RESEARCH STUDY OPEN ACCESS

Quality of Water Sources, Sanitation, and Hygiene in Households with Stunted Children in Rural and Urban Areas in West Java

Kualitas Sumber Air, Sanitasi, dan Higiene pada Keluarga dengan Balita Stunting di Daerah Pedesaan dan Perkotaan di Jawa Barat

Vieta Annisa Nurhidayati[1], Hadi Riyadi[2]*

[1]Management of Food Service and Nutrition Study Program, College of Vocational Studies, IPB University, Bogor, Indonesia
[2]Department of Community Nutrition, Faculty of Human Ecology, IPB University, Bogor, Indonesia

ARTICLE INFO

***Received:** 14-10-2022*
***Accepted:** 29-11-2022*
***Published online:** 23-12-2022*

***Correspondent:**
Hadi Riyadi
hadiri@apps.ipb.ac.id

DOI:
10.20473/amnt.v6i1SP.2022.13-18

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

Keywords:
Hygiene, Sanitation, Stunting, Water source

ABSTRACT

Background: The quality of water sources, sanitation, and hygiene have long been associated with the incidence of stunting in a household. Various studies show that this is also influenced by differences in access to water, sanitation, and hygiene in rural and urban areas.
Objectives: This study aims to determine the condition of the quality of water sources, sanitation, and hygiene in household with stunted children under five in rural and urban areas.
Methods: The study was conducted in June 2022 using cross-sectional method to 96 household with stunted children under five that were selected by systematic random sampling in Cianjur District and Sukabumi City. Structured questionnaire was used to collect data. Descriptive analysis and bivariate analysis were conducted to determine the distribution of use of water sources, sanitation facilities, and hygiene practices in household with stunted children under five based on the categories of improved sanitation facilities and drinking-water sources by World Health Organization and its differences in rural and urban areas.
Results: The sources of drinking and cooking water used by the household with stunted children under five have been entirely improved sources. Most of the households in both areas had defecation facilities used only by household members. There were significant differences in the type of fecal waste disposal in household with stunted children under five in rural and urban areas. Majority of households in rural area (70.0%) already used septic tank for fecal waste disposal while majority of households in urban area (65.2%) disposed their fecal waste to river/lake/sea. Mothers' handwashing practice at critical time were all above 80%, but only 33.6% of the households had separate handwashing facility and only 50.0% of them provide soap for handwashing.
Conclusions: Based on the results, it is known that household with stunted children in rural and urban areas have used proper drinking water sources and have good hygiene practices. However, fecal disposal facilities in urban areas with high prevalence of stunting need to be improved as an effort to reduce stunting prevalence.

ABSTRAK

Latar Belakang: *Kualitas sumber air, sanitasi, dan higiene telah lama dihubungkan dengan kejadian stunting dalam suatu keluarga. Berbagai penelitian menunjukkan bahwa hal ini juga dipengaruhi oleh perbedaan akses terhadap air, sanitasi, dan higiene pada wilayah pedesaan dan perkotaan.*
Tujuan: *Penelitian ini bertujuan untuk mengetahui kondisi kualitas sumber air, sanitasi, dan higiene pada keluarga dengan balita stunting di wilayah pedesaan dan perkotaan.*
Metode: *Penelitian dilakukan pada bulan Juni 2022 dengan menggunakan metode cross-sectional pada 96 keluarga stunting yang dipilih melalui sampling acak sistematis di Kabupaten Cianjur dan Kota Sukabumi dengan menggunakan kuesioner terstruktur. Analisis deskriptif dan bivariat dilakukan untuk mengetahui sebaran penggunaan sumber air, fasilitas sanitasi, dan praktik higiene pada keluarga dengan balita stunting berdasarkan kategori sumber air dan fasilitas sanitasi yang layak menurut World Health Organization dan perbedaannya pada pedesaan dan perkotaan.*
Hasil: *Sumber air minum dan masak yang digunakan oleh keluarga stunting telah seluruhnya menggunakan sumber yang layak dan terlindung. Sebagian besar rumah tangga di wilayah pedesaan dan perkotaan memiliki fasilitas buang air besar pribadi yang hanya digunakan oleh anggota rumah tangga. Terdapat perbedaan yang signifikan pada fasilitas saluran pembuangan tinja pada rumah tangga dengan balita stunting di pedesaan dan perkotaan. Sebagian besar rumah tangga di*

Amerta Nutrition
Copyright ©2022
Faculty of Public Health Universitas Airlangga
Open access under a CC BY – SA license
Joinly Published by IAGIKMI & Universitas Airlangga

pedesaan (70,0%) sudah menggunakan septic tank untuk pembuangan limbah tinja sedangkan sebagian besar rumah tangga di perkotaan (65,2%) membuang limbah tinjanya ke sungai/danau/laut. Praktik cuci tangan ibu pada waktu-waktu kritis berada di atas 80%, akan tetapi hanya 33,6% rumah tangga yang memiliki fasilitas cuci tangan terpisah dan hanya 50,0% rumah tangga yang menyediakan sabun untuk cuci tangan.

Kesimpulan: *Berdasarkan hasil penelitian, diketahui bahwa keluarga stunting di daerah pedesaan dan perkotaan telah menggunakan sumber air minum yang layak dan memiliki praktik higiene yang baik. Akan tetapi, fasilitas saluran pembuangan tinja di daerah perkotaan dengan prevalensi stunting tinggi perlu ditingkatkan kembali sebagai upaya penurunan angka stunting.*

Kata kunci: *Higiene, Sanitasi, Stunting, Sumber air*

INTRODUCTION

Stunting is a complex nutritional issue that is led by multifactorial causes[1]. The complexity of stunting and its possible complication for the children and for the nation in the future, has made stunting becomes Indonesia's national priority. According to Nutritional Status Study of Indonesia in 2021, the prevalence of stunting is 24.4%[2]. This number is still higher than the estimates of global stunting prevalence in 2020 at 22%[3]. West Java is Indonesia's most populated province in 2021 with 48,220,094 people that lives in 65.7% urban and 34.3% rural area[4]. The prevalence of children with stunting in West Java is slightly higher than national level at 24.5%. The prevalence of stunting is higher in Cianjur District as rural area at 33.7% than to Sukabumi City as urban area at 19.1%[2].

Water, sanitation, and hygiene (WASH) is an important factor of healthy life. Limited access to safe and improved WASH facilities have been linked into several health and nutritional conditions including stunting through several mechanism: recurring diarrhea, soil-transmitted helminth infections, and environmental enteric dysfunction (EED) [1,5–9]. Poor WASH access and practice increases the probability of ingestion of microbes and helminth from environmental contamination that causes infectious disease[6]. The microbes or helminth can be transmitted directly through contaminated hands or through indirect transmission from contaminated of water, soil, and foods. The inflammation caused by microbes and helminth will be responded by impaired bone growth and remodeling and growth hormone resistance. At the same time, increased nutrient requirement caused by the inflammation is not fulfilled by oral intake and malabsorption caused by the infection. These conditions contribute to linear growth impairment in children with poor WASH access[6,8,10].

Differences of access to WASH between urban and rural area have long been found in previous studies[9,11–13]. In West Java, only 75.2% households have access to safe sanitation facility and only 67.6% households have access to safe drinking water sources[2]. It is said that most people in urban areas have better access to WASH compared to people in rural area[9]. Urban area, however, have complex population pattern. People who lived in peri-urban are mostly have limited access to safe WASH facilities compared to other part of the town. Ever-growing population and mix of socio-economic characteristics may hinder any improvement of WASH facilities used in urban area[9,12]. Moreover, peri-urban area might have both central urban and remote rural characteristics[11]. The differences of access to WASH in urban and rural area makes it important to understand the quality of water sources, sanitation, and hygiene in household with stunted children under five in rural and urban areas in West Java as the most populated province in Indonesia.

METHODS

This study was conducted in June 2022 at Sukabumi City (urban) and Cianjur District (rural). Anthropometric measurement was done at six integrated health care centers (posyandu) to systematically randomized subjects. Children who were categorized as stunted included in the study. The total of selected subjects was 50 household with stunted children from rural area and 46 household with stunted children from urban area. Data was collected using interview and all subjects signed informed consent form.

This study used a questionnaire developed from World Health Organization (WHO) Nutrition Landscape Information System (NLiS) on improved sanitation facilities and drinking water sources[14]. Improved water sources are water that are protected from contamination, especially fecal matter. Water sources that are considered as improved includes household connections, public standpipes, boreholes, protected dug wells, protected springs, and protected rainwater collection. Unimproved sources include unprotected wells, unprotected springs, and surface water.

Improved sanitation facilities separate human waste from human contact, these include flush toilet, ventilated-improved pit latrines, pit latrines with slab, or composting toilet and the waste should be discarded to piped sewer system or septic tank. Open defecation, open pit latrines, pit latrines without slab, bucket latrines, hanging latrines, and waste that is discarded to elsewhere such as pond, rice field, river, lake, or sea are not considered as improved. Shared or public toilets are also not considered as improved.

Hygiene was measured by handwashing facilities and practice[7,8,15]. Improved hygiene practice is defined as the availability of separate handwashing facility, clean water, and soap. Handwashing practice is measured at critical time of contamination from hands such as before preparing and cooking, before and after eating, after using the toilet, after changing diaper or helping children in toilet, after holding animal, after handling trash, and when hands look dirty. The subjects could answer to more than one answers in each category according to the existence and type of water source, sanitation facilities, and hygiene practice they have.

The data was analyzed descriptively to know the distribution of the use of water source, sanitation facilities, and hygiene on household with stunted

Amerta Nutrition
Copyright ©2022
Faculty of Public Health Universitas Airlangga
Open access under a CC BY – SA license
Joinly Published by IAGIKMI & Universitas Airlangga

children. Bivariate analysis by Chi-square test was used to analyze the differences of proportion between rural and urban household. All analyses were carried out using SPSS 26.0. This study and its instruments passed ethical review of the Research Ethics Commission involving Human Subjects of LPPM IPB University with registration number 680/IT3.KEPMSM-IPB/SK/2022.

RESULTS AND DISCUSSION

The socio-economic characteristics of household with stunted children under five is shown on Table 1. The occupation of household head in each area is mostly laborers with average income IDR 3,587,162.03 ± 2,259,043.38. This is also found in previous studies where the occupation of the household head with stunted children were laborers[1,16]. Most of the household in rural area (24.0%) belongs to the lowest income quintile, while most of the household in urban area belongs to the third quintile (23.9%). The ratio of income to expenditure in rural area is 0.96 while in urban area the ratio is 0.88. This shows that household with stunted children spent more money than what they earn, leaving no savings for the future or emergency situation. Low income and economic status reduce the purchasing power of household with stunted children, limiting their access to wide variety of food, health care service, and WASH facilities[6]. When looking into the proportion of expenditure for sanitation products, household with stunted children in urban area (3.9%) spent more money than household with stunted children in rural area (3.5%) although not significantly.

Table 1. Socio-economic characteristics of the subjects

Socioeconomic Characteristics	Rural n= 50	Urban n= 46	Total n= 96
Household head's occupation, n (%)			
- Civil servants	0 (0.0)	1 (2.2)	1 (1.0)
- Private employees	4 (8.0)	9 (19.6)	13 (13.5)
- Self-employed	10 (20.0)	6 (13.0)	16 (16.7)
- Farmers	4 (8.0)	0 (0.0)	4 (4.2)
- Laborers	21 (42.0)	20 (43.5)	41 (42.7)
- Others	11 (22.0)	10 (21.7)	21 (21.9)
Income quintile, n (%)			
- Lowest	12 (24.0)	10 (21.7)	22 (22.9)
- Second	9 (18.0)	8 (17.4)	17 (17.7)
- Third	9 (18.0)	11 (23.9)	20 (20.8)
- Fourth	10 (20.0)	8 (17.4)	18 (18.8)
- Highest	10 (20.0)	9 (19.6)	19 (19.8)
Income, median (IQ range)	3,000,000 (1,677,750 – 4,625,500)	3,150,000 (2,085,000 – 4,700,000)	3,000,000 (2,000,000 – 4,600,000)
Expenditure, median (IQ range)	3,128,999 (2,131,833 – 4,465,999)	3,562,563 (2,873,312 – 4,720,125)	3,477,500 (2,504,937 – 4,711,208)
Sanitation expenditure, median (IQ range)	110,000 (63,750 – 213,500)	141,000 (73,000 – 227,500)	130,000 (70,000 – 220,000)

The distribution of water source used for drinking, cooking, bathing, and washing are presented on Table 2. All household in rural and urban areas uses improved water sources for drinking. Refilled water is the major water source in rural (52.0%) and urban (78.3%) area (χ^2: 7.223; p<0.05). The second source for drinking in rural area is water from protected dug well (42.0%), this number is significantly higher than the use of protected dug well water in urban area that only counts to 15.2% (χ^2: 8.318; p<0.01). This is similar to the findings in Surabaya where household with stunted children use refilled water or treated tap water as drinking water sources[6]. Water source that is used for cooking is as important to water used for drinking. All household have used improved water source, with the major source are protected dug well (rural: 74.0%, urban: 63.0%). The second major source for cooking in rural area is drilled/pumped well as much as 20.0%, while the next source of water for cooking in urban area other than drilled/pumped well is refilled water.

Table 2. Distribution of water sources type according to type of use

Water Sources Indicators	Rural n= 50	Urban n= 46	Total n= 96	χ^2	p-value
Water for drinking, n (%)					
- Branded bottled water	2 (4.0)	0 (0.0)	2 (2.1)	1.879	0.496
- Refilled water	26 (52.0)	36 (78.3)	62 (64.6)	7.223	0.010*
- Metered tap water	0 (0.0)	1 (2.2)	1 (1.0)	1.098	0.479
- Drilled/pumped well	6 (12.0)	3 (6.5)	9 (9.4)	0.846	0.490
- Protected dug well	21 (42.0)	7 (15.2)	28 (29.2)	8.318	0.006*

Copyright ©2022
Faculty of Public Health Universitas Airlangga
Open access under a CC BY – SA license
Joinly Published by IAGIKMI & Universitas Airlangga

Water Sources Indicators	Rural n= 50	Urban n= 46	Total n= 96	χ^2	p-value
Water for cooking, n (%)					
- Refilled water	1 (2.0)	8 (17.4)	9 (9.4)	6.680	0.013*
- Metered tap water	2 (4.0)	3 (6.5)	5 (5.2)	0.309	0.668
- Drilled/pumped well	10 (20.0)	8 (17.4)	18 (18.8)	0.107	0.798
- Protected dug well	37 (74.0)	29 (63.0)	66 (68.8)	1.339	0.277
- Protected water springs	1 (2.0)	0 (0.0)	1 (1.0)	0.930	1.000
Water for bathing and washing, n (%)					
- Refilled water	1 (2.0)	0 (0.0)	1 (1.0)	0.930	1.000
- Metered tap water	2 (4.0)	2 (4.3)	4 (4.2)	0.007	1.000
- Drilled/pumped well	9 (18.0)	12 (26.1)	21 (21.9)	0.917	0.459
- Protected dug well	36 (72.0)	31 (67.4)	67 (69.8)	0.241	0.661
- Unprotected dug well (*unimproved*)	2 (4.0)	0 (0.0)	2 (2.1)	1.879	0.496
- Surface water (*unimproved*)	1 (2.0)	0 (0.0)	1 (1.0)	0.930	1.000

*Significant at p<0.05

The prominent water source used for bathing and washing in rural (72.0%) and urban (67.4%) area is protected dug well. Drilled/pumped well is the second most used water source for bathing and washing in both areas. It is found that three household from rural area still uses unimproved water source from unprotected dug well and surface water. Although not directly consumed, the use of unprotected water source could lead to several health problems caused by thoroughly unwashed eating utensils. Washing utensils with contaminated water source increase the possibility of living microbes to stay and grow until it is used again for eating, causing indirect transmission[6,7,15]. These findings also supported by the study that showed low awareness of the cleanliness of eating utensils and the use of improved water source for daily needs[16].

Most of the household in rural and urban has private sanitation facilities for defecation for their household members, that accounts to 70.8% common toilets inside the house and 25% private toilets. The common type of toilet used in the households are flush toilets (rural: 84.0%, urban: 82.6%). The second most used toilet in both areas is open pit latrines as much as 16% in rural area and 15.2% in urban area. The use of healthy toilets is effective to stop the spread of infectious disease caused by fecal-oral transmission and create better environment[15]. However, there are four households in both area that still uses public toilets with high risk of contamination and categorized as unimproved sanitation facilities. Moreover, there is one household in rural area that does not have defecation facilities. Limited budget and space, large family size, and more than one household living under one roof are the most common reasons for using public toilets and open defecation[12].

Table 3. Distribution of type of sanitation facilities owned

Sanitation Indicators	Rural n= 50	Urban n= 46	Total n= 96	χ^2	p-value
Facilities for defecation and those who use, n (%)					
- Available, used only for specific household members	13 (26.0)	11 (23.9)	24 (25.0)	0.056	1.000
- Available, shared with all household members	35 (70.0)	33 (71.7)	68 (70.8)	0.035	1.000
- Available, in public toilets where anyone can use (*unimproved*)	2 (4.0)	2 (4.3)	4 (4.2)	0.007	1.000
- None (*unimproved*)	1 (2.0)	0 (0.0)	1 (1.0)	0.930	1.000
Type of toilet used, n (%)					
- Flush toilets	42 (84.0)	38 (82.6)	80 (83.3)	0.033	1.000
- Pit latrines with slab	0 (0.0)	1 (2.2)	1 (1.0)	1.098	0.479
- Open pit latrines (*unimproved*)	8 (16.0)	7 (15.2)	15 (15.6)	0.011	1.000
- None (*unimproved*)	1 (2.0)	2 (4.3)	3 (3.1)	2.849	0.243
Fecal waste disposal, n (%)					
- Septic tank	35 (70.0)	13 (28.3)	48 (50.0)	16.696	0.000*
- Wastewater sewer	2 (4.0)	0 (0.0)	2 (2.1)	1.879	0.496
- Pond/rice field (*unimproved*)	1 (2.0)	1 (2.2)	2 (2.1)	0.004	1.000
- River/lake/sea (*unimproved*)	11 (22.0)	30 (65.2)	41 (42.7)	18.288	0.000*

*Significant at p<0.05

There are three households that have no toilet facilities, these households usually use hanging latrines in pond or rice field. Disposal of fecal waste is an important indicator of environmental healthiness[11]. Septic tank is the most used disposal facilities used in rural area (70%), whereas disposal to river/lake/sea is the most common disposal facilities in urban area (65.2%), the differences between both areas is significant. This finding is also found in previous study where 60.6% fecal waste in household with stunted children is disposed to the river

Amerta Nutrition
Copyright ©2022
Faculty of Public Health Universitas Airlangga
Open access under a CC BY – SA license
Joinly Published by IAGIKMI & Universitas Airlangga

stream[15]. The reason of why these households chooses this type of disposal is because they do not have the cost to construct the suitable disposal facility. The study, however, was done in rural area as opposed to the result of current study where household in rural area showed better result. Small urban towns usually have diverse urban-rural characteristics, indicating that they still have rural community characteristics[11]. The cause of poor fecal waste management in urban area might also be caused by rapid population growth that is not compensated by the town's matching sanitation facility development[13].

Disposal of fecal waste into water stream is categorized as unimproved type of sanitation facility as it could cause environmental contamination. Dirty environments could cause direct transmission to stunted children and indirect transmission through contaminated food consumption. Children under five enjoy exploratory play in the nature; they play by touching soil, water, and animals around them. Mouthing behavior that is observed in the children during playing could cause direct transmission of microbe and helminth[7,10]. Livestock that were raised in dirty environments spoiled with human excretes are found to grow slower than livestock in clean environments. Fresh product grown with human excretes also found to be in high risk of microbe contamination. Moreover, the fresh products and livestock from dirty environments tend to have lower nutritional qualities[10].

There are more household in urban area (45.7%) that have a separate handwashing facility in their house compared to those in rural area (χ^2: 7.223; p<0.05). Clean water is mostly available (70.8%) for handwashing in both areas, but only 50.0% of the households provide soap for handwashing (Table 4). The use of soap during handwashing is important to reduce the microbes on dirty hands to avoid direct transmission, but less than 20% people globally wash their hands using soap after defecation and other critical times[6,9].

Table 4. Distribution of hygiene practice of mothers with stunted children

Hygiene Indicators	Rural n= 50	Urban n= 46	Total n= 96	χ^2	p-value
Handwashing facilities, n (%)					
- Have a separate handwashing facility	11 (22.0)	21 (45.7)	32 (33.3)	6.031	0.018*
- Clean water is available for handwashing	33 (66.0)	35 (76.1)	68 (70.8)	1.180	0.369
- Soap is available for handwashing	22 (44.0)	26 (56.5)	48 (50.0)	1.503	0.307
Handwashing time, n (%)					
- Before preparing and cooking food	44 (88.0)	40 (87.0)	84 (87.5)	0.024	1.000
- Before and after eating	50 (100.0)	46 (100.0)	96 (100.0)	-	-
- After using the toilet	48 (96.0)	46 (100.0)	93 (96.9)	1.879	0.496
- After changing diaper or helping children in toilet	46 (92.0)	46 (100.0)	92 (95.8)	3.840	0.118
- After holding animal	43 (86.0)	39 (84.8)	82 (85.4)	0.029	1.000
- After handling trash	45 (90.0)	45 (97.8)	90 (93.8)	2.504	0.206
- When hands look dirty	46 (92.0)	46 (100.0)	92 (95.8)	3.840	0.118

*Significant at p<0.05

Mothers' practice of washing hands influenced the incidence of stunting in children[6,7]. In terms of practicing personal hygiene through washing hands, subjects in both areas have already good understanding and practice of critical time to wash their hands to avoid contamination or infection. The recent pandemic has shown great impact on people's knowledge, attitude, and practice on personal hygiene. Two lowest answers of hand washing time are before preparing and cooking food (87.5%) and after holding animal (85.4%). Dirty hands could cause cross contamination to food during cooking process. The consumption of food processed with bad hygiene practices could cause food poisoning with symptoms like decrease of appetite, vomiting, and diarrhea. The symptoms could reduce food intake of the children so that the nutritional needs are unfulfilled, causing growth disorder[16].

Animal can transmit disease to human through its excretes, feathers, and skin[15]. One of the most known microbes lives in animal's body is *Escherichia coli* that can cause diarrhea, fever, nausea, and vomiting. Diarrhea is the common condition found in stunted children, a study in Surabaya showed that stunted children suffer from two to three incidence of diarrhea in the last three months[16]. The transmission of this bacteria could be prevented by washing hands using soap, proving the importance of washing hands after handling animals[15].

Stunting must be treated by intervening its underlying determinants, including nutrition-sensitive determinants such as WASH[7,9]. The incidence of stunting is reportedly higher in household with unimproved defecation facility, household that did not use soap while washing hands, and household that drink untreated and unimproved water source[8]. Education on personal hygiene in the practice of handwashing with emphasizing the use of soap might be needed to improve personal hygiene in mothers with stunted children. Moreover, it is important to interfere with fecal-oral transmission through the improvement of household sanitation. Closed fecal waste disposal could reduce fecal load in living environment, creating cleaner environment for the children to eat and play[10].

This study adds to the limited investigation of WASH conditions among household with stunted children under five in Indonesia. The differentiation between households in urban and rural area is the main strength of this study that provides detailed information on each component of WASH. The limitation of this study is that practice of handwashing was only measured using questionnaire and not through observation, mothers'

Amerta Nutrition
Copyright ©2022
Faculty of Public Health Universitas Airlangga
Open access under a CC BY – SA license
Joinly Published by IAGIKMI & Universitas Airlangga

practice might be different with what they reported during interview. Further studies are needed to causal relationship between WASH conditions to the incidence of stunting in each area.

CONCLUSIONS

All of households in urban and rural area uses improved water sources for drinking and cooking, although several households in rural area still uses unimproved water sources for bathing and washing. Most households also have private defecation facility for household members with improved toilet types. However, majority of household in urban area still have poor fecal waste management by disposing excretes to water stream. Improvement is needed to change this type of waste management to end fecal-oral transmission that causes infection in stunted children.

ACKNOWLEDGEMENT

We would like to thank Cianjur District and Sukabumi City Health Offices and the Public Health Centers at the study site for their support of the study.

CONFLICT OF INTEREST AND FUNDING DISCLOSURE

All authors have no conflict of interest in this article. This research was funded by Neys – van Hoogstraten Foundation/NHF (The Netherlands).

REFERENCES

1. Wiyono, S. *et al.* The role sanitation to stunting children age 6-35 months, Purwojati subdistrict, Banyumas district, Central Java, Indonesia. *Int J Community Med Public Health* **6**, 82-88 (2018).
2. Kementerian Kesehatan Republik Indonesia. *Buku Saku Hasil Studi Status Gizi Indonesia (SSGI) Tahun 2021*. (2021). Available at: https://www.litbang.kemkes.go.id/buku-saku-hasil-studi-status-gizi-indonesia-ssgi-tahun-2021/. (Accessed: 12th October 2022)
3. World Health Organization. Joint child malnutrition estimates. (2022). Available at: https://www.who.int/data/gho/data/themes/topics/joint-child-malnutrition-estimates-unicef-who-wb. (Accessed: 12th October 2022)
4. Direktorat Jenderal Kependudukan dan Pencatatan Sipil Kementerian Dalam Negeri Republik Indonesia. Rilis Data Kemendagri: Jumlah Penduduk Jabar Terbanyak, Kaltara Tersedikit. (2022). Available at: https://dukcapil.kemendagri.go.id/berita/baca/1033/rilis-data-kemendagri-jumlah-penduduk-jabar-terbanyak-kaltara-tersedikit. (Accessed: 12th October 2022)
5. Yustianingrum, L. N. & Adriani, M. Perbedaan Status Gizi dan Penyakit Infeksi pada Anak Baduta yang Diberi ASI Eksklusif dan Non ASI Eksklusif. *Amerta Nutrition* **1**, 415-423 (2017).
6. Audiena, N. P. & Siagian, M. L. Association between Infectious Disease and Hygiene Practice on Stunting Toddler Aged 24-59 Months. *Amerta Nutrition* **5**, 149-157 (2021).
7. Rah, J. H. *et al.* Household sanitation and personal hygiene practices are associated with child stunting in rural India: a cross-sectional analysis of surveys. *BMJ Open* **5**, e005180–e005180 (2015).
8. Torlesse, H., Cronin, A. A., Sebayang, S. K. & Nandy, R. Determinants of stunting in Indonesian children: evidence from a cross-sectional survey indicate a prominent role for the water, sanitation and hygiene sector in stunting reduction. *BMC Public Health* **16**, 669 (2016).
9. Cumming, O. & Cairncross, S. Can water, sanitation and hygiene help eliminate stunting? Current evidence and policy implications. *Matern Child Nutr* **12**, 91–105 (2016).
10. Mbuya, M. N. N. & Humphrey, J. H. Preventing environmental enteric dysfunction through improved water, sanitation and hygiene: an opportunity for stunting reduction in developing countries. *Matern Child Nutr* **12**, 106–120 (2016).
11. Marks, S. J. *et al.* Water supply and sanitation services in small towns in rural–urban transition zones: The case of Bushenyi-Ishaka Municipality, Uganda. *NPJ Clean Water* **3**, 21 (2020).
12. Iddi, S. *et al.* Determinants of transitions in water and sanitation services in two urban slums of Nairobi: A multi-state modeling approach. *Glob Epidemiol* **3**, 100050 (2021).
13. Angoua, E. L. E., Dongo, K., Templeton, M. R., Zinsstag, J. & Bonfoh, B. Barriers to access improved water and sanitation in poor peri-urban settlements of Abidjan, Côte d'Ivoire. *PLoS One* **13**, e0202928 (2018).
14. World Health Organization. Improved sanitation facilities and drinking-water sources. (2022). Available at: https://www.who.int/data/nutrition/nlis/info/improved-sanitation-facilities-and-drinking-water-sources. (Accessed: 12th October 2022)
15. Sinatrya, A. K. & Muniroh, L. Hubungan Faktor Water, Sanitation, and Hygiene (WASH) dengan Stunting di Wilayah Kerja Puskesmas Kotakulon, Kabupaten Bondowoso. *Amerta Nutrition* **3**, 164-170 (2019).
16. Desyanti, C. & Nindya, T. S. Hubungan Riwayat Penyakit Diare dan Praktik Higiene dengan Kejadian Stunting pada Balita Usia 24-59 Bulan di Wilayah Kerja Puskesmas Simolawang, Surabaya. *Amerta Nutrition* **1**, 243-251 (2017).

Amerta Nutrition
Copyright ©2022
Faculty of Public Health Universitas Airlangga
Open access under a CC BY – SA license
Joinly Published by IAGIKMI & Universitas Airlangga