

## The Relationship Between Drinking Water Treatment and Clean Water Sources on The Incidence Of Stunting

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**Abstract**

This study examined the correlation between drinking water treatment, clean water sources, and the prevalence of stunting among children under five in Astambul District, Banjar Regency, Indonesia, where stunting rates surpass government targets. The study utilized a quantitative, observational analytic method with a cross-sectional design to evaluate data from 110 randomly selected children aged 0 to 59 months. The study identified a significant stunting prevalence of 42.7% through structured questionnaires and direct observations. A notable correlation was identified between home drinking water treatment and the incidence of stunting ( $OR = 4.555, p = 0.021$ ), indicating that children from families that do not treat water are 4.555 times more likely to experience stunting. No substantial correlation was detected between water source protection and stunting ( $OR = 1.444, p = 0.441$ ). Although 77.3% of families purify their drinking water, stunting rates persist at elevated levels, indicating the impact of supplementary factors. These findings emphasize the intricate connection between water management and child nutrition, indicating the necessity for holistic interventions that tackle both water quality and wider nutritional and environmental issues to effectively mitigate stunting in the region.

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**Highlight**

- 42.7% of children in Astambul District, Banjar Regency are stunted, exceeding the 14% national target.
- Untreated drinking water increases stunting risk by 4.555 times ( $OR = 4.555, p = 0.021$ ).
- No significant link between water source protection and stunting ( $OR = 1.444, p = 0.441$ ).
- 77.3% of households treat their drinking water, despite high stunting rates.
- *Refill Water Risks: Some households using refill water don't follow proper storage or reboiling practices.*

**Introduction**

Stunting, a condition marked by hindered growth and development in children under five resulting from chronic malnutrition, persists as a major public health issue, especially in developing nations such as Indonesia. This problem is not exclusively due to inadequate nutrition but is also closely associated with environmental variables, particularly water, sanitation, and hygiene (WASH) conditions.

UNICEF's global figures from 2020 indicate that around 21.9%, or 149 million children under the age of 5, experience stunting worldwide. In Southeast Asia, 14.4 million children under the age of five are impacted by stunting. Despite Indonesia's advancement in decreasing stunting rates from 37.2% in 2013 to 30.8% in 2018 (Risksesdas, 2018), the prevalence remains elevated and does not meet the national target of 14%.

Banjar Regency in South Kalimantan province confronts a notably difficult predicament. The incidence of stunting in this region has varied in recent years, recording 40.2% in 2021, 26.4% in 2022, and 30.6% in 2023, as per the Nutritional Status Monitoring Study (SSGI). These results markedly surpass the national target and underscore the pressing necessity for focused actions.

Direct factors, like insufficient food consumption and infectious illnesses, contribute to stunting, but indirect factors such as inadequate sanitation and restricted access to clean water are also significant. The intricate interaction among these factors can result in environmental intestinal dysfunction (EED), compromised nutrient absorption, and heightened vulnerability to infections, all of which contribute to stunting.

This study seeks to examine the correlation between drinking water treatment techniques and availability to clean water sources with the prevalence of stunting in Astambul District, Banjar Regency. Through the analysis of these environmental factors, we aim to offer significant insights that can guide targeted interventions and aid in the continuous efforts to diminish stunting rates in the region.

This research corresponds with national priorities established in Presidential Regulation No. 72 of 2021 regarding the acceleration of stunting reduction, as well as local initiatives shown by Banjar Regent Regulation No. 48 of 2020 focused on stunting prevention. This study aims to enhance child health and development in Banjar Regency and beyond by concentrating on the essential environmental factors related to water treatment and access to clean water sources.

### **Methodology**

This study utilized a quantitative, observational analytic methodology with a cross-sectional design to examine the correlation between drinking water treatment, clean water sources, and stunting in children. The study was carried out in the Astambul District of Banjar Regency, chosen for its representation of zones with high, medium, and low stunting prevalence.

The research population comprised children aged 0 to 59 months living in Banjar Regency. A total of 110 youngsters were selected for the study using basic random sampling. The inclusion criteria mandated that participants fell within the designated age range, resided in the study location, and were devoid of chronic or acute disorders that could influence growth patterns.

The data collection encompassed both primary and secondary sources. Primary data were collected via structured questionnaires and direct observations. The surveys, distributed to parents or primary caregivers, gathered data on demographics, water accessibility and treatment methods, sanitation conditions, and hygiene practices. Trained researchers performed observations utilizing an established checklist to evaluate household water storage, sanitation facilities, and overall hygiene conditions. Secondary data, comprising local health reports and pertinent papers, were acquired from local health authorities to furnish contextual information.

The research concentrated on two primary independent variables: water treatment methodologies and the origin of potable water. The dependent variable was the stunting status of children, assessed using height-for-age Z-scores in accordance with WHO growth criteria.

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Trained professionals conducted anthropometric measurements utilizing established equipment and methods to guarantee precision.

Data analysis was conducted with SPSS software and encompassed both univariate and bivariate analyses. Univariate analysis yielded descriptive statistics for each variable, encompassing frequencies and proportions. Bivariate analysis, particularly the Chi-Square test, was employed to investigate the correlation between water treatment methods, clean water sources, and the incidence of stunting. A significance level of  $\alpha = 0.05$  was established, with p-values below 0.05 deemed indicative of a significant association.

Ethical issues were paramount during the study. Informed consent was secured from all participants' parents or guardians, and the confidentiality of personal information was rigorously upheld. The study protocol received approval from the appropriate ethical review board before initiation.

This methodological approach facilitated a thorough analysis of the correlation between water-related parameters and stunting, yielding significant insights to guide public health interventions and policy recommendations in Banjar Regency and analogous contexts..

## Finding

### Respondent Characteristics

The research investigated the correlation between water treatment, clean water sources, and the prevalence of stunting in children under five in Banjar Regency. A total of 110 participants, predominantly moms, engaged in the study. Table 1 indicates that the predominant age group of respondents (54.5%) was early adulthood (26-35 years), a period deemed advantageous for child-rearing owing to heightened maturity and experience. The remaining respondents were categorized as late youth (22.7%), late adulthood (20%), and early elderly (2.7%).

Table 1. Age Distribution of Respondents

Age Category	Frequency	Percentage (%)
Late adolescence	25	22.7
Early adulthood	60	54.5
Late adulthood	22	20.0
Early elderly	3	2.7
<b>Total</b>	<b>110</b>	<b>100.0</b>

### Univariate Analysis

The incidence of stunting among the children in the research was exceedingly high. Table 2 indicates that 47 children (42.7%) were categorized as stunted, whereas 63 (57.3%) were not stunted. This incidence markedly surpasses the national target of 14%, highlighting the gravity of the stunting issue in the studied area.

Table 2. Prevalence of Stunting Among Study Participants

Stunting	Number	Percentage (%)
Yes	47	42.7
No	63	57.3
<b>Total</b>	<b>110</b>	<b>100.0</b>

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The study revealed positive outcomes in water purification methods for households, although raised issues regarding the sources of water. Table 3 indicates that a significant majority of households (77.3%) reported treating their drinking water, whilst 22.7% did not. Table 3 also demonstrates that 80% of families accessed protected water sources, whereas the other 20% depended on unsafe sources.

Table 3. Household Water Management Practices

Category	Subcategory	Number	Percentage (%)
Drinking Water Treatment	Treated	85	77.3
	Untreated	25	22.7
Clean Water Source	Protected	88	80.0
	Unprotected	22	20.0
<b>Total</b>		<b>110</b>	<b>100.0</b>

### Bivariate Analysis

The correlation between water treatment methods and clean water sources with the prevalence of stunting in children under five years of age.

The bivariate study, illustrated in Table 4, demonstrated a strong correlation between drinking water treatment and the incidence of stunting. Children from households that did not purify their drinking water had 4.555 times greater odds of experiencing stunting compared to those from households that did clean their water ( $OR = 4.555$ ,  $p = 0.021$ ). This discovery underscores the vital significance of household water purification in mitigating stunting.

Table 4. Bivariate Analysis of Water Management Practices and Stunting

Variable	Stunting	Not Stunting	Total	OR	p-value
<b>Drinking Water Treatment</b>					
Treated	28	57	85	4.555	0.021
Untreated	13	12	25		
<b>Clean Water Source</b>					
Protected	36	52	88	1.444	0.441
Unprotected	11	11	22		

### The correlation between clean water sources and the prevalence of stunting in children under five years of age.

The analysis revealed no significant correlation between the source of clean water and the incidence of stunting ( $OR = 1.444$ ,  $p = 0.441$ ). This unforeseen outcome indicates that, although access to safeguarded water sources is significant, the treatment of drinking water at the household level may be more pivotal in mitigating stunting in this demographic.

Supplementary observations from the study elucidate these findings. Certain households indicated that they utilize replenishment water (bottled water) as their principal source of drinking water, perceiving it as convenient and readily available. Nevertheless, not all of these households adhered to hygienic storage standards or reboiled the water prior to use, which could jeopardize its safety.

These findings highlight the intricate relationship between water management methods and stunting. Although access to clean water sources is undeniably significant, the findings underscore that household-level water treatment is essential in mitigating stunting. The research underscores the necessity for holistic interventions that tackle both water sources and domestic water purification methods to successfully mitigate stunting in Banjar Regency. Future public health campaigns must prioritize educating families on appropriate water treatment techniques and safe storage practices, especially while utilizing ostensibly clean water sources.

### **Analysis & Discussion**

The research undertaken in Banjar Regency, South Kalimantan, offers essential insights into the intricate connection between water management practices and stunting in children under five years of age. The results indicate a substantial correlation between the treatment of household drinking water and the incidence of stunting, while unexpectedly demonstrating no significant link between the protection of water sources and stunting.

The prevalence of stunting in the research area is 42.7%, significantly above the national target of 14% and surpassing Indonesia's overall rates, which declined from 37.2% in 2013 to 30.8% in 2018 (Riskesdas, 2018). The significant prevalence corresponds with the wider issue of stunting in Southeast Asia, where UNICEF (2020) indicates that 14.4 million children under five are impacted. Banjar Regency exemplifies the ongoing issue of stunting in poor nations, where environmental determinants, especially concerning water, sanitation, and hygiene (WASH), significantly influence nutritional parameters (Aguayo & Menon, 2016).

The study's most notable conclusion is the significant correlation between household water treatment and stunting. Children from households that did not purify their drinking water had 4.555 times greater odds of experiencing stunting compared to those from households that did purify their water. This outcome highlights the essential significance of point-of-use water treatment in averting stunting. Comparable results have been documented in other emerging nations. A study in Ethiopia indicated that the consumption of water from untreated sources elevated the risk of stunting seven-fold (Batiro et al., 2017). The mechanism underlying this link presumably pertains to the mitigation of waterborne pathogens, which can result in environmental intestinal dysfunction (EED), compromised nutritional absorption, and heightened susceptibility to infections, all of which contribute to stunting (Guerrant et al., 2013).

The study found no significant correlation between the supply of pure water (protected versus unprotected) and the occurrence of stunting. This unforeseen outcome diverges from earlier research, like the study of Kwami et al. (2019) in Ethiopia, which identified a substantial correlation between water source and stunting. The gap may be attributed to the significant percentage of houses in Banjar Regency (80%) that indicated access to protected water sources. The elevated access rate may have diminished the sample's variability, complicating the detection of an effect. Furthermore, evidence indicates that, in this context, household-level water treatment may be more vital than source protection in mitigating stunting.

The survey indicated that certain households utilize replenishment water (bottled water) as their principal source of drinking water, deeming it convenient and readily available. Nevertheless, not all of these households adhered to hygienic storage protocols or reboiled the water before to use. This conclusion corresponds with findings from other research in Indonesia, like

Yasmin et al. (2021), which indicated that the quality of refill water can fluctuate considerably and may not always be acceptable for eating without further treatment.

The significant prevalence of household water treatment (77.3%) in the research area is promising and may indicate effective public health activities. Nonetheless, the consistently elevated stunting rates indicate the influence of additional causes. Potential factors may encompass insufficient sanitation, substandard hygiene habits, or nutritional deficits, as indicated by Cumming and Cairncross (2016) in their analysis of WASH interventions and nutritional status.

The results of this study hold significant significance for public health initiatives in Banjar Regency and comparable environments. Efforts to enhance access to protected water sources must persist, but there should be a significant focus on advocating and guaranteeing appropriate household water treatment procedures. This corresponds with the WHO's endorsement of a holistic strategy for water safety that encompasses both source protection and point-of-use treatment (WHO, 2017).

The study emphasizes the necessity for treatments that tackle the several mechanisms by which inadequate water quality contributes to stunting. This encompasses not only the prevention of waterborne infections but also the mitigation of environmental intestinal dysfunction, a subclinical condition that can hinder nutritional absorption and is linked to inadequate WASH conditions (Owino et al., 2016).

The research underscores the significance of accounting for local water utilization habits, such as dependence on refill water, when formulating remedies. Educational programs must emphasize safe storage and handling protocols for all water sources, including those regarded as clean.

This work offers significant insights; however, it possesses limitations. The cross-sectional architecture restricts the capacity to determine causality. Longitudinal research would be advantageous for comprehending the enduring effects of water management policies on infant development. Moreover, subsequent research ought to incorporate a more thorough evaluation of WASH practices, encompassing sanitation and hygiene behaviours, to furnish a more holistic understanding of the environmental elements influencing stunting.

## Conclusions

The research performed in Astambul District, Banjar Regency, has illuminated the significant correlation between household water management practices and stunting in children under five years of age. The significant frequency of stunting (42.7%) identified in the research area highlights the necessity of addressing this public health concern. The study demonstrated a substantial correlation between the treatment of household drinking water and the incidence of stunting, indicating that children from households without treated drinking water had 4.555 times greater odds of experiencing stunting. This discovery underscores the vital importance of point-of-use water treatment in mitigating stunting. The study revealed no significant correlation between the source of clean water (protected versus unprotected) and the incidence of stunting, indicating that household-level water treatment may be more essential than mere source protection in this scenario. The results emphasize the intricate relationship between water management practices and child nutrition, highlighting the necessity for holistic treatments that tackle both water quality and household treatment.

The study's results hold significant significance for public health policies and interventions in Banjar Regency and comparable environments. Although initiatives to

enhance access to safeguarded water sources must persist, there is an evident necessity for a robust focus on advocating and guaranteeing appropriate domestic water purification methods. Public health campaigns must prioritize teaching people on effective water treatment techniques, safe storage practices, and the significance of maintaining proper cleanliness, especially when utilizing ostensibly clean water sources like replenishment water. The findings indicates the need for a comprehensive strategy to combat stunting, addressing water quality alongside sanitation, hygiene, and nutrition.

This study offers significant insights, although it is crucial to recognize its limits. The cross-sectional design constrains the establishment of causality, and subsequent longitudinal studies would be advantageous for comprehending the long-term effects of water management policies on infant growth. A more thorough evaluation of WASH practices, encompassing sanitation and hygiene behaviors, would yield a more full understanding of the environmental factors contributing to stunting. Notwithstanding these constraints, the study substantially enhances the existing data connecting water management methods to child nutritional status and provides a robust basis for subsequent research and interventions.

This study highlights the essential role of household water purification in combating child stunting in Banjar Regency. It corresponds with and bolsters national and international efforts to diminish stunting rates and enhance child health. To achieve stunting reduction targets, interventions must prioritize the promotion of safe water management practices within households, while also addressing overarching WASH conditions. Concentrating on these critical domains may yield substantial advancements in diminishing stunting rates and enhancing the overall health and welfare of children in Banjar Regency and beyond. Subsequent study ought to expand upon these findings by examining the long-term effects of enhanced water management techniques and assessing how integrated WASH interventions might optimally aid in stunting reduction initiatives.

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### **Conflict of interest**

The authors affirm that they possess no recognized financial conflicts of interest or personal affiliations that might be perceived as influencing the research presented in this paper. Each author has participated in the work, reviewed, and endorsed the final manuscript. The findings of this study are derived exclusively from the data gathered and analysed, free from any impact by funding entities or outside influences.

### **References**

Aguayo, V. M., & Menon, P. (2016). Stop stunting: Improving child feeding, women's nutrition and household sanitation in South Asia. *Maternal & Child Nutrition*, 12(S1), 3-11. <https://doi.org/10.1111/mcn.12283>

Akombi, B. J., Agho, K. E., Hall, J. J., Merom, D., Astell-Burt, T., & Renzaho, A. M. N. (2017). Stunting and severe stunting among children under-5 years in Nigeria: A multilevel analysis. *BMC Pediatrics*, 17(1), 15. <https://doi.org/10.1186/s12887-016-0770-z>

Anwar, K., & Setyani, L. I. (2022). Hubungan perilaku pengelolaan air minum dan tingkat kecukupan zat gizi makro dengan status gizi balita. *Amerta Nutrition*, 6(1), 306-313. <https://doi.org/10.20473/amnt.v6i1.2022.306-313>

Batiro, B., Demissie, T., Halala, Y., & Anjulo, A. A. (2017). Determinants of stunting among children aged 6-59 months at Kindo Didaye woreda, Wolaita Zone, Southern Ethiopia: Unmatched case control study. *PLoS ONE*, 12(12), e0189106. <https://doi.org/10.1371/journal.pone.0189106>

Cumming, O., & Cairncross, S. (2016). Can water, sanitation and hygiene help eliminate stunting? Current evidence and policy implications. *Maternal & Child Nutrition*, 12(S1), 91-105. <https://doi.org/10.1111/mcn.12258>

Guerrant, R. L., DeBoer, M. D., Moore, S. R., Scharf, R. J., & Lima, A. A. (2013). The impoverished gut—a triple burden of diarrhoea, stunting and chronic disease. *Nature Reviews Gastroenterology & Hepatology*, 10(4), 220-229. <https://doi.org/10.1038/nrgastro.2012.239>

Kwami, C. S., Godfrey, S., Gavilan, H., Lakhanpaul, M., & Parikh, P. (2019). Water, sanitation, and hygiene: Linkages with stunting in rural Ethiopia. *International Journal of Environmental Research and Public Health*, 16(20), 3793. <https://doi.org/10.3390/ijerph16203793>

Owino, V., Ahmed, T., Freemark, M., Kelly, P., Loy, A., Manary, M., & Loechl, C. (2016). Environmental enteric dysfunction and growth failure/stunting in global child health. *Pediatrics*, 138(6), e20160641. <https://doi.org/10.1542/peds.2016-0641>

Rezki, M., Utami, W. S., & Raksanagara, A. S. (2024). Association between environmental factors and stunting in children aged 6-59 months: A systematic review. *Journal of Environmental Health Science and Engineering*, 22(1), 1-14. <https://doi.org/10.1007/s40201-023-01203-0>

Riskesdas. (2018). Laporan Nasional Riskesdas 2018. Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan Republik Indonesia.

Soraya, S., Ilham, I., & Hariyanto, H. (2022). Kajian Sanitasi Lingkungan Terhadap Kejadian Stunting di Wilayah Kerja Puskesmas Simpang Tuan Kabupaten Tanjung Jabung Timur. *Jurnal Pembangunan Berkelanjutan*, 5(2), 98-114.

Soeracmad, Y., Ikhtiar, M., & Bachtiar, I. (2019). Hubungan Sanitasi Lingkungan Rumah Tangga Dengan Kejadian Stunting Pada Anak Balita Di Puskesmas Wonomulyo Kabupaten Polewali Mandar Tahun 2019. *J-KESMAS: Jurnal Kesehatan Masyarakat*, 5(2), 138-150.

Suryani, A., & Kusumayati, A. (2022). Faktor yang berhubungan dengan kualitas biologis air minum isi ulang: Literature Review. *PREPOTIF: Jurnal Kesehatan Masyarakat*, 6(2), 1852-1860.

UNICEF. (2020). Malnutrition in Children. UNICEF Data. <https://data.unicef.org/topic/nutrition/malnutrition/>

Wardita, Y., Hasanah, L., & Rasyidah, R. (2023). Hubungan Sumber dan Pengolahan Air Minum terhadap Kejadian Stunting pada Balita. *Gorontalo Journal of Public Health*, 6(2), 99-106.

World Health Organization (WHO). (2017). Guidelines for drinking-water quality: Fourth edition incorporating the first addendum. World Health Organization.

Yasmin, S., Pujiyanti, A., & Riandi, M. U. (2021). Microbiological quality of refill drinking water in Depok City, Indonesia. *E3S Web of Conferences*, 232, 01008. <https://doi.org/10.1051/e3sconf/202123201008>



Yunanda, T. F., Rahayu, W. P., & Herawati, D. (2023). Keamanan Mikrobiologis Air Minum Isi Ulang dan Perubahannya Selama Penyimpanan. *Jurnal Ilmu Pertanian Indonesia*, 28(4), 581-590.