

# Improved sanitation is associated with reduced child stunting amongst Indonesian children under 3 years of age

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## Abstract

Growing evidence suggests that household sanitation is associated with child nutritional status in low- and middle-income countries. This paper examined whether household access to improved sanitation facilities and sources of drinking water was associated with stunting and anaemia amongst children aged 6–35 months of age in Indonesia. The sample for the analysis comprised 1,450 children aged 6–35 months who participated in the end-line survey of the maternal and young child nutrition security project in Asia, conducted in three selected districts in Indonesia. Logistic regression models were used to determine the association between household sanitation and water source, and stunting and anaemia. Approximately 26% and 56% of children 6–35 months of age were stunted and anaemic, respectively. Children living in a household with improved sanitation facilities had 29% reduced odds of being stunted compared with those in a household with unimproved sanitation facilities, after adjusting for potential confounders including child's age and gender, maternal education, and iron-folic acid supplementation, as well as household wealth status and source of drinking water (OR = 0.68, 95% CI: 0.48–0.96). No association between household sanitation and childhood anaemia was observed. Source of drinking water was not associated with stunting or anaemia amongst children. There were no synergistic effects of household sanitation and water supply on stunting and anaemia. This suggests that efforts to improve household sanitation condition may need to be considered an essential, integral part of the programmatic responses by governments and development partners for the prevention of childhood nutritional status. Further randomised research is necessary to determine the causal link.

## KEYWORDS

Anaemia, Indonesia, sanitation, stunting, WASH

## 1 | INTRODUCTION

Worldwide, stunting and anaemia affects an estimated 22% and 43% of children under-fives, respectively (Gretchen et al., 2013; United Nations Children's Fund et al., 2018). Nearly 40% of Indonesian children are deprived of a good start in life due to undernutrition (National Institute of Research and Development, Ministry of Health, 2013). The prevalence of stunting in Indonesia is unacceptably high,

affecting 9 million children (37%) under 5 years of age, the fifth highest national burden in the world (National Institute of Research and Development, Ministry of Health, 2013; United Nations Children's Fund, 2013). Anaemia is also a significant public health and development challenge, with approximately 28% of Indonesian under-fives being anaemic (National Institute of Research and Development, Ministry of Health, 2013). The persistent high prevalence of stunting and anaemia constrains progress towards the Sustainable

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Development Goals and poses a significant threat to the formation of Indonesia's cognitive capital, economic growth, and development (Strass & Thomas Strauss & Thomas, 1998; Samson, Fajth, & François, 2016).

Fortunately, Indonesia has begun to take major steps to reduce child undernutrition. Stunting has been included as a main development indicator in the National Medium Term Development Plan (2015–2019), demonstrating the government's commitment to address malnutrition and recognizing the need for a multisector response (National Development Planning Agency, 2014). The Government of Indonesia has also been implementing programmes to control anaemia in selected age groups (National Development Planning Agency, 2014). However, these programmes focus primarily on pregnant women, and iron and folic acid supplementation, which in general, at best can only resolve approximately half the burden of anaemia in women (Stoltzfus, Mullany, & Black, 2002). Therefore, the prevalence of child anaemia has remained stagnant.

Both stunting and anaemia result primarily from three proximate causes: (a) limited quantity, quality, and diversity of children's diets coupled with suboptimal feeding and care practices; (b) inadequate nutrition and care for women; and (c) high rates of infectious diseases due predominantly to an unhealthy environment, poor access to essential health services, and/or poor hygienic practices. Though iron deficiency has commonly been reported as the cause of half of all anaemia cases, recent evidence suggests the proportion of anaemia associated with iron deficiency could be lower than previously assumed, with inflammation and genetic haemoglobin disorders likely accounting for a larger share of the burden than previously estimated (Petry et al., 2016; Sachdev & Gera, 2013). Other micronutrient deficiencies also lead to stunting and anaemia, such as zinc and essential amino-acid deficiencies lead to stunted growth, whereas iron, folic acid, vitamin B-12, and vitamin A deficiencies lead to anaemia.

Emerging evidence suggests that water, sanitation, and hygiene (WASH) practices affect the nutritional status of children, especially linear growth in early childhood (Ngure et al., 2014). In Indonesia, it is estimated that in excess of 30 million people defecate in the open (World Health Organization & United Nations Children's Fund, 2017). Intake of faecal pathogens due to poor hygiene, sanitation, and contaminated water is known to cause intestinal infections (Dewey & Mayers, 2011), which exacerbates a child's nutritional status by reducing appetite and nutrient absorption, as well as enhancing nutrient losses (Cronin et al., 2017; Dewey & Mayers, 2011).

Less is known about the links between anaemia and household WASH practices. Inflammation is known to be the second most common cause of anaemia after iron deficiency and is caused by conditions such as acute respiratory infections and diarrhoea, which are associated with poor WASH services and practices (Ngure et al., 2014; Weiss & Goodnough, 2005). Chronic inflammation and immune stimulation as a result of subclinical disorder of the small intestine known as environmental enteric dysfunction may also contribute to the development of anaemia (Ngure et al., 2014).

The Maternal and Young Child Nutrition Security Initiative in Asia (MYCNSIA) project was launched by the European Union and UNICEF in Indonesia and four other Asian countries in 2011 to improve nutrition security amongst women and young children (United Nations

### Key messages

- Unimproved sanitation was found to be a significant predictor of stunting amongst children under 3 years of age in an area where stunting prevalence had already been reduced by 23% within 3 years by scaling up essential nutrition interventions.
- Urgent integrated multisectoral policy and programme actions encompassing WASH interventions are required in Indonesia, and other low- and middle-income countries, to accelerate progress towards reduction of stunting and anaemia in children, with a particular focus on the 1,000 day window of opportunity.
- Randomised controlled trials are warranted to validate the causal association between child stunting and sanitation.

Children's Fund, 2015). The project aimed at reducing child stunting and anaemia amongst pregnant women and children by scaling up a package of essential nutrition interventions. An analysis of MYCNSIA's baseline data in Indonesia indicated that child stunting was associated with household access to drinking water and improved latrines (Torlesse, Cronin, Sebayang, & Nandy, 2016).

The main objective of this paper is to use MYCNSIA's end-line data to examine the association between household access to improved sources of drinking water and sanitation facility with stunting and anaemia amongst children 6–35 months of age. A better understanding of this link will help promote the design and implementation of holistic and integrated programmatic strategies to combat child undernutrition.

## 2 | METHODS

### 2.1 | Data

We analysed the MYCNSIA end line survey data collected in December 2014 from three districts in Indonesia, namely, Jayawijaya District in Papua Province, Klaten District in Central Java Province, and Sikka District in Nusa Tenggara Timur (NTT) Province. Details of the MYCNSIA project are described elsewhere (Torlesse et al., 2016; United Nations Children's Fund, 2015). Briefly, in all three districts, concerted actions were taken from 2011 to improve the coverage and quality of essential nutrition interventions, by strengthening the enabling environment (i.e., policies, plans, budget for nutrition), building the capacity of health workers and community workers, and improving the health and nutrition information systems.

For the end-line assessment, a multistage cluster random sampling technique was used to include a representative sample of 11732 children aged less than 3 years and 1,119 pregnant women. The sample size was determined to be sufficient to detect a 5 percentage point decline in the estimated baseline stunting prevalence of 46.4%.

Children who were reported to have a chronic disease such as cerebral palsy, asthma, or diabetes, lasting more than 3 months were excluded. The survey provided information on environmental hygiene, fertility, family planning, health, nutritional status, and the socio-economic status of selected households in the three districts. The children and women included in the baseline and end-line surveys were not identical, but were selected using random sampling techniques.

## 2.2 | Data collection

All eligible respondents in each of the selected households were visited by field data collectors for home-based paper-based interviews and anthropometric measurements. Information on household composition, demography, socio-economic status, source of drinking water, access to sanitation facilities, and utilization of Government social safety net programmes was collected from the household head. The mother of the child or other caregiver was requested to provide information on the child's age, sex, birthweight, morbidity in the past week, immunization status, breastfeeding practices, and dietary intake. Age assessment of children was done using immunization cards or home records of date of birth. When these documents were unavailable, the local events calendar was used to help determine the child's age. Information on the mother/caregiver's age, education, reproductive history, access to health and nutrition services (antenatal care, assistance at delivery, micronutrient supplementation), and recent morbidity was also collected. All interviews were conducted using a standardized questionnaire.

Anthropometric measurements were taken following standard procedures (Gibson, 1990). Height was measured to the nearest 0.1 cm using a locally produced height/length board. Weight was assessed to the nearest 0.1 kg using seca electronic scales (seca, model 874, Germany). Haemoglobin concentration in capillary blood was assessed by HemoCue (Model 201+, Angelholm Sweden).

The field interviewers and anthropometrists were trained prior to data collection according to the procedures in the survey protocol. Their performance during data collection was regularly monitored and supervised. For randomly selected 10% samples, duplicate measurements of anthropometry were taken, and the within-subject coefficient of variation in both children and women was estimated to be less than 5%. Non-response and refusals to participate in the survey were minimal.

## 2.3 | Statistical analysis

A total of 1,450 children aged 6–35 months who participated in the MYCNSIA end-line survey were included in the analysis. Of these, haemoglobin data were available for 853 randomly selected children, as the required sample size was 697 to detect the expected change (15%) in anaemia prevalence between baseline and endline. The data were weighted for probability of selection and adjusted for the multi-stage cluster design of the surveys.

Anaemia was defined as having haemoglobin concentration below 110 g/L for children under 3 years of age. Using the WHO growth standards, stunting and wasting were defined as having z-scores less

than  $-2$  for height-for-age and weight-for-height, respectively. Sources of drinking water were divided into two categories: improved (piped into a dwelling, plot or yard, piped into public taps, or protected wells) and unimproved (open well, tube wells or bore holes, protected natural springs, and rain water; World Health Organization & United Nations Children's Fund, 2015). Sanitation facilities were also divided into two categories: improved (only if a latrine with a septic tank) and unimproved (all remaining categories; World Health Organization & United Nations Children's Fund, 2015). A household wealth index was computed as an indicator of household economic status using the same methodology described in our earlier analysis (Torlesse et al., 2016). Appropriate cut-offs were applied to create dichotomous or categorical variables for some variables such as maternal education and age.

The associations between stunting or anaemia with type of sanitation facility and source of drinking water were assessed using logistic regression models. Stunting and anaemia were included as the dependent variable, and household sanitation and source of drinking water as the independent variables along with all the potential confounding variables including child's age and gender, maternal education, and iron-folic acid supplementation as well as household wealth status. Potential confounders were first selected based on their known association with child stunting and anaemia in low- and middle-income countries. Next, characteristics in the bivariate analyses ( $p < 0.05$ ) that differed by stunting and anaemia status, and that were associated with household sanitation facility or drinking water source, were identified and included in the final model. Separate models were constructed for stunting and anaemia. All analyses were performed using STATA version 14.0 (Stat Corp., College Station, TX, USA).

Only respondents who gave written consent were interviewed and assessed for anthropometry. For infants and children, consent was sought from parents or guardians. Ethical clearance for the study protocol was received from the Ethical Committee of the Faculty of Public Health, University of Indonesia and local authorities including the district health offices and local health centres.

## 3 | RESULTS

The mean ( $\pm$  standard deviation [SD]) age of children included in the analysis was  $19.5 \pm 9$  months, and 51% were boys (Table 1). Approximately 26% ( $N = 374$ ) of children aged 6–35 months were stunted, and 10% ( $N = 140$ ) were wasted. More than half (56%) the children were anaemic ( $N = 477$ ) and 13% ( $N = 184$ ) had experienced diarrhoea in the previous 2 weeks. Most children had been weighed at birth and 9% had low birth weight ( $<2500$  g,  $N = 75$ ). Children for whom haemoglobin data were not available ( $n = 597$ ) had a comparable nutritional status, as well as comparable demographic, household, and maternal characteristics to children who were included in the haemoglobin analysis (data not shown).

In a multivariate analysis, having improved toilet facilities at home was associated with a 29% reduced odds of being stunted amongst children 6–35 months of age after adjusting for all potential confounders including child's age and sex, maternal education, and iron folic acid supplementation as well as household wealth status

**TABLE 1** Characteristics of children 6–35 months included in analysis

N	1,450
Child characteristics	
Age in months (mean ± SD)	19.5 (±8.6)
Male	51%
Stunted height-for-age z-score, <−2 <sup>a</sup>	26%
Wasted weight-for-height z-score, <−2 <sup>a</sup>	10%
Anaemic (haemoglobin <110 g/L)	56%
Low birth weight (<2500 g)	9%
Had diarrhoea in last 2 weeks	13%
Had fever in last 2 weeks	22%
Breastfeeding started within 1 hr of birth	67%
Received deworming tablet in the past 6 months <sup>b</sup>	45%
Child received MNP in the last 6 months (6–35 months)	24%
Mother characteristics	
Age, year (mean ± SD)	30.7 (± 6.8)
Education	
No schooling	8%
Primary school	18%
Secondary school	24%
>secondary school	50%
≥4 antenatal visits during last pregnancy	76%
Received >90 iron and folic acid supplements during pregnancy	64%
Household characteristics	
Sanitation facility	
Improved sanitation facility <sup>c</sup>	71%
Unimproved sanitation facility	29%
Source of drinking water	
Improved sources of drinking water <sup>d</sup>	57%
Water treated <sup>e</sup>	67%
Hygiene practices	
Handwashing with water and soap	70%
Safe disposal of child's faeces	53%

Note. MNP: micronutrient powders; SD: standard deviation.

<sup>a</sup>Estimated by using 2006 World Health Organization (WHO) growth reference.

<sup>b</sup>Amongst children 12–35 months of age.

<sup>c</sup>Improved sanitary facility refers to using latrine with a septic tank.

<sup>d</sup>Improved sources of drinking water include water piped into the dwelling, yard or plot, a public tap, a protected well in the dwelling, yard or plot, and a protected public well.

<sup>e</sup>Treated household water refers to water that is boiled, bleached, filtered or solar disinfected.

and source of drinking water (adjusted OR = 0.71, 95% CI: 0.51–0.97; Table 2). Household access to an improved water source did not predict childhood stunting. There were no synergistic effects of household sanitation and water supply on childhood stunting (data not shown).

On the other hand, there was no significant association between household access to improved sanitation facilities and anaemia amongst children aged 6–35 months after adjusting for all potential confounders including child's age and sex, maternal education, and

iron folic acid supplementation as well as household wealth status and source of drinking water (adjusted OR = 0.74, 95% CI: 0.50–1.01; Table 3). Household access to a piped water source was not associated with anaemia amongst young children either, and no interactions between household access to toilet facilities and improved drinking water sources were observed (data not shown).

## 4 | DISCUSSION

In this cross-sectional analysis of the MYCNSIA end-line survey conducted in a representative sample of households across three districts of Indonesia, improved household sanitation facilities emerged as an important predictor of stunting amongst young children, reinforcing the plausible link between children's linear growth and sanitation in children's immediate environment. Importantly, the presence of a household toilet facility was associated with a 29% reduced odds of being stunted amongst children under 3 years of age in an area where stunting prevalence had already been reduced by 23% within 3 years by scaling up access to and uptake of essential nutrition interventions. On the other hand, child anaemia was not associated with household sanitation. Finally, household access to an improved source of drinking water or piped water was associated with neither stunting nor anaemia in children.

This study replicated the previous analysis of MYCNSIA baseline survey data collected in 2011, which found a significant association between child stunting and household sanitation (Torlesse et al., 2016). Since 2011, the MYCNSIA in Indonesia has contributed to improved nutrition security amongst women and children in three target districts by taking a multipronged approach. Some of the key strategies included enhancing the infant and young child feeding counselling capacity of community health workers and strengthening the links between the national social safety net programme and nutrition services (United Nations Children's Fund, 2015). This had led to a substantial reduction in child stunting from 30% in 2011 to 24% in 2014 (United Nations Children's Fund, 2015). Notably, the fact that household sanitation remained a strong predictor of stunting at end line highlights the potential importance of integrating WASH interventions into the broader multisectoral approach in order to achieve further reduction of child stunting. At the same time, however, this observational analysis needs to be interpreted with caution, in view of the important findings from the Kenya and Bangladesh WASH Benefits trials which reported no additive benefit of combined WASH interventions over single nutrition-specific interventions in those settings (Arnold, Null, Luby, & Colford, 2018; Luby et al., 2018) and with associated commentary on the external validity (Cumming & Curtis, 2018).

In this study, household sanitation was not linked with anaemia amongst children aged 6–35 months old, which needs to be confirmed in future studies. For resource-poor settings, there is scarce evidence on the effect of WASH conditions of the physical environment on anaemia amongst children. In a longitudinal study from Nepal, Panter-Brick et al. showed that haemoglobin concentration was associated with the severity of small intestinal mucosal damage in young children (Panter-Brick, Lunn, Langford, Maharjan, & Manandhar,

**TABLE 2** Crude and adjusted OR of household water and sanitation conditions in relation to stunting for children aged 6–35 months who participated in MYCNSIA end-line survey

	N	% stunted	Crude OR (95% CI)	Adjusted OR (95% CI)
Sanitation facility				
Unimproved facility	415	32.8	1.00 (reference)	1.00 (reference)
Improved sanitation facility	1035	23.1	0.61 (0.48–0.79)	0.71 (0.51–0.97)
Improved source of drinking water				
Unimproved	618	28.1	1.00 (reference)	1.00 (reference)
Improved	832	24.3	0.82 (0.65–1.04)	0.91 (0.70–1.18)
Wealth index				
Middle/richer/richest	873	22.5	1.00 (reference)	1.00 (reference)
Poorer/poorest	577	31.1	1.56 (1.22–1.98)	1.26 (0.93–1.71)
Maternal education				
Below primary	120	31.1	1.00 (reference)	1.00 (reference)
Primary and above	1,330	25.5	0.68 (0.53–0.89)	1.05 (0.88–1.89)
Child sex				
Male	745	27.7	1.00 (reference)	1.00 (reference)
Female	705	24.2	0.83 (0.66–1.05)	0.79 (0.61–1.01)
Child age				
24–35 months	927	21.1	1.00 (reference)	1.00 (reference)
6–23 months	523	34.4	1.94 (1.53–2.48)	2.04 (1.38–3.00)
Mothers who consumed IFA more than 90 days				
No	543	31.8	1.00 (reference)	1.00 (reference)
Yes	843	21.7	0.60 (0.47–0.76)	0.99 (0.67–1.47)

Note. CI: confidence interval; IFA: iron–folic acid; MYCNSIA: Maternal and Young Child Nutrition Security Initiative in Asia; OR: odds ratio.

**TABLE 3** Crude and adjusted OR of household water and sanitation conditions in relation to anaemia for children aged 6–35 months who participated in MYCNSIA

	N	% Anaemia	Crude OR (95% CI)	Adjusted OR (95% CI)
Sanitation facility				
Unimproved facility	246	64.6	1.00 (reference)	1.00 (reference)
Improved sanitation facility	607	52.4	0.60 (0.44–0.82)	0.74 (0.50–1.01)
Improved source of drinking water				
Unimproved	384	60.1	1.00 (reference)	1.00 (reference)
Improved	469	52.4	0.73 (0.55–0.96)	0.79 (0.58–1.08)
Age group				
24–35 months	536	62.7	1.00 (reference)	1.00 (reference)
6–23 months	317	44.5	0.47 (0.36–0.63)	0.39 (0.23–0.64)
Wealth index				
Middle/richer/richest	669	50.5	1.00 (reference)	1.00 (reference)
Poorer/poorest	184	62.3	1.60 (1.22–2.11)	1.23 (0.86–1.75)
Maternal education				
Below primary	776	54.1	1.00 (reference)	1.00 (reference)
Primary and above	77	74.0	2.41 (1.42–4.10)	1.83 (1.04–3.20)
Child sex				
Male	449	59	1.00 (reference)	1.00 (reference)
Female	404	52.5	0.76 (0.58–1.00)	0.79 (0.59–1.05)
Mother consumed IFA more than 90 days				
No	324	47.8	1.00 (reference)	1.00 (reference)
Yes	485	60.2	1.64 (1.24–2.19)	0.82 (0.50–1.35)

Note. CI: confidence interval; IFA: iron–folic acid; MYCNSIA: Maternal and Young Child Nutrition Security Initiative in Asia; OR: odds ratio.

2009). The finding indicated that more severe mucosal damage due to a poor pathogenic environment might lead to a decreased concentration of haemoglobin (Panter-Brick et al., 2009). Larsen et al. did find positive associations between sanitation access and anaemia for both children living in households with and without access to any sanitation and concluded that further gains in reducing the risk of stunting, anaemia, and diarrhoea can be made as communities move towards universal access to any sanitation (Larsen, Grisham, Slawsky, & Narine, 2017). On the other hand, in a large scale cluster-randomized controlled trial conducted in 80 villages in rural Madhya Pradesh in India, the Total Sanitation Campaign, which aimed at improving households' access to improved sanitation facilities, did not reduce anaemia prevalence in young children (Patil et al., 2014). The results, however, should be interpreted with caution as the study had important limitations such that the campaign led to only modest improvements in the availability of household latrines and even less reduction in open defecation (Patil et al., 2014).

Poor WASH conditions lead to increased exposure to fecally-derived pathogens from both human and animal sources. Ingestion of faecal pathogens results in repeated bouts of diarrhoea and intestinal worm infection, as well as environmental enteropathy (EE), a subclinical disorder of the small intestine. Villous atrophy, crypt hyperplasia, increased permeability, and modest malabsorption are the characteristic symptoms of EE, damaging the absorptive and barrier functions of the small intestine mucosa lining, which eventually leads to impaired nutritional status such as stunting (Humphrey, 2009; Ngure et al., 2014). EE has been suggested as the primary causal pathway to explain the association between poor sanitation and hygiene and stunting (Humphrey, 2009; Ngure et al., 2014).

Chronic inflammation and immune stimulation as a result of EE is suggested to be an underlying cause of anaemia (Ngure et al., 2014). Inflammation is also triggered by infections such as malaria, acute respiratory infections, and diarrhoea, which result from poor levels of water and sanitation service and unhygienic practices. The inflammation cascade disturbs iron homeostasis by hampering iron absorption and diversion of iron from the circulation into storage sites, contributing to limited availability of iron for erythropoiesis (Cronin et al., 2017). Inflammation also reduces plasma retinol, which is required for erythropoiesis (Cronin et al., 2017). These processes lead to anaemia by reducing iron uptake by erythroblasts (Cronin et al., 2017). On the other hand, worm infection causes anaemia by feeding on host tissues including blood, impairing nutrient absorption, and reducing appetite (Muthayya et al., 2007).

The immense burden of anaemia in Indonesian children remains undiminished. Approximately one-half of this burden is estimated to be a result of iron deficiency, whereas the remaining half is estimated to be due to deficiencies in other vitamins and trace minerals as well as non-nutritional causes (Petry et al., 2016; Stoltzfus et al., 2002). Future research is warranted to elucidate the importance of environmental risk factors of anaemia, particularly amongst young children, though it would seem likely that the solutions to this problem will need to combine nutrition interventions with efforts made from other nutrition-sensitive sectors.

There are some limitations to this study that need to be considered. This was a cross-sectional analysis, and thus, a causal association

between household access to sanitation facility and the risk of child stunting cannot be established. In addition, future studies looking at the relationship between WASH and stunting should also compare the current levels of community sanitation coverage given recent research pointing to protective effects of sanitation on stunting at community level (Fuller et al. Fuller & Eisenberg, 2016; Bauza & Guest, 2017; Harris, Alzua, Osbert, & Pickering, 2017). Notably, we were unable to control for all potential confounders, because important information such as maternal body mass index was not collected. Haemoglobin was estimated using HemoCue from a finger prick blood sample in all children and women. The inherited abnormalities of haemoglobin synthesis ranging from thalassemia syndromes to structurally abnormal haemoglobin variants are considered an important, but unexplored, cause of anaemia (Ghosh, Colah, & Mukherjee, 2015; Timan et al., 2002). This information, however, could not be adjusted for given that this data was not collected. In addition, the lack of association between WASH and anaemia may be due to insufficient statistical power. Nevertheless, we demonstrated significant links between household sanitation conditions and stunting in children using representative survey data coming from the local context, and therefore, provided a good starting point for further research on this topic in Indonesia.

## 5 | CONCLUSION

In conclusion, unimproved sanitation was found to be an important predictor of stunting amongst young children in Indonesia. This study adds to the growing literature on the effects of sanitation on child nutritional status. It also has an important message to countries where the prevalence of childhood stunting remains unacceptably high and where the government's response to this persisting problem predominantly focuses on nutrition-specific interventions. It is evident that urgent policy and programme actions are required in Indonesia, and other low- and middle-income countries, to accelerate progress towards reduction of stunting and anaemia in children, with a particular focus on the 1,000 day window of opportunity. Advocacy, policy, and programme actions may need to take an integrated approach to addressing stunting, going beyond the conventional nutrition-specific interventions, and encompass WASH interventions as well. In view of the recent findings from the WASH Benefits trials, however, further programme evaluation may be warranted to determine how best to measure and optimise the value addition of integrating WASH interventions in the programmatic response to address child stunting in Indonesia.

## DISCLAIMER

The opinions expressed are those of the authors and do not necessarily reflect the views of UNICEF or the United Nations.

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## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

## CONTRIBUTIONS

JHR conceptualized and drafted the manuscript. NB conducted the data analysis. All authors read and approved the final manuscript.

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