of five between 2005 and 2017 was 36.4%. (World Health Organization, 2013; Indonesian Ministry of Health, 2018). In 2017, Indonesia exhibited a prevalence rate of 9.8% for extremely short toddlers and 19.8% for short toddlers aged 0-59 months. The incidence of extremely short toddlers has risen by 8.5% compared to the previous year, while the prevalence of short toddlers has climbed by 19% (Ministry of Health RI, 2018).

Many factors influence the incidence of stunting, including parents' education, parent's occupation, family income, parenting style, history of exclusive breastfeeding, and infectious diseases, such as diarrhea and acute respiratory infections (ARI). Stunting is more common in children who are not exclusively breastfed than in children who are exclusively breastfed. Growth disturbances will result in stunting in children, as well as children who have an infection are prone to nutritional deficiencies, which if left unchecked can be at risk of stunting (Chairunnisa, 2017). Several factors are thought to be related to the incidence of stunting in toddlers, including the toddler's birth weight, history of infection, history of pregnancy disease, parents’ height, and socioeconomic factors (Nasikhah and Margawati, 2012). According to
WHO, the factors that influence the incidence of stunting are parenting style, coverage and quality of health services, environment and food security, household and family factors, inadequate complementary food, breastfeeding, and infection (World Health Organization, 2013).

According to UNICEF/Lancet, the issue of stunting mostly stems from various factors, including parenting styles, the extent and quality of healthcare facilities, environmental conditions, and food security. An unsanitary environment can heighten the susceptibility of infants to infectious infections. The absorption of nutrients in the digestive tract might be impeded by infectious diseases resulting from inadequate hygiene and sanitation practices. Certain viral disorders can lead to weight loss in infants. Prolonged duration of this condition, in the absence of sufficient intake to facilitate the healing process, may lead to the development of stunted growth (Ministry of Health RI, 2018). The growth of children is hindered when they are raised in an environment characterised by inadequate sanitation, resulting in an increased susceptibility to contracting diseases and a higher probability of disease recurrence (Yunizahraini, 2016).

In 2017, 72.04% of households in Indonesia had access to an adequate source of drinking water. Sources of proper drinking water in question are protected drinking water including tap water (taps), public taps, public hydrants, water terminals, rainwater reservoirs (PAH) or protected springs and wells, drilled wells or pumps, which are at least 10 meters apart from sewage disposal, waste storage, and waste disposal. (RI Ministry of Health, 2018)

The percentage of households that had access to proper sanitation in Indonesia in 2017 is 67.89%. Households that have sanitation facilities that meet health requirements, among others, are equipped with a type of gooseneck toilet or a bowl with a lid and have a septic tank or Waste Water Disposal System (SPAL), and have a defecation facility. used alone or together. (RI Ministry of Health, 2018)

West Sumatra is a province that has access to proper drinking water sources and access to proper sanitation below the Indonesian average, namely 68.83% and 52.77% which is the sixth lowest (Kemenkes RI, 2018). The prevalence of stunting under five in West Sumatra is around 33% with one of the high districts being Solok Regency (Dinkes, 2017). Therefore it is necessary to do a General Structural Equation Modeling (GSEM) analysis of environmental factors as a risk in increasing infectious diseases in toddlers to the incidence of stunting in Solok Regency.
2 RESEARCH METHOD

The present investigation employs a quantitative research approach, utilising a cross-sectional study design. The purpose of this study was to investigate the potential impact of environmental factors on the prevalence of infectious diseases among toddlers and the occurrence of stunting in Solok Regency. The research population consisted of all moms who had toddlers with stunted growth in Solok Regency. The participants in this study consisted of mothers who were chosen as respondents for the research. The study employs a probability random selection procedure, ensuring that every district in Solok Regency has an equal chance of being selected as a sample. The participants in this study were chosen by the Simple Random Sampling (SRS) technique, with a sample size of 200 respondents, based on the specific requirements of each area.

The required sample size is 200 using the following formula:

\[ n = \frac{Z_{1-\alpha/2} \sqrt{2P(1-P)} + Z_{1-\beta} \sqrt{P_1 (1-P_1) + P_2 (1-P_2)}}{(P_1 - P_2)^2} \]

Information:

- \( N \) = Minimum Number of Samples
- \( Z_{1-\alpha/2} \) = The level of confidence is 95%
- \( Z_{1-\beta} \) = Strength test that is 80%
- \( P_1 \) = Proportion of stunting with high infectious disease (0.15)
- \( P_2 \) = Low proportion of stunting with infectious diseases (0.05)

Univariate analysis was carried out by looking at the description of the incidence of stunting in toddlers, the characteristics of the mother, and environmental factors with tables, graphs, and curves. The bivariate analysis uses the chi-square test where the results of the p-value are compared with the alpha of 5%. Multivariate analysis was carried out using the general structural equalization model (GSEM) through 4 stages, namely model specification, model identification, coefficient estimation, and respecification.

3 RESULTS

Generalized Structural Equation Modeling (GSEM) Analysis
In this study, there were four latent variables consisting of three exogenous latent variables, namely parenting, diet, and environment, and one endogenous latent variable, namely infection. The endogenous variable observed was stunting. 18 observed variables are forming latent variables.

3.1 INITIAL MODEL SPECIFICATIONS

The initial model was created based on the results of factor analysis of the research conceptual framework. The results of the factor analysis will summarize the constructs (factors) for each latent variable. The path diagram for the initial model can be seen in the following figure.

Figure 1

*Early Model of Stunting*

Source: Author 2024

3.2 MODEL IDENTIFICATION

In GSEM, it is necessary to have adequacy between the number of parameters to be estimated and the number of existing data points (over-identified). Model identification is used to find out whether the model is over-identified, just identified, or under identified. The number of parameters must be the same or less than the data point. Parameters are calculated based on the sum of $e$, $\lambda$, $\beta$ and $\gamma$ in the initial model specifications above. The description of the mathematical notation is as follows:
1. \( E \) = measurement error (variance) added to each observed variation;
2. \( \lambda \) = factor loads or factor loadings that link between endogenous and exogenous latent variables and the observed variables;
3. \( \beta \) = regression coefficient between endogenous latent variables and endogenous latent variables;
4. \( \gamma \) = regression coefficient between exogenous latent variables and endogenous latent variables.

The data point is the sum of the variance and covariance of the variable (observed variable or indicator). With 18 variables observed, then:

\[
\text{Data Point} = \frac{k (k + 1)}{2} \\
= \frac{18(18+1)}{2} = 171
\]

\[
\text{Parameter} = e + \lambda + \beta + \gamma \\
= 18 + 18 + 1 + 3 = 40
\]

From the calculation results above, it can be seen that the number of parameters is less than the data points, meaning that the model to be tested is included in the over-identified category. Once it is known that the model to be tested belongs to the over-identified category, the next identification step is Confirmatory Factor Analysis (CFA) to see the coefficient values of the observed variables which form latent variables and path coefficient values, the process is as follows:
Figure 2

*Latent CFA Parenting*

![Diagram showing Latent CFA Parenting](image)

Source: Author 2024

Figure 2 shows that the variable that has the greatest influence on parenting is the variable of the compensation question (path coefficient = 0.86).

Figure 3

*Dietary Latent CFA*

![Diagram showing Dietary Latent CFA](image)

Source: Author 2024

Figure 3 shows that the variable that has the greatest influence in shaping eating patterns is the variable from the socioeconomic question (path coefficient = 0.64).
Environmental Factors and Their Impact on The Risk of Infectious Diseases in Under-Fives to Counting Incidents in Solok District: a Gsem Analysis

3.3 OVERALL MODEL ESTIMATION

The next step is to check the estimation results. Parameter estimation used in this analysis is the path coefficient if done simultaneously. The following is the initial model after testing with data:

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Figure 4

*Latent CFA Environmental Factors*

![Diagram of Latent CFA Environmental Factors]

Source: Author 2024

Figure 4 shows that the variable that has the greatest influence in shaping environmental factors is the variable from the waste question (path coefficient = 0.34).

Figure 5

*CFA Latent Infection*

![Diagram of CFA Latent Infection]

Source: Author 2024

Figure 5 shows that the variable that has the greatest influence in shaping environmental factors is the variable from the diarrhea question (path coefficient = 0.41).
The estimation of this model has reached convergence but needs further analysis. Figure 4.6 shows that the variable that has the greatest influence on the incidence of stunting is diet (path coefficient = 0.96). Then the loading factor on each variable is also quite strong, namely > 0.05. However, the variable mother's age (X14), diarrhea (X41), dysentery (X42), and intestinal worms (X43) have low loading factor values.

3.4 MODEL SPECIFICATIONS

The respecification of the model is carried out without involving the mother's age, the child gets vitamin A capsules and worms, so the respecification model consists of parenting, diet, environment, infection, and stunt events. The results of the model respecification are as follows:
The results of the model respecification show that the variable that has the greatest indirect effect on the incidence of stunting is the diet variable (path coefficient = 0.90) compared to parenting and environment (Figure 4.7).

The variable that has the greatest influence on each latent variable is the variable of the mother giving MP ASI to her child/X13 (path coefficient 0.76). Then followed by mother's education/X22 (path coefficient = 0.72). The largest observed variable coefficient value in the environment is the waste water disposal facility/X32 (koef = 0.30).

Overall, the coefficient value of the observed variable for each latent variable shows that the parenting variable, namely washing hands when feeding children/X15, has the greatest value (coef 0.76). In fact, the biggest path coefficient is the diet obtained from the mother's education.

3.5 STRUCTURAL EQUATION MODEL

The structural model obtained from the results of this study is as follows:
1. Stunting = 0.24*infection
2. Infection = 0.13*parenting style+0.90*diet pattern+0.09*environment
To see the calculation of direct effects, indirect effects and total effects, see the following table:

**Table 1**  
*Calculation of Direct Effect, Indirect Effect and Total Effect*

<table>
<thead>
<tr>
<th>Latent variable</th>
<th>Direct Effect</th>
<th>Indirect Effect</th>
<th>Total Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Parenting -&gt; stunting</td>
<td>0.13</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>2. Dietary habit -&gt; stunting</td>
<td>0.9</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>3. Environment -&gt; stunting</td>
<td>0.09</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>4. Infection -&gt; Stunting</td>
<td>0.24</td>
<td>0.24</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author 2024

From table 1. With regards to the computation of direct and indirect effects among latent variables in the aforementioned stunting model, it is established that the model includes a single direct effect, specifically infection. Furthermore, the proposed model incorporates three indirect factors, namely parenting, diet, and the environment, which can be mediated by infection in order to examine their association with stunting.

4 DISCUSSION

4.1 STUNTING EVENTS

Stunting, often known as dwarfism, refers to a condition in which a toddler's length or height is shorter than their actual age. This condition is quantified by a length or height that exceeds or falls below two standard deviations from the median of the World Health Organization's child growth standard. Stunting refers to a condition in children between the ages of 0 and 59 months, when their height for their age is less than or equal to 2 Standard Deviations (-2SD) from the median standard set by the World Health Organisation (WHO). The statistical study reveals that the prevalence of stunting in Solok Regency is 82%, which is significantly higher than the stunting toddler prevalence data in West Sumatra, which stands at approximately 33%.

Stunting will have an impact and be associated with disrupted brain development processes and affect cognitive abilities. Stunted children who manage to survive result in reduced capacity for better education and loss opportunities for work opportunities with better incomes. Stunted children in adulthood tend to be fat (obese) and have the opportunity to suffer from non-communicable diseases (PTM), such as hypertension, diabetes, cancer, and others.
4.2 INFECTIOUS DISEASES

The prevalence of infectious diseases in the healthcare industry is steadily increasing over time. Infection refers to a pathological condition that has the potential to be spread between individuals or from animals to humans (Putri, 2010). Annually, a staggering 3.5 million individuals succumb to illnesses, primarily including economically disadvantaged youngsters and those residing in low- and middle-income nations (World Health Organisation, 2014). Toddlers are susceptible to and frequently encounter infectious infections. Toddlers are a vulnerable population that is susceptible to both nutritional deficiencies and diseases.

In Indonesia, around 83% of deaths are caused by infectious diseases, birth, and nutritional conditions acquired by children (Fikawati, 2017). Diarrhea is a condition characterized by an increase in the frequency of defecation, more than three times a day, accompanied by a change in the consistency of the stool to liquid with/without blood and with/without mucus. Diarrhea is the second most common cause of death in children under five years old (WHO, 2012)

Infectious disease is a direct factor that can cause stunting in toddlers. The incidence of stunting due to infectious diseases is highly dependent on the severity, duration, and recurrence of infectious diseases suffered by toddlers. Infectious diseases that are often suffered by toddlers are diarrhea, dysentery, and worms.

The results of the statistical analysis carried out found that infectious diseases are one of the factors causing stunting, more than half of the respondents experienced diarrheal disease, namely 57.5%, dysentery 38.5%, and helminthiasis 5.5%. The data shows that most toddlers have experienced infectious diseases which can affect nutritional status and affect the growth and development of toddlers. According to Wanda Lestari’s research results, infectious diseases are one of the risks of stunting.

4.3 ENVIRONMENTAL FACTORS

The issue of stunting is not solely attributed to inadequate food consumption. Stunting, like other forms of malnutrition, is a direct result of insufficient nutrition and the risk of recurring infectious infections, which mutually affect each other. Upon closer examination, it becomes evident that these two primary factors are significantly shaped by the maternal upbringing, the accessibility of food within the household, and the state of environmental
sanitation. Several studies have proven that the contribution of environmental sanitation to alleviating the problem of stunting is quite large, one of which is a study on children in Bangladesh who have access to clean drinking water, latrines, and CTPS facilities whose height growth is 50% higher than children who do not have access. In addition, poor hygiene and sanitation cause inflammatory disorders of the small intestine which reduces the absorption of nutrients and increases intestinal permeability, which is also called Environmental Enteropathy (EE), where energy diversion occurs, which should be used for growth but is ultimately used to fight infections in the body (Yunizahraini, 2016).

The primary areas of interest for researchers studying child stunting are the environmental factors related to water, sanitation, and hygiene (WASH). The potential for stunting is reduced if there are interventions that focus on changing behavior in sanitation and hygiene, such as getting access to clean water to stop open defecation, hand washing with soap (CTPS), household food processing, household waste management, and waste management.

5 CONCLUSION AND SUGGESTION

The prevalence of stunting in Solok Regency has increased even above the data from the provincial health office, which is 82%. Infectious diseases are a direct factor causing stunting in Solok Regency. Parenting, eating, and environmental factors are indirect factors causing stunting in Solok Regency with the most influencing factor being diet.

By knowing the direct and indirect factors that cause stunting in Solok Regency, prevention efforts such as education related to stunting should be taken from the time of pregnancy to children (1000 days). The government should always screen couples of childbearing age in maintaining health and nutrition as well as sanitation behavior in preventing stunting in Solok Regency. The community should always implement community-based total sanitation behavior so that it can cut off the indirect causes of stunting from environmental factors.
REFERENCES


