Amerta Nutrition
e-ISSN: 2580-1163 (Online)
p-ISSN: 2580-9776 (Print)
Budiastutik et al. | Amerta Nutrition Vol. 8 Issue 1SP (August 2024). 70-75

RESEARCH STUDY
English Version

OPEN ACCESS

The Relation of Infectious Diseases, Water Access, Hygiene Practice, and Sanitation with the Stunting: A Case-Control Study in Sambas Regency

Hubungan Penyakit Menular, Sumber Air Bersih, Praktik Kebersihan, dan Sanitasi dengan Kejadian Stunting*: Studi Kasus Kontrol di Kabupaten Sambas*

Indah Budiastutik[1]*, Resky Nanda Pranaka[2], Nurul Amaliyah[3], Giska Hediyanti[2], Elly Trisnawati[1]

[1]Faculty of Health Sciences, Universitas Muhammadiyah Pontianak, West Kalimantan, Indonesia
[2]Regional Research and Innovation Agency of West Kalimantan Province, West Kalimantan, Indonesia
[3]Ministry of Health Polytechnic, Semarang, Indonesia

ARTICLE INFO

Received: *25-04-2024*
Accepted: *26-08-2024*
Published online: *30-08-2024*

Correspondent:
Indah Budiastutik
indahbudiastutik@unmuhpnk.ac.id

DOI:
10.20473/amnt.v8i1SP.2024.70-75

Available online at:
https://e-journal.unair.ac.id/AMNT

Keywords:
Infectious Diseases, Water Access, Hygiene Practice, Sanitation, Stunting

ABSTRACT

Background: The main nutritional problem concerned by the Indonesian government is the stunting. This condition is affected by various aspects, mainly caused by infectious diseases, clean and unharmonious living behavior, the availability of drinking water, and environmental sanitation.
Objectives: The purpose of this study is to determine the relation of infectious diseases, water access, hygiene practices, and sanitation towards the stunting incidence factors in Sambas Regency.
Methods: This research used Ex Post Facto with a case-control design. The study population was residents of Sambas Regency with a total of 535,725 people, a total sample of 241 children aged 0-59 months comprising of 89 respondents as cases and the rest 159 respondents as controls, using inclusion and exclusion criteria both from the control group and from the case group. Data analysis used the chi-square test.
Results: The results showed a relation of infectious diseases (p-value=0.000), drinking water sources (p-value=0.000), clean and healthy living behavior (p-value=0.000), and environmental conditions (p-value=0.000) with the stunting incidences.
Conclusions: The study concludes that there is a significant relation of infectious disease variables, the drinking water sources, hygiene practices, and environmental conditions with the stunting. It requires control and completion of the stunting cases through environmental sanitation improvement, namely the provision of access to clean water, healthy and clean living behaviors, and good cooperation between the government and the community, in educating people through counseling and socialization of the stunting prevention and management.

INTRODUCTION

Children's emotional and physical well-being, how mature they become, and how well they do in school are all affected by their nutritional state[1]. A shocking one-third of the under-five child fatalities worldwide are linked to malnutrition. Characteristically, the stunted growth is permanent in human capital development and affects one out of every five children younger than five years[2].

Indonesia is among the countries with the most malnutrition cases, including the stunting[3]. In 2022, the stunting prevalence in Indonesia was 21.6%, as reported in the Indonesia Nutritional Status Survey. This figure was a decrease in the number of cases, compared to last year's prevalence rate at 24.4%[4]. As a result, the number of stunting cases decreased by 2.8% within a year. Notably, the government's annual goal is to reduce the stunting incidences by 3%, so this decrease was rather close to that target. Resolving the stunting problem demands an improvement strategy that spans multiple sectors, not limited to health only.

Indonesia has demonstrated a promising progress in reducing malnutrition over the past decade. However, the stunting prevalence has hardly decreased. Research has shown that children under the age of five years are more likely to be malnourished for living in the unsanitary and unhygienic environments[5,6]. There are a number of ways in which Water, Sanitation and Hygiene (WASH) practices are associated with the stunting, including environmental intestinal dysfunction, infection

How to cite: *Budiastutik, I., Pranaka, R. N., Amaliyah, N., Hediyanti, G., & Trisnawati, E. (2024) The Relation of Infectious Diseases, Water Access, Hygiene Practice, and Sanitation with the Stunting: A Case-Control Study in Sambas Regency: Hubungan Penyakit Menular, Sumber Air Bersih, Praktik Kebersihan, dan Sanitasi dengan Kejadian Stunting: Studi Kasus Kontrol di Kabupaten Sambas. Amerta Nutrition, 8(1SP), 70–75.*

routes, and recurrent diarrhea[7]. For instance, many people in Indonesia's rural areas drink the polluted surface water, thus putting their health at risk. As an additional concern, many people still defecate in the open space, thus leading to the spread of disease[8].

A disorder known as the pediatric environmental enteropathy has a strong evidence linking environmental causes to a chronic inflammatory sickness of the stomach[9]. A chronic inflammatory condition of the gut known as pediatric environmental enteropathy has been found to be associated with the environmental variables, according to the available evidence[10]. These disorders have the potential to disturb the gut microbiota and have further negative effects on children's development and growth. The diarrhea-causing pathogens are part of the gut microbiota and thought to play a significant role in malnutrition[11]. Even without the outward symptoms of illness, like diarrhea, the subclinical changes in the gut microbiome can lead to the stunting. Children younger than two years are particularly vulnerable to the enteric diseases in areas with extreme poverty and inadequate sanitation. Enteric infections cause malabsorption and intestinal barrier failure, which can contribute to the stunting and wasting. Children's cognitive development and general health are predicted by measuring their height at the age of two years. Nutritional issues in children younger than five years are affected by sociodemographic, environmental, cultural, and economic variables[12,13].

Child healthcare practice is crucial and involves paying attention to the child's condition, practicing good hand washing, maintaining environmental hygiene, and providing proper care for children[14]. This set of behaviors is referred to as Clean and Healthy Life Behavior (CHLB), involving preventive measures against various diseases for individuals and families. It is recommended to incorporate CHLB into daily life, as behavioral factors are known to impact 30-35% of health status. Previous research has found that a lack of access to hygiene was associated with a 52% higher risk of the stunted growth (odds ratio of 1.52, [95% CI (1. 28–1.80)][3].

In West Kalimantan Province, Indonesia, many toddlers were short or had the stunted nutritional status[15]. In particular, Sambas District had one of the highest stunting rates (at 27.67%) in the province[16]. However, the potential causes of this high prevalence have not been explored. Therefore, a study was conducted to assess the prevalence and factors associated with the stunting among children aged 0-59 months in the Sambas Regency, West Kalimantan, in 2020. The study considered several factors, such as infectious diseases, drinking water sources, clean and healthy living behavior, and environmental sanitation.

METHODS

Study Design and Setting

The current study was designed as a case-control study to investigate a specific research question. It was conducted in Sambas Regency, over a period from June to November 2020.

Study Population and Sampling

Research participants were children in the Sambas Regency at the age of at least 59 months with the stunted growth. The study's inclusion criteria were used to select the youngsters. The study included children within the 0-59 month age range at the time of data collection. Information of their weight and height for assessing the stunting was documented at the public health centers situated in the Sambas Regency. The sampling method used was the purposive sampling. The case groups were children with the confirmed stunting and both acute or chronic infection diseases in the past year, using the data recorded by the public health centers. Meanwhile, the control group, those with normal records a year before the study, was taken from the same area.. The sample size reached 89 cases and 159 controls (1:2) based on the formula of different proportions between two groups with 80% power of study. All of the 241 children screened for the assessment were found eligible to participate in this study. The informed consent was obtained before the interview.

Study's Variables

To gather information about the stunting prevalence in Sambas Regency, we conducted interviews with the residents and assessed their homes using the standardized questionnaires. The dependent variable was the stunting incidence, while the independent variables included environmental factors, hygiene practices, water sources, and history of infectious diseases. A history of infectious diseases in children was constituted by more than six illnesses or chronic infections last year, such as tuberculosis, acute respiratory infections, and diarrhea. The drinking water sources are considerable feasible for meeting the standards outlined in Regulation of the Minister of Health No. 492/Menkes/PER/IV/2010 \. To promote children's health, parents should demonstrate good hygiene habits, such as using clean water for bathing and household tasks, washing hands with soap, staying active, and refraining from smoking inside the house. This study also measured environmental variables related to sanitation, such as ownership of latrines, frequency of garbage and waste disposal, and the condition of house. The environment was considered harmful for not meeting any of these conditions[17].

Data Analysis

The children's sociodemographic factors were subjected to a descriptive statistical analysis. To determine whether or not there was a significant link ($p<0.05$) between the predictors and the outcome (potency of the stunting incidence), a cross-tabulation chi-square analysis was carried out. The research was given permission by the Pontianak Ministry of Health's Health Ethics Commission (registration no. 018/KEPK-PK. PKP/II/2021). Every single participant gave their informed consent.

How to cite: *Budiastutik, I., Pranaka, R. N., Amaliyah, N., Hediyanti, G., & Trisnawati, E. (2024) The Relation of Infectious Diseases, Water Access, Hygiene Practice, and Sanitation with the Stunting: A Case-Control Study in Sambas Regency: Hubungan Penyakit Menular, Sumber Air Bersih, Praktik Kebersihan, dan Sanitasi dengan Kejadian Stunting: Studi Kasus Kontrol di Kabupaten Sambas. Amerta Nutrition, 8(1SP), 70–75.*

RESULTS AND DISCUSSIONS

The respondents' characteristics are presented in Table 1. From total 241 respondents, 49.79% were fathers and the rest 52.28% were mothers, while most of them had graduated from elementary or junior high school. In terms of occupations, 52.28% of fathers were farmers, while 64.73% of mothers did not work.

Table 1. Frequency Distribution of Parental Characteristics of the Stunting Respondents with Education and Employment Criteria in Sambas Regency

Characteristics	n	%
Parents' Education		
Father		
Primary/Junior High School	120	49.79
Senior High School	74	30.71
University	47	19.50
Mother		
Primary/Junior High School	126	52.28
Senior High School	69	28.63
University	46	19.09
Parents' Occupation		
Father		
Farmer	126	52.28
Self-Employed	78	32.37
Civil Servant	37	15.35
Mother		
Employed	85	35.27
Unemployed	156	64.73

n: frequency, %: percentage

In Table 2, the study outlines the characteristics of the focus variable. Out of the 241 respondents, 58.51% reported no history of infectious diseases, while 55.19% had access to a reliable drinking water source. Additionally, 55.19% of respondents demonstrated good hygiene and health, while 53.11% reported living in a healthy environment.

Table 2. Frequency Distribution of Respondents based on the Infectious Diseases, Clean and Healthy Living Behavior, and Environmental Conditions in Sambas Regency

Characteristics	n	%
Records of Infectious Diseases		
Yes	100	41.49
No	141	58.51
Source of Drinking Water		
Not Eligible	108	44.81
Eligible	133	55.19
Clean and Healthy Living Behavior		
Less	108	44.81
Good	133	55.19
Environment Condition		
Healthy	128	53.11
Unhealthy	113	46.89

n: frequency, %: percentage

Table 3 shows the statistical analysis on a relation of infectious diseases, clean and healthy living behavior, and environmental conditions with the stunting incidence. The data in Table 3 demonstrate that up to 78% of individuals affected by infectious diseases experienced the stunting. The statistical analysis yielded p-values (0.000) < α (0.05), indicating a correlation between the two. The Odd Ratio (OR) values of 41.901 further emphasized the impact of infectious diseases on the stunting rates in young children. Statistical analysis revealed a p-value of 0.000, lower than the significance level of α (0.05), indicating a relevance between CHLB and the stunting incidence. Additionally, an OR value of 46.875 indicated the effect of CHLB on the stunting incidence in children under 2 years and toddlers, while the majority of respondents on CHLB variable reported a 75% reduction in the stunting. According to the statistical analysis, a p-value of 0.000 was lower than the significance level of α (0.05), indicating a correlation between environmental factors and the stunting incidence. Additionally, an odds ratio (OR) of 37.875 indicated that infectious diseases affected the stunting incidence in infants and toddlers. The majority of environmental variables showed the stunting rates at 71.68%. The results of the correlation between infectious diseases and stunting are detailed in Table 3. It shows a history of infectious diseases associated with stunting, with a p-value of 0.000 and an OR=41.901 value.

How to cite: *Budiastutik, I., Pranaka, R. N., Amaliyah, N., Hediyanti, G., & Trisnawati, E. (2024) The Relation of Infectious Diseases, Water Access, Hygiene Practice, and Sanitation with the Stunting: A Case-Control Study in Sambas Regency: Hubungan Penyakit Menular, Sumber Air Bersih, Praktik Kebersihan, dan Sanitasi dengan Kejadian Stunting: Studi Kasus Kontrol di Kabupaten Sambas. Amerta Nutrition, 8(1SP), 70–75.*

Therefore, it can be concluded that there is a relation between infectious diseases and the stunting. Additionally, it shows that the stunted toddlers are more likely to experience infectious diseases, compared to the typically stunted toddlers.

Table 3. The Relation of Infectious Diseases, Clean and Healthy Living Behavior, and Environmental Conditions with the Stunting Incidence in Sambas Regency

Variable	Stunting				Total		p-value	OR (95% Confidence Interval)
	Case		Control					
	n	%	n	%	n	%		
Records of Infectious Diseases								
Yes	78	78.00	22	22.00	100	41.49	0.000*	41.901
No	11	7.80	130	92.20	141	58.51		
Source of Drinking Water								
Not Eligible	77	71.30	31	28.70	108	44.81	0.000*	25.046
Eligible	12	9.02	121	90.98	133	55.19		
Clean and Healthy Living Behavior (PHBS)								
Less	81	75.00	27	25.00	108	44.81	0.000*	46.875
Good	8	6.02	125	93.98	133	55.19		
Environment's Condition								
Unhealthy	81	71.68	32	28.32	113	46.89	0.000*	37.969
Healthy	8	6.25	120	93.75	128	53.11		

n: frequency, %: percentage, chi-square test, *) significant relationship at p-value<0.05

The growth of children under five can be negatively affected by infectious diseases, such as Acute Respiratory Infections (ARI), diarrhea, and worms[18]. The stunted children are more susceptible to illnesses due to their low body resistance. According to the World Health Organization (WHO), common infectious diseases in the stunted children are helminthiasis, diarrhea, inflammation, malaria, and respiratory tract disorders/ARI. Children who have not been fully immunized are at a higher risk of having the infectious diseases, such as diarrhea as well as the stunting. Research conducted in Ethiopia shows that children suffering from diarrhea are more likely to be stunted[19]. In children aged 6–59 months from the low-income urban and rural regions, the stunting was linked to the infectious illnesses, such as diarrhea, respiratory infections, and fever[20].

This study has found that people obtain their drinking water from various sources, such as rainwater, wells, rivers, gallons, and Local Water Company. The majority of respondents used rainwater and the least used water from the Local Water Company. However, well used by one of the respondents was located very close to household waste disposal, at a distance of less than 10 meters. In addition, most people in the area disposed of their household waste directly into the river. Based on the information provided by residents, there have been the unlicensed gold mining activities in the upper reaches of the river in Makrampai Village. This situation can potentially affect safety and quality of the drinking water consumed by families because water obtained from these sources may not be treated independently by individuals. As a result, it may not meet the eligibility requirements for the drinking water, such as water processed by Local Water Company.

A higher stunting risk in children was found to be related to the unfit drinking water, according to a study on the drinking water sources. Those who did not preserve their drinking water sources at home were more likely to have children with the stunted growth. When asked about the origin of their drinking water, most people answered rainwater, while the least said Local Water Company. The household waste disposal site was located near the well used by most respondents, and many people dumped their trash into the river. The respondents' families' access to the safe drinking water may be compromised by these factors.

The stunting prevalence in toddlers is significantly correlated with availability of the safe drinking water. An increased stunting risk in children can be caused by water sources unsuitable for drinking and insufficient waste disposal, according to research. Another study found that the stunting was more common in areas with the unimproved latrines and the unprocessed drinking water, compared to areas with better sanitation and hygiene practices. Although the current explanation for causation has its shortcomings, this study has shown new relevance among stunting, water treatment, and household cleanliness.

Some noteworthy conclusions have been drawn from the statistical analysis performed in this study. Only 8.9% of respondents with good CHLB in place had no stunting, according to the data, but 91% of those who had inadequate CHLB in place had stunting. Additional statistical evidence pointed to a correlation between CHLB and the stunting rates. A statistically significant

How to cite: *Budiastutik, I., Pranaka, R. N., Amaliyah, N., Hediyanti, G., & Trisnawati, E. (2024) The Relation of Infectious Diseases, Water Access, Hygiene Practice, and Sanitation with the Stunting: A Case-Control Study in Sambas Regency: Hubungan Penyakit Menular, Sumber Air Bersih, Praktik Kebersihan, dan Sanitasi dengan Kejadian Stunting: Studi Kasus Kontrol di Kabupaten Sambas. Amerta Nutrition, 8(1SP), 70–75.*

association between CHLB and stunting incidence (at p-value=0.000) ruled out the possibility of random coincidence. Poor CHLB implementation was 46.875 times more likely to result in the stunting than good CHLB, as shown by the OR value of 46.875.

The CHLB implementation in households is crucial for improving the degree of health and nutritional status [21]. Better implementation of good hygiene practices in the family means fewer people getting sick, the stunting in particular. On the other hand, poor hygiene practices could increase the potential for family members and toddlers to experience illness and decrease their nutritional status, leading to a higher stunting risk in children[22,23]. To enhance the nutritional status of family members and toddlers for the stunting prevention, it is crucial to prioritize the establishment of healthy CHLB in families. Even simple habits (e.g., regularly washing hands before and after touching food, drinking, or using the restroom) can have a significant impact on health[24,25].

In addition, factors that contribute to the stunting incidence in toddlers included household poverty, maternal education, government aid, and the availability of proper sanitation[26,27]. As shown in the respondent data, most of the parents have only graduated from elementary or junior high school education, while fathers usually worked as farmers and most mothers were not employed. These socioeconomic factors are likely to have a negative effect on the stunting in toddlers. On the other hand, considering availability of the qualified drinking water sources and healthy environmental conditions, socioeconomic factors can have a positive effect on the stunting in toddlers.

The best policies and initiatives to reduce the stunting in Indonesian children should focus on water, sanitation, and hygiene treatments, according to a comprehensive assessment and analysis of the research and the available data. Sustainable Development Goals and the stunting prevention can be accomplished through such initiatives. The availability of safe drinking water and other forms of clean water is a societal responsibility that falls squarely on local governments. Programs, like Community-Based Drinking Water and Sanitation Provision Program, with a priority on the use of indigenous knowledge and practices in water and sanitation supply, are among approaches to address this problem. To improve health outcomes and reduce the prevalence of water-borne infections, these programs were more than just clean water; they also encouraged better sanitation and hygiene habits. People can improve the quality of life for families and communities across the region by prioritizing these measures and working towards a reduction in the child stunting rates in Indonesia.

CONCLUSIONS

Preventing the stunting in children is crucial for the future of country and health worldwide, intelligence, and economic prosperity. The rising stunting incidence in Sambas was caused, in part, by infectious infections, a lack of the standardized drinking water, inadequate hygiene practices, and the unfavorable climatic factors, according to the present study. This research emphasizes the need of establishing precise and stringent criteria to establish causation to implement transdisciplinary approaches to deal with the stunting.

ACKNOWLEDGEMENT

This project has been funded by the West Kalimantan Provincial Research and Development Agency, and the researchers would like to thank the village government, regional organizations dealing with the stunting in Sambas Regency, and others.

CONFLICT OF INTEREST AND FUNDING DISCLOSURE

All authors have no conflict of interest in this article.

AUTHOR CONTRIBUTIONS

IB: conceptualization, writing–original draft; RNP: formal analysis, writing editing; NA: methodology, writing-review and editing; GH: supervision, writing-review and editing; ET: supervision, writing–review and editing.

REFERENCES

1. Abdulahi, A., Shab-Bidar, S., Rezaei, S. & Djafarian, K. Nutritional Status of Under Five Children in Ethiopia: A Systematic Review and Meta-Analysis. *Ethiop J Health Sci* **27**, 175–188 (2017).
2. Victora, C. G. *et al.* Maternal and Child Undernutrition 2 Maternal and Child Undernutrition: Consequences for Adult Health and Human Capital. *www. thelancet. com* **371**, (2008).
3. Mulyaningsih, T. *et al.* Beyond personal factors: Multilevel Determinants of Childhood Stunting in Indonesia. *PLoS One* **16**, (2021).
4. Ministry of Health of the Republic of Indonesia. *Result of Indonesian Nutrient Status Survey in 2022*. Retrieved from https://monalisa.bkkbn. go. id (2023).
5. Purba, I. G., Sunarsih, E., Trisnaini, I. & Sitorus, R. J. Environmental Sanitation and Incidence of Stunting in Children Aged 12-59 Months in Ogan Ilir Regency. *Journal of Environmental Health* **12**, 189–199 (2020).
6. Adi, S., Krisnana, I., Rahmawati, P. D. & Maghfiroh, U. Environmental Factors that Affect the Incidence of Stunting in Under-five Children: A Literature Review. *Pediomaternal Nursing Journal* **9**, 42–44 (2023).
7. Wolf, J. *et al.* Systematic review: Assessing the Impact of Drinking Water and Sanitation on Diarrhoeal Disease in Low and Middle- Income Settings: Systematic Review and Meta-regression. *Tropical Medicine and International Health* **19**, 928–942 (2014).
8. World Health Organization. *Soil-Transmitted Halminthiases : STH : Eliminating Soil-Transmitted Helminthiases as a Public Health Problem in Children : Progress Report 2001-2010 and Strategic Plan 2011-2020.* (World Health Organization, 2012).

How to cite: *Budiastutik, I., Pranaka, R. N., Amaliyah, N., Hediyanti, G., & Trisnawati, E. (2024) The Relation of Infectious Diseases, Water Access, Hygiene Practice, and Sanitation with the Stunting: A Case-Control Study in Sambas Regency: Hubungan Penyakit Menular, Sumber Air Bersih, Praktik Kebersihan, dan Sanitasi dengan Kejadian Stunting: Studi Kasus Kontrol di Kabupaten Sambas. Amerta Nutrition, 8(1SP), 70–75.*

9. Richard, S. A. *et al.* Wasting is Associated with Stunting in Early Childhood. *Journal of Nutrition* **142**, 1291–1296 (2012).
10. Colston, J. M. *et al.* A Methodologic Framework for Modeling and Assessing Biomarkers of Environmental Enteropathy as Predictors of Growth in Infants: An Example from a Peruvian Birth Cohort. doi:10. 3945/ajcn. 116.
11. Vonaesch, P. *et al.* Identifying the Etiology and Pathophysiology Underlying Stunting and Environmental Enteropathy: Study Protocol of the AFRIBIOTA Project. *BMC Pediatr* **18**, (2018).
12. Ma, E. *et al.* Socio-demographic and Environmental Determinants of Under-stunting in Rwanda: Evidence from a Multisectoral Study. *Front. Public Health 11:1107300* (2023) doi:10. 3389/fpubh. 2023. 1107300.
13. Murtaza, S. F., Gan, W. Y., Sulaiman, N., Shariff, Z. M. & Ismail, S. I. F. Sociodemographic, Nutritional, and Environmental Factors are Associated with Cognitive Performance among Orang Asli Children in Malaysia. *PLoS One* **14**, (2019).
14. Sriyanah, N., Efendi, S., Ilyas, H. , Rusli, R. & Nofianti, N. Clean and Healthy Lifestyle Behavior (PHBS) in Families with Stunted Children at Karuwisi Public Health Center. *Aisyah Journal: Journal of Health Sciences* **8**, (2023).
15. Basic Health Research. *2018 Report of Basic Health Research*. (2019).
16. Ministry of Health of the Republic of Indonesia. Report of West Kalimantan Province in Basic Health Research in 2018 (2018).
17. Lazzeri, G. *et al.* Factors Associated with Unhealthy Behaviours and Health Outcomes: A Cross-sectional Study among Tuscan Adolescents (Italy). *Int J Equity Health* **13**, (2014).
18. Ikhtiarti, W. , Rahfiludin, M. Z. & Nugraheni, S. A. Determinant Related to the Stunting Incidence in Toddlers at the Age of 1-3 Years in the Coastal Area of Brebes Regency **10**, 51–56 (2020).
19. Batiro, B., Demissie, T., Halala, Y. & Anjulo, A. A. Determinants of Stunting among Children aged 6-59 Months at Kindo Didaye Woreda, Wolaita Zone, Southern Ethiopia: Unmatched Case Control Study. *PLoS One* **12**, 1–15 (2017).
20. Beal, T., Tumilowicz, A., Sutrisna, A., Izwardy, D. & Neufeld, L. M. A Review of Child Stunting Determinants in Indonesia. *Maternal and Child Nutrition* vol. 14 Preprint at https://doi. org/10. 1111/mcn. 12617 (2018).
21. Saaka, M., Saapiire, F. N. & Dogoli, R. N. Independent and Joint Contribution of Inappropriate Complementary Feeding and Poor Water, Sanitation and Hygiene (WASH) Practices to Stunted Child Growth. *J Nutr Sci* **10**, (2021).
22. Chattopadhyay, A. *et al.* WASH Practices and Its Association with Nutritional Status of Adolescent Girls in Poverty Pockets of Eastern India. *BMC Women's Health* **19**, (2019).
23. Mshida, H. A., Kassim, N., Mpolya, E. & Kimanya, M. Water, Sanitation, and Hygiene Practices Associated with Nutritional Status of Under-five Children in Semi-pastoral Communities Tanzania. *American Journal of Tropical Medicine and Hygiene* **98**, 1242–1249 (2018).
24. Shinsugi, C. & Mizumoto, A. Associations of Nutritional Status with Full Immunization Coverage and Safe Hygiene Practices among Thai Children Aged 12–59 Months. *Nutrients* **14**, (2022).
25. Singh, P. *et al.* An Assessment of Personal Hygiene Practices among Young Adults: A Cross-Sectional, Descriptive Study. *Cureus* (2023) doi:10. 7759/cureus. 44308.
26. Yani, D. I., Rahayuwati, L., Sari, C. W. M., Komariah, M. & Fauziah, S. R. Family Household Characteristics and Stunting: An Update Scoping Review. *Nutrients* vol. 15 Preprint at https://doi. org/10. 3390/nu15010233 (2023).
27. Rizal, M. F. & van Doorslaer, E. Explaining the Fall of Socioeconomic Inequality in Childhood Stunting in Indonesia. *SSM Popul Health* **9**, (2019).

How to cite: *Budiastutik, I., Pranaka, R. N., Amaliyah, N., Hediyanti, G., & Trisnawati, E. (2024) The Relation of Infectious Diseases, Water Access, Hygiene Practice, and Sanitation with the Stunting: A Case-Control Study in Sambas Regency: Hubungan Penyakit Menular, Sumber Air Bersih, Praktik Kebersihan, dan Sanitasi dengan Kejadian Stunting: Studi Kasus Kontrol di Kabupaten Sambas. Amerta Nutrition, 8(1SP), 70–75.*