EVIDENCE REVIEW

POTENTIAL IMPACT OF SANITATION ON HEALTH AND WELLBEING

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POTENTIAL IMPACT OF SANITATION ON HEALTH AND WELLBEING

Final Report

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February 2018

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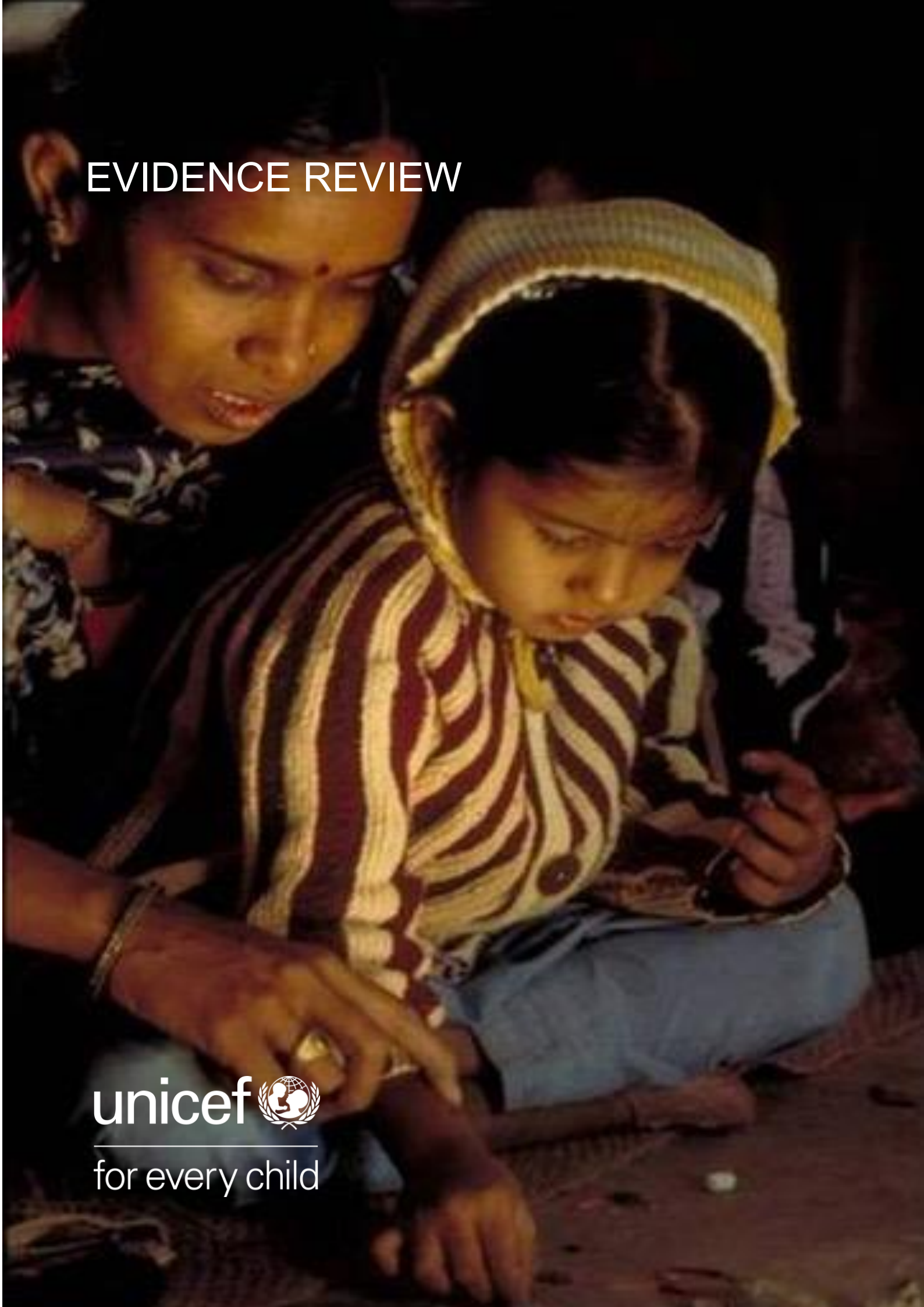

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Introduction

On 2nd October 2014, the Prime Minister of India Shri Narendra Modi launched the Government of India's *Swachh Bharat Mission* (SBM) with the aim of making India *open defecation free (ODF)* by 2nd October 2019. All Government of India ministries and public sector autonomous agencies are mandated to make and implement a *Swachhta* (Clean) Plan. All state governments are required to implement SBM, and to monitor progress towards attaining the ODF status for their states. Consequently, momentum has built up around the SBM and most people in India are familiar with the programme's goals.

SBM has an ambitious timeline to realize an ODF India in five years, in a country which had very high levels of open defecation at the start of the programme.

This is especially challenging compared to other countries that sought the same goals but required a much longer time frame. Bangladesh, for instance, took 15 years to become ODF, while Thailand took 40 years to do so. To date, there has been clear progress in coverage. The rural component of the SBM, known as Swachh Bharat Mission-Gramin (SBM-G), has achieved a significant improvement in sanitation coverage in rural areas, from 39 percent at baseline to 79 percent in February 2018, with 314 districts declaring ODF status, as reported by the Ministry of Drinking Water and Sanitation (MDWS), Government of India.

This evidence review draws from research already undertaken and highlights the potential impact of sanitation achievements on improving the health and wellbeing of communities, particularly the poorest and most vulnerable.

It is based on a selection of relevant global literature, ongoing studies and research on Water, Sanitation and Hygiene (WASH) topics in India and draws on additional documents including literature reviews provided by UNICEF India.

WASH Evidence Gap Map

Figure 1 is an evidence gap map showing what studies have been undertaken at a global level investigating WASH intervention and their outcomes.

It reveals that the majority studies conducted on sanitation is through the prism of health impacts (specifically diarrhoea and Acute Respiratory Infections). This is further discussed in Section 1 of this evidence review.

The studies focused on sanitation and non-health impacts are much scarcer but where they do exist, are focused on educational outcomes, which is explored further in Section 2 of the review.

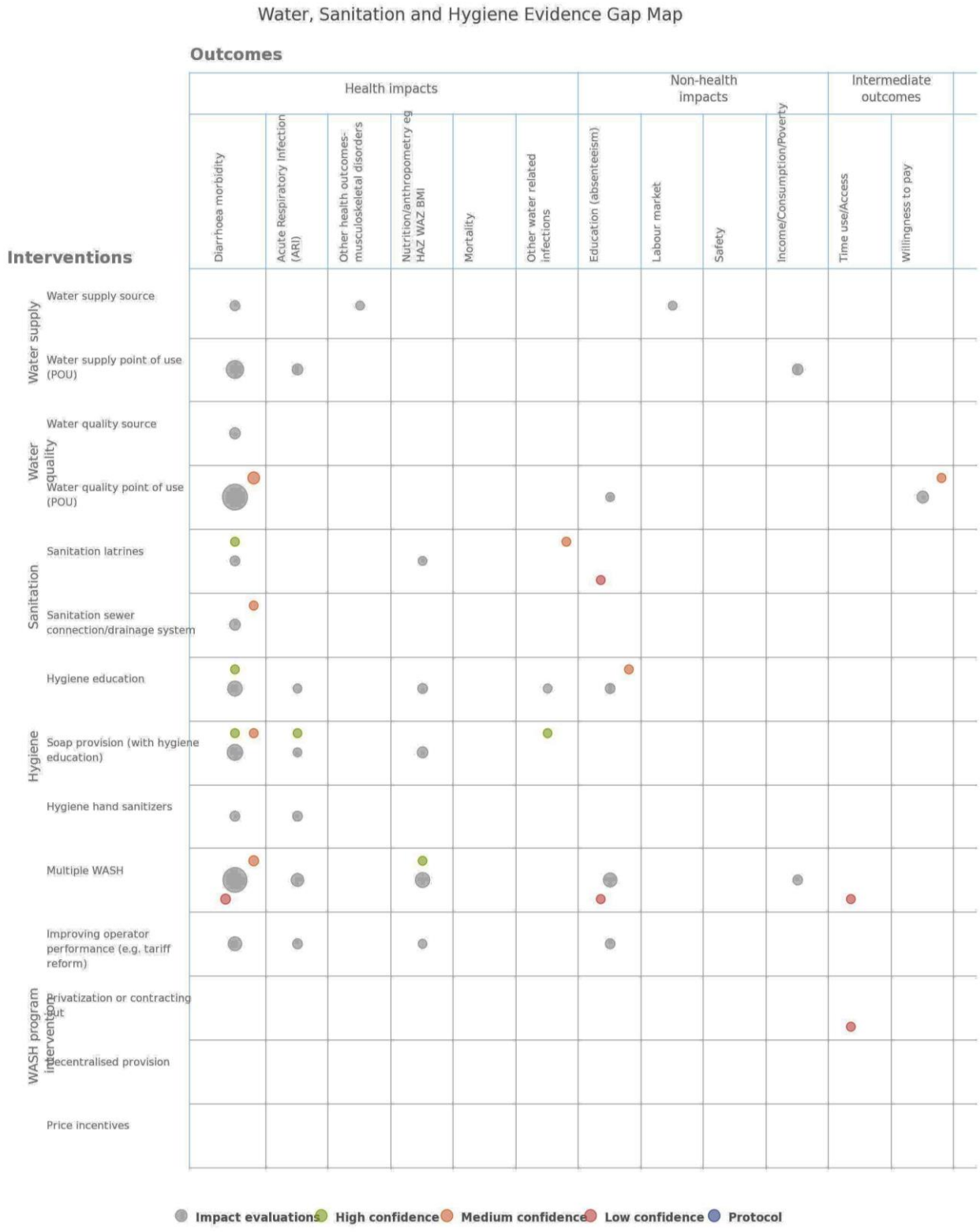
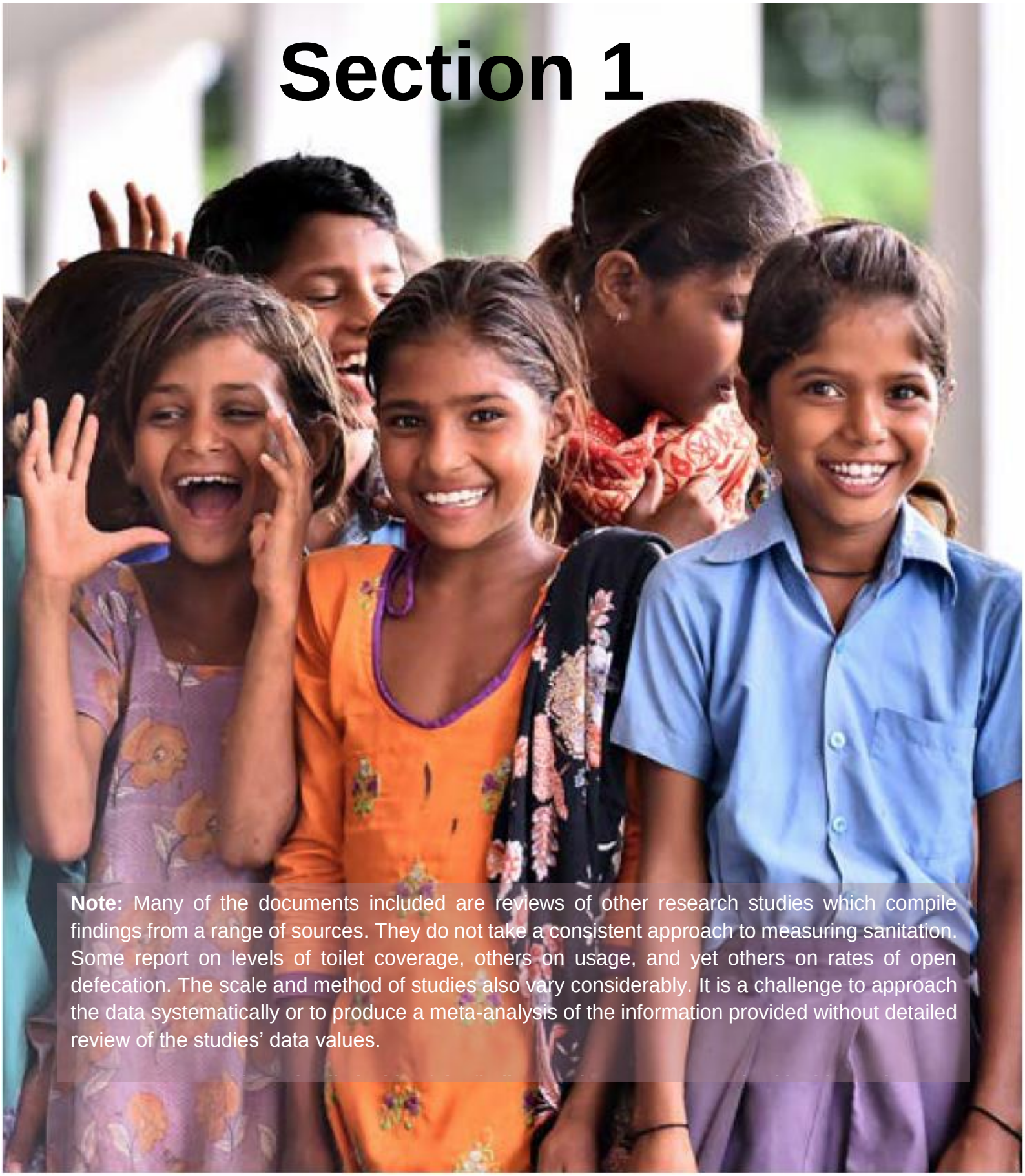


Figure 1: Evidence Gap Map (EGM) investigating WASH interventions and their outcomes at global level

Source: International Initiative for Impact Evaluation (3Ie) (2015). Water, Sanitation and Hygiene Evidence Gap Map. Available from: http://gapmaps.3ieimpact.org/evidence-maps/water-sanitation-and-hygiene-evidence-gap-map

Section 1



Note: Many of the documents included are reviews of other research studies which compile findings from a range of sources. They do not take a consistent approach to measuring sanitation. Some report on levels of toilet coverage, others on usage, and yet others on rates of open defecation. The scale and method of studies also vary considerably. It is a challenge to approach the data systematically or to produce a meta-analysis of the information provided without detailed review of the studies' data values.

The impact of increased sanitation coverage on health

The studies pertaining to main impacts of sanitation coverage on health relate to the prevalence of anaemia, diarrhoea and parasitical worms, all of which contribute to poor nutrition and stunting. Stunting is a major impact of poor sanitation. The range of study methods and objectives reduces the level of comparability between study findings. However, it is possible to identify some initial conclusions from the different studies.

Strong evidence exists on the link between effective water and sanitation coverage and interventions in improving health. Some of this evidence is available through formal reviews that summarize epidemiological trials on the impacts of sanitation interventions as well as showing the positive impacts associated with it. (1-5)

Summary of Findings

Unsafe water supply and sanitation cause an estimated 1.6 million deaths per year worldwide (5). Diarrhoeal diseases account for 88 percent of global deaths due to unsafe water supply and sanitation. Unsafe water supply accounts for almost all deaths from trachoma, schistosomiasis, ascariasis, trichiasis and hookworm disease. Health literature indicates that poor sanitation, hygiene and water cause half of all childhood and maternal underweight cases, mainly through the joint impact of diarrhoeal diseases and undernutrition as exposure to one increases vulnerability to the other. **Diarrhoea is the third largest cause of death of children under five, accounting for 9 percent of all deaths in 2015.**

This translates to over 1,400 young children dying each day, or about 526,000 children a year, despite the availability of simple effective treatment (6). **In India, about 60,700 children under five die each year from diarrhoea** (7)**.**

Figure 2, taken from a meta-analysis assessing the impact of community-level sanitation access on child stunting, anaemia, and diarrhoea shows the “adjusted odds ratios of the impact of increasing levels of community-level sanitation access on the outcomes of child growth stunting, any anaemia, moderate or severe anaemia, and reported symptoms of diarrhoea in the previous two weeks for children living in households with and without sanitation access” (12).

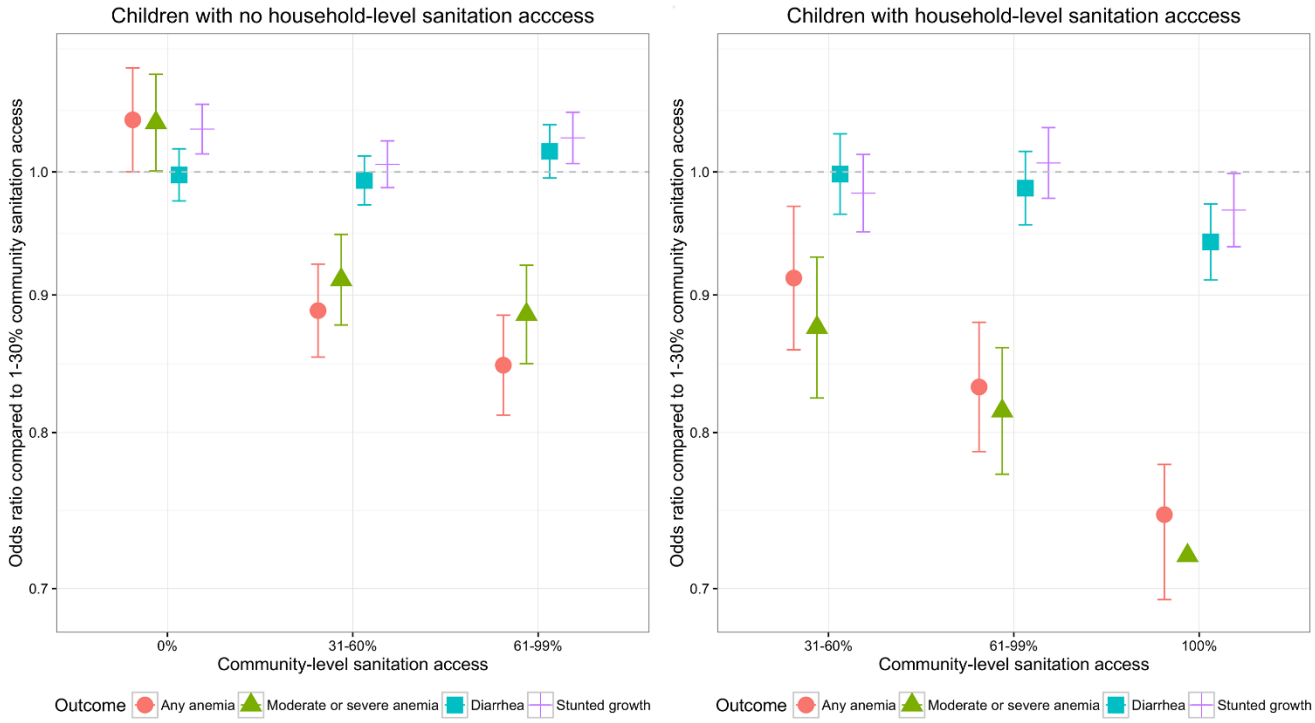


Figure 2: Adjusted odd ratios of the impact of increasing levels of community sanitation on child health outcomes

There is evidence that there is a strong association between sanitation coverage and child mortality, as shown in Figure 3 adapted from WHO/UNICEF (2008). Each point in Figure 3 is a single country, with countries in Sub-Saharan Africa indicated by the red diamonds.

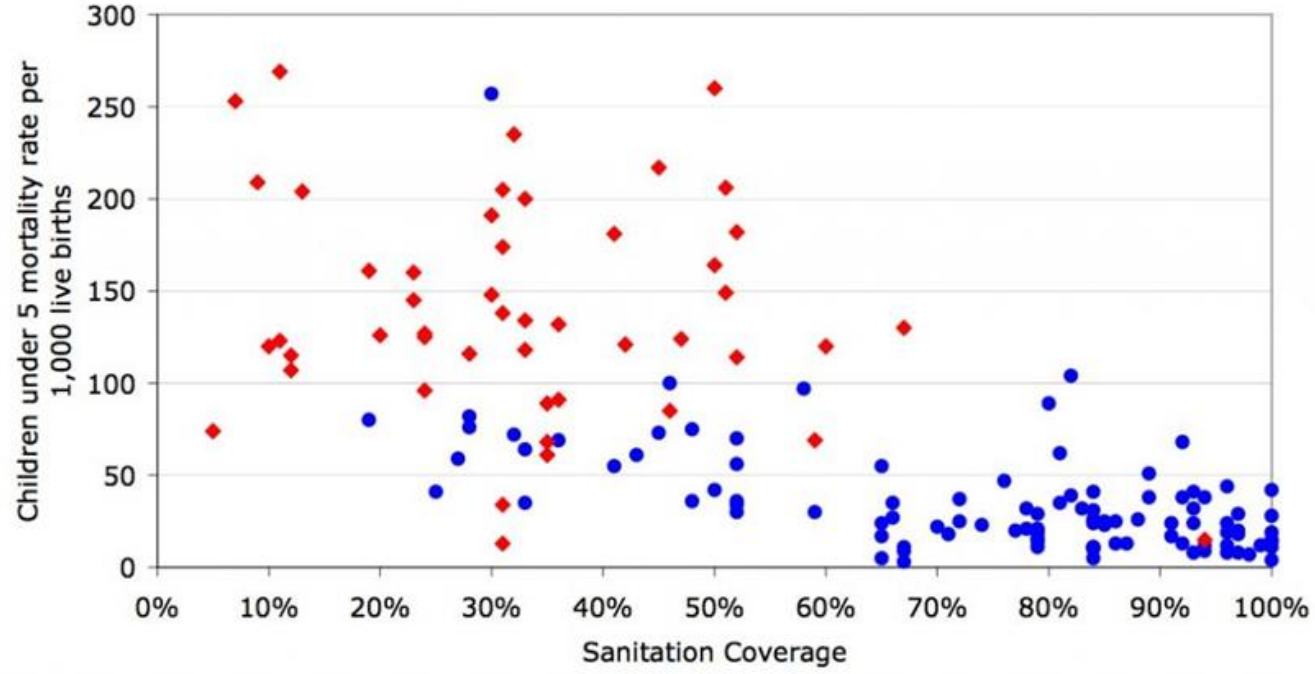


Figure 3: Under 5 mortality compared to sanitation coverage for individual developing countries
Source (adapted from): World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply and Sanitation (JMP) (2008). Progress on Drinking Water and Sanitation: Special Focus on Sanitation. UNICEF, New York and WHO: Geneva

Impact on Diarrhoea

The impact of sanitation on diarrhoea is significant, although attribution is not always clear.

A study investigating the health impacts of sanitation which used a sample of children under 48 months in India in rural areas from the 'Third Round of Districts Level Households Surveys 2007-2008' found positive and significant benefits for both improved sanitation and a fixed-point defecation, albeit with qualifications. There was a reduction from 12.54 percent to 6.79 percent in diarrhoea prevalence between children aged 0 - 48 months in the two groups (18).

However, a cluster-randomised trial in Odisha seeking to explore the effectiveness of a rural sanitation programme on various health issues (diarrhoea, soil-transmitted helminth and child malnutrition) concluded that their intervention, which involved increasing latrine coverage from 9% to 63%, did not have any significant impact on diarrhoea incidence in under 5s (8). The same study concluded that the number of latrines alone may not be the best primary metric for progress. Thus, behaviour change regarding open defecation, safe disposal of faeces and handwashing before handling food are also important.

Three global studies (1, 9, 10) found some impact on diarrhoea, but these included interventions to improve water supply and handwashing, so the **specific and separate impact of increasing sanitation is not clear.** Other studies, (10) also combined the impact on diarrhoea with impact on other diseases, **making it hard to assign independently a value to sanitation or the impact on diarrhoea.** Several other studies note that there is little (11, 12) or no (13-16) impact of sanitation on the incidence of diarrhoea**.**

Impact on anaemia

A study of Nepal's different types of sanitation improvements during the years 2006 and 2011 and covering groups of children that were exposed to the improvements (17) found that children from areas with worse sanitation had lower haemoglobin levels and showed higher levels of anaemia.

A global meta-analysis (12) of 301 surveys of sanitation impacts on health for children under 60 months shows that the **largest impact of higher levels of sanitation coverage and access is on reduced levels of anaemia.**

Impact on Stunting

Evidence suggests a strong relationship between sanitation access and stunting.

In their study '*Where India Goes'*, Coffey and Spears provide a strong argument for the impact of poor access to sanitation on stunting, comparing growth between children observed within their case study, and presenting comparative data from other countries with lower OD rates (18).

A study of 30 villages in India found that on average, children who had received sanitation motivation treatment grew taller. The same study however also found that even though latrine use was higher in the sanitation treatment group, open defecation remained prevalent in every village (19, 20).

This suggests that improved health for children can be achieved through small improvements in sanitation, showing that positive effects are realizable even without completely eradicating open defecation.

It is worth noting the converse as well: according to an analysis by Dean Spears, **a 10 percent increase in open defecation is associated with increase up to 0.7 percentage point in both stunting and severe stunting** in a study of 112 districts in India (21). The studies indicate that over 1 billion people who practice open defecation in the world, over 600 million reside in India(21A) and of about 215 million children who are stunted today, 28.5% reside in India. (12)

There is no clear evidence on the relationship between the size of the increase in sanitation access and size of impact on stunting, although it is evidently positive. This may relate to the extent to which coverage leads to actual use of latrines and to a reduction in OD.

Studies in other countries have found an association between levels of open defecation and the prevalence of stunting.

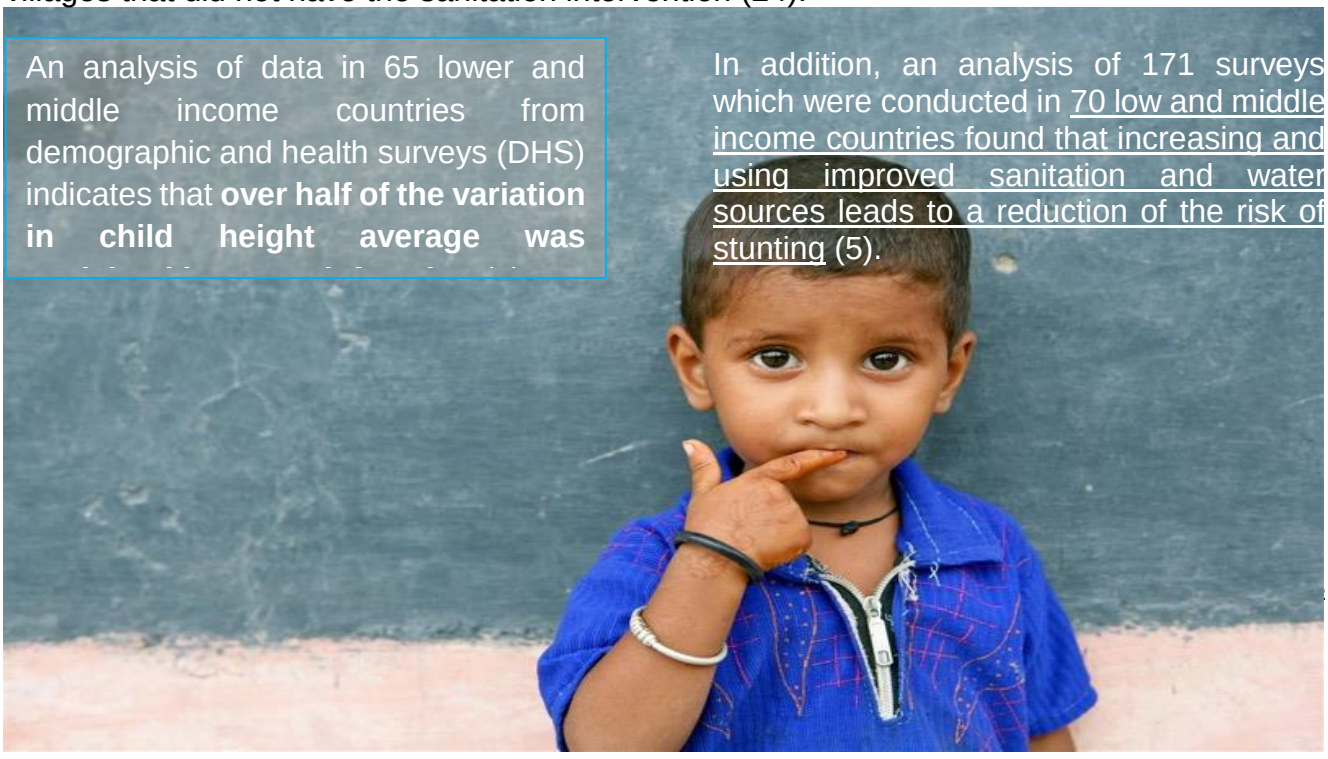
There are decreases in stunting and increases in child growth associated with sanitation coverage of 65 percent (23); 27 percent (11); and 50 percent (21). A global review of 301 surveys found that, stunting was 36 percent at 0-30 percent coverage, but this reduced to 34 percent at 60-99 percent coverage (12).

A global study on the impact of sanitation found that open defecation explains 54 percent of international variation in child height. GDP only explains 29 percent. (22).

A cluster randomized trial of 121 villages in Mali found that children in the communities that reduced open defecation by 33 percent through CLTS had 13 percent less stunting than villages that did not have the sanitation intervention (24).

An analysis of data in 65 lower and middle income countries from demographic and health surveys (DHS) indicates that **over half of the variation in child height average was**

In addition, an analysis of 171 surveys which were conducted in 70 low and middle income countries found that increasing and using improved sanitation and water sources leads to a reduction of the risk of stunting (5).



Level of sanitation coverage or usage and impact on health

Rates of sanitation coverage and usage are often used to assess the impact of sanitation programmes. Access without use is unlikely to have any impact on open defecation and sanitation's benefits though, and usage is generally lower than access in India. High levels of open defecation within communities mitigate against the full health benefits of individual households having access to toilets (12).

As noted in other literature, **sanitation and hygiene programmes need to achieve very high levels or usage or community compliance to realise significant health impacts** (25).

Higher levels of community wide access to sanitation appears to provide greater benefits than individual household access alone.
A study on rural India which showed a 47 percent reduction in diarrhoea (26) observes that potential benefits are greater at higher levels of coverage due to the reduction in the probability of contact with human excreta. A key finding was that only a quarter of the effect was due to the child's access to his or her own sanitation facilities, while three-quarters came from the high sanitation level in the village.

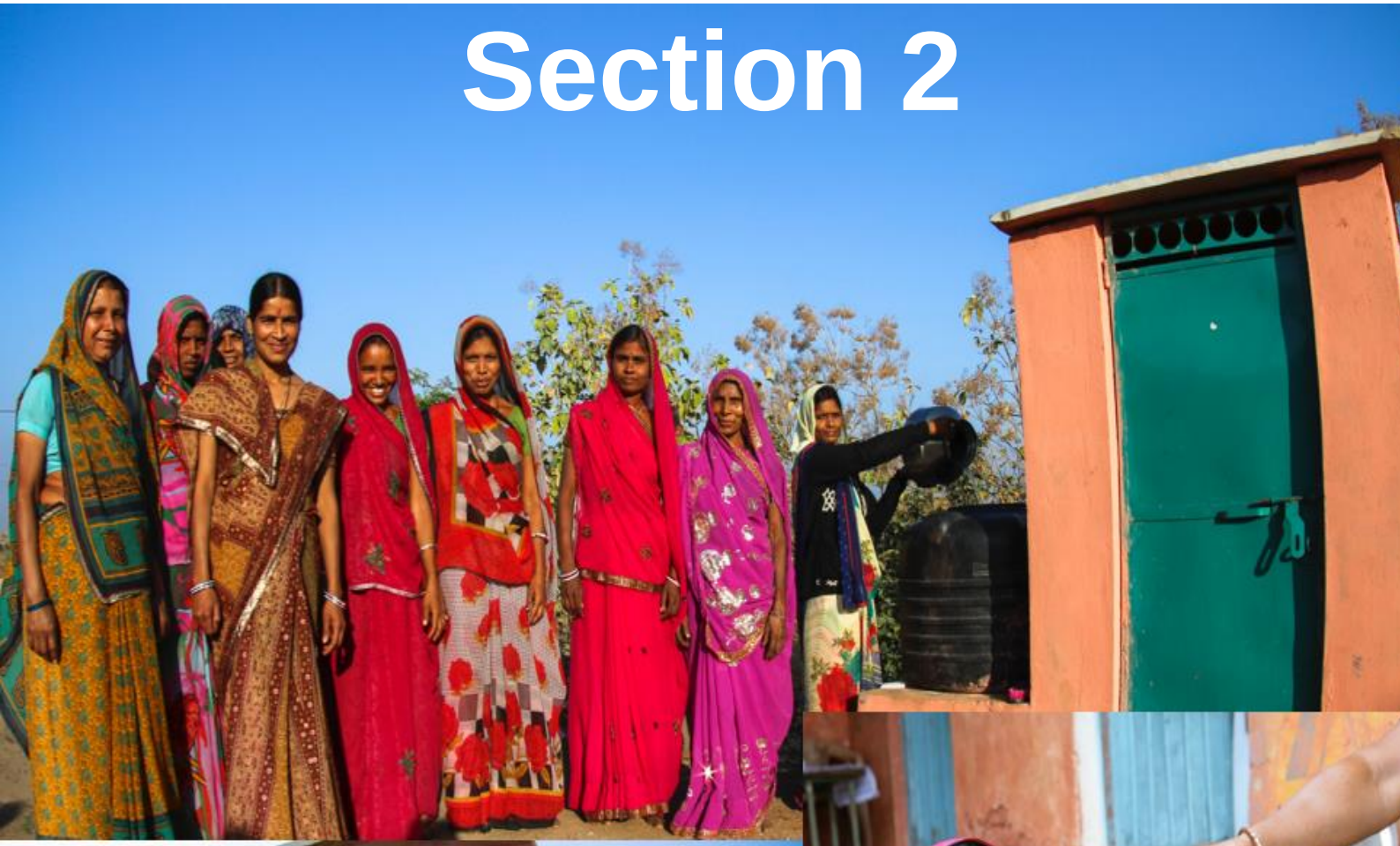
Estimates indicate that there is no improvement at all until 30 percent coverage is achieved and that half of the potential total gains are only reached when coverage is approximately 75 percent (26).

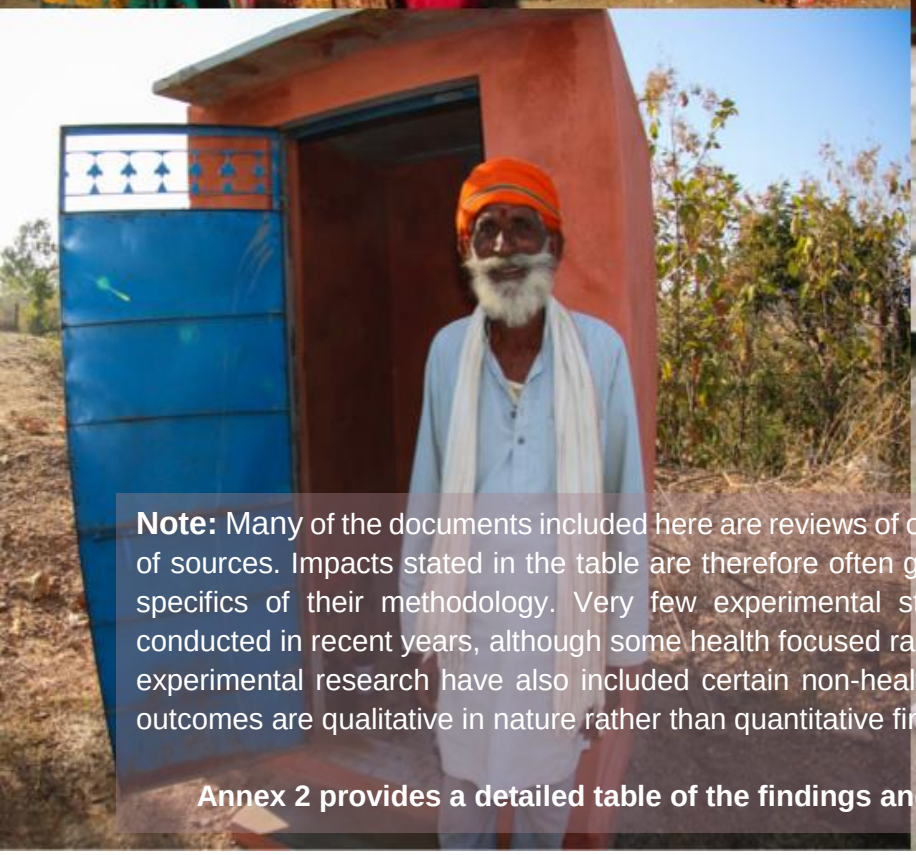
In one of the two studies in Mali addressing the impact of different levels of coverage, it is suggested that a threshold level of sanitation may be needed to prevent transmission of pathogens associated with diarrhoeal symptoms (13). There may also be upper limits to the impact of increased coverage. Another study in Mali (27) suggested that increases in latrine coverage appear not to improve growth beyond approximately 75 percent coverage; however, stunting continued to decrease up to 100 percent latrine coverage. Above approximately 60 percent sanitation coverage, improvements in weight-for-height and weight-for-age taper off and may even decrease, although uncertainty in estimates increase at higher levels of latrine coverage.

A recent review of global evidence suggests that significantly more than 65 per cent of toilet usage and widespread handwashing practice are required to achieve significant health impact. **Situations where water services are poor, sanitation and hygiene interventions, while valuable for other reasons, are unlikely to have significant health impacts** (25).

The global review mentioned above notes that **a strong practice of handwashing as well as high levels of usage of toilets are together necessary conditions for achieving significant health impacts** (25). This is supported by findings elsewhere (8,9) that while sanitation, hygiene and water all make independent and valid contributions to health improvement, "It is almost impossible to practise good hygiene without a ready supply of available water, and excreta disposal is hardly hygienic without sanitation. **Water and sanitation are prerequisites for good hygiene"**(28). These findings are supported by findings from the study in Odisha that increased numbers of latrines on their own do not reduce diarrhoea (25).

Section 2





Note: Many of the documents included here are reviews of other research, compiling findings from a range of sources. Impacts stated in the table are therefore often generic and there is limited information on the specifics of their methodology. Very few experimental studies in themselves appear to have been conducted in recent years, although some health focused randomized control trials (RCT) based or quasi-experimental research have also included certain non-health outcomes. Many of the non-health related outcomes are qualitative in nature rather than quantitative findings.

Annex 2 provides a detailed table of the findings and sources summarised in this section.

Impact of Sanitation on other outcomes

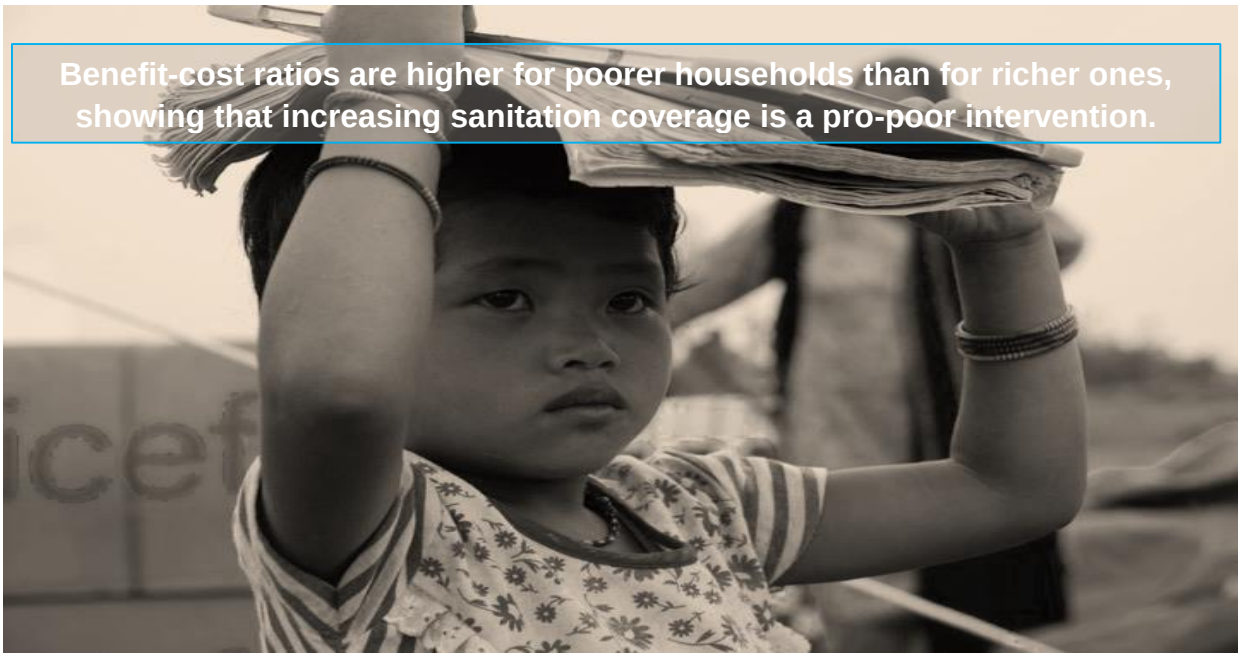
Sanitation interventions such as a household toilet has impacts on people's wellbeing at a broader scale rather than just health. A recent study (29) states that **only including health impact in impact evaluations of sanitation can severely underestimate the overall intervention benefits**. Therefore, it is important for this review to also consider impacts of sanitation on non-health matters.

Summary of findings

Time savings

It is suggested in the literature that improved sanitation can contribute to time savings (30, 31). People have more time on a day-to day- basis once they do not need to walk to a distant place to defecate, and also the reduced health problems they face contributes to longer term time savings. An RCT based study (24) found that working adults with sanitation facilitates spend more hours working (though this is not statistically significant). **Rural households that owned their own latrine saved from 4 to 20 minutes of travel time per trip** (32) in (33). This is a major convenience and allows more time for other activities. Studies which also address water supply note that **timesaving helps women to have more time to spend on work of family and household tasks** (34, 35) in (33).

A recent study (36) has calculated the value of time savings and saved lives amongst other parameters as a result from sanitation at varying levels of coverage in India. The assumption is that this saved capital can be directed to other areas, indirectly influencing wellbeing. For instance, it finds **that medical costs savings at 85 percent toilet use are on average, INR 5,296 per household per year, with INR 4,355 saved by those in the poorest quintile**. Reduction in time lost due to sickness and seeking a place for open defecation at 85 percent toilet use leads to, **an average of INR 20,200 savings per household per year, with INR 17,431 saved by those in the poorest quintile.** The economic value of saved lives due to lower mortality rates, at 85 percent toilet use is, an average of INR 11,631 is saved per household per year, with INR 13,321 saved by those in the poorest quintile. Overall, **an average of approximately INR 48,000 can be saved each year by the poorest quintile when there is household access to toilets.**



Other economic Impact

Apart from time saved translating to cost benefits, other economic impact include gains from reduce absenteeism of children (mainly girls) from school and women from their workplaces; potential loss of tourism revenues and economic impacts of gastrointestinal illnesses among foreign tourists; and the costs of fetching and treating water, and bottled water.
Another study found that the cost of poor sanitation is 2 percent of GDP in East Asia and the Pacific and sub-Saharan Africa. In South Asia, it is 4 percent (29).

A study by the World Bank based on modelling national data in India estimates that the **total economic impacts of inadequate sanitation in India amounts to Rs. 2.44 trillion (US$53.8 billion) a year — the equivalent of 6.4 percent of India's GDP in 2006** (37).

India, therefore, is far worse afflicted economically by the lack of sanitation than its region's average.

Educational attainment

There is some evidence to suggest that access to improved sanitation improves educational outcomes in schools; various studies in sub-Saharan Africa and Asia have been undertaken which **claim to show the positive impacts of comprehensive WASH programmes in schools** (46, 47).

The RCT study in Mali (48) found a marginal, statistically significant increase in school attendance for children aged 5-12 and a statistically significant reduction on missing school days for children aged 10-13 years. One study in India seeking to explore how improving the school environment through latrine construction influenced educational decisions of school children found that **latrine construction had a greater effect on female enrolment rather than male, but that the type of latrine was also important;** it is more important for pubescent aged girls to have separate facilities than their younger counterparts (48).

Improved sanitation is also thought to be able to assist with menstrual hygiene management and **enable girls to attend school during menses and reduce absenteeism** (42, 49). A pilot study in Ghana showed attendance to improve with the provision of sanitary pads (50) yet other studies actually found interventions not to have any effect on attendance and attainment (51-53). **Improvements in children's growth and reduction of stunting also improves cognitive abilities and hence educational outcomes.**

An evaluation of WASH in Kenyan schools showed that **girls were less absent when toilet use and handwashing practice was higher, and there were reduced incidences of waterborne diseases and helminth infestation**; (46) one programme reduced diarrhoeal diseases by around 50%. A programme in Bangladesh contributed to the increase of female enrolment by over 10% and likewise, findings from a longitudinal study in Cambodia suggested that the provision of safe drinking water reduced rates of absence among school children (54). However whilst provision of sanitation facilities is important, some literature emphasises the importance of such being private or 'sex segregated' when considering the wellbeing of girls (55). An

International Reference Centre for Community Water Supply (IRC) study in Kenya found, for example, three quarters of adolescent girls to drop out of school due to the lack of adequate private sanitation facilities (46). With this in mind, safety and sanitation is also a recurring theme amongst literature whereby studies have found girls to feel uncomfortable and unsafe using sanitary facilities (56-58). **When asked to take photos and draw pictures of 'unsafe places' many girls took photos of the latrines** during a study using visual methodologies and a transect walk in Zimbabwe and Swaziland (59).

There is a general scarcity of literature showing the explicit links between WASH and educational outcomes.

UNICEF has stated that no rigorous research has been conducted into the relationship between appropriate sanitary facilities in schools and dropout rates (60). An evidence review of WASH on health and social outcomes suggests that, although there is sufficient evidence to support the plausibility of sanitation having impacts on education, there is limited empirical evidence from studies (44). Instead, it seems that most papers claiming that WASH has positive impacts on educational outcomes make this assertion based on the assumption that improved health in children equates to improved educational outcomes (58, 61). Therefore, **more research on this particular area of intersection is required to better appreciate any linkages.**

Safety and security of Women

An evidence review of key health and social outcomes (38) states that that the lack of adequate WASH facilities is likely to increase the vulnerability of violence in a given setting for women and girls but there is insufficient evidence to substantiate this claim. However, there are case examples in the documented literature that suggest **women's safety improves with increased levels of sanitation access**.

An RCT undertaken in Mali (24) found that there was a reduction in the percentage of women experiencing any sort of harassment (2 percentage point increase in this indicator). A second RCT study in Mali (13) found that 9.9 percent more women feel safe at night in the CLTS-targeted group than the control group. Other studies also found positive impacts related to women's safety and reductions in sexual violence including (39) and (40-43) in (44). **A study in India finds that women have trained as masons and taken on leadership roles with social recognition. As a result, they have greater personal influence in both personal and public spheres** (43, 45).

A major finding from these initiatives revolve around the transformative impact that emerging opportunities for women who play public roles in village sanitation has on their empowerment, that is manifested in feelings of increased confidence, safety and opportunities (39, 45).

Dignity

Access to water and sanitation can be considered a human right and there is case study evidence to suggest that having **access to one's own latrine can increase comfort and dignity for individuals especially those who are vulnerable** (often the poor, children, women and girls, the sick, people with disabilities and manual scavengers).

Within the Indian context, it seems that the caste system largely affects the impacts of sanitation on people's dignity although there is a dearth of published literature supporting this. Since pit latrines require emptying, a task normally undertaken by the lowest 'dalit' or 'untouchable' caste, many non-dalit people are unwilling to empty their own pit latrines since it is considered a practice of 'rural untouchability' (18, 62). This further perpetuates the oppression of Dalits and the association of them with degrading work, affecting dignity. While the Government of India has taken steps to address issues around safely managed waste removal and incentive structures, which can potentially serve to alleviate caste-related tensions in WASH work, more research and interventions may be required in this area to comprehensively tackle the social barriers.

Globally, people with a disability are reportedly at higher risk of having inadequate access to sanitation facilities that other people (38). Documentation presents an emerging problem when facilities are present, but not appropriate or accessible to people with a disability (63). Inaccessible WASH sanitation designs frequently force people with physical disabilities to crawl on the floor to get to a toilet, defecate in the open, reduce food intake or sometime soil themselves and be reliant on family members and carers to clean them up, heavily affecting their sense of dignity (64-66). WASH interventions, particularly sanitation, can thus help improve quality of life for this group and assist in their realisation of rights.

WASH programming, including access to sanitation has been found to be beneficial for people living with HIV/AIDs for example (67), who often experience more frequent or severe cases of some of the health issues discussed in section 1 such as diarrhoea due to compromised immune systems.

Annexure1

Impact of sanitation on health – summary of studies

a) Studies in India

Study	Location	Objective	Study period	Methodology	Study Strength	Change in sanitation coverage/usage/OD	Health impacts Red text indicates no significant impact
Clasen et al. (2014) (8)	Odisha, 100 villages	The study investigates the effectiveness of a rural sanitation program on Diarrhoea, soil-transmitted helminth infection, and child malnutrition.	2011-2014	Cluster-randomised controlled trial in 100 rural villages. 50 villages to the intervention group and 50 villages to the control group. There were 4586 households (24,969 individuals) in intervention villages and 4894 households (25,982 individuals) in control villages	Strong	The intervention increased mean village-level latrine coverage from 9% of households to 63%, compared with an increase from 8% to 12% in control villages	7-day prevalence of reported diarrhoea in children younger than 5 years was 8·8% in the intervention group and 9·1% in the control group No significant change in diarrhoea incidence
Patil et al. (2014)	Madhya Pradesh	To measure the effect of the TSC implemented with	Baseline 2009;		Strong	9.5 percent reduction in OD	Improvements were insufficient to improve child health outcomes (diarrhoea,

Study	Location	Objective	Study period	Methodology	Study Strength	Change in sanitation coverage/usage/OD	Health impacts Red text indicates no significant impact
(68)		capacity building support from the World Bank's Water and Sanitation Program in Madhya Pradesh on availability of individual household latrines (IHLs), defecation behaviours, and child health	Follow up 2011	Cluster-randomized, controlled trial in 80 rural villages.		Increase of households with increased sanitation facilities by average of 19 percentage points in intervention villages.	HCGI, parasite infection, anemia, growth) No significant change in health outcomes
Andres et al (2014) (26)	India - rural areas	The study makes an estimation of the two sources of benefits related to the impact that sanitation infrastructure access has on early childhood health	2007-08	Subsample of children between 0 to 48 months of age that live in rural areas from the Third Round of the District Level Household Survey (DLHS-3)	Strong	Difference between children living in households without access to improved sanitation in a village without coverage of improved sanitation and children with access to improved sanitation in a village with complete coverage.	Reduction from 12.54 percent to 6.79 percent in diarrhoea prevalence between children in the two groups (47 percent reduction)
Dickinson et al (2015)	Bhadrak district, Orissa	The objective of the study was to understand the	2006	Experimental trial on a CLTS intervention	Strong	27 percentage points increase in latrine coverage from 7	Increase in children's nutritional status (the mid-upper arm circumference Z

Study	Location	Objective	Study period	Methodology	Study Strength	Change in sanitation coverage/usage/OD	Health impacts Red text indicates no significant impact
(11)		impacts of sanitation choices.		carried out in Odisha		percent to 35 percent; 17 percentage points reduction in open defecation	score 0.20–0.30 standard deviations higher in treatment villages relative to controls after the sanitation campaign). There were similar improvements in height and weight Z scores. No significant impact on diarrhoea prevalence in children.
Spears et al (2013) (21)	112 districts in India	The study aimed to understand the relationship between open defecation and childhood stunting.	2010-11 data	Regression analysis of national survey (HUNGaMA survey data)	Strong	10 percent *increase* in open defecation	0.7 percentage point *increase* in both stunting and severe stunting Differences in open defecation can statistically account for 35 to 55 percent of the average difference in stunting between districts identified as low-performing and high-performing in the HUNGaMA data
Spears (2013) (69)	Ahmednagar district, Maharashtra	The study aimed to study the effect of a sanitation motivation intervention as part of the Total Sanitation Campaign on the height of children.	Baseline 2004; Endline survey 2005	RCT (30 villages assigned to intervention groups, 30 villages assigned to control group).	Medium Originally the study was to include two other districts, but the study size was	Increase of latrine coverage of 8.2 percentage points ; OD not eliminated.	Children were 1.8 percent taller in treatment villages

Study	Location	Objective	Study period	Methodology	Study Strength	Change in sanitation coverage/usage/OD	Health impacts Red text indicates no significant impact
					reduced since these did not receive the treatment.		
Coffey and Spears (2017) (18)	Uttar Pradesh	The aim of this study is to provide an analysis of India's poor, early-life health and the process of stunting affecting many children	2011- 2016	Primary data and research Quasi experimental use of large data sets Case study research	Strong Studies based on analyses e.g. difference in difference analysis of DHS data, regression; primary data	Not specified, other than higher access to individual latrine as well as higher community sanitation levels ; data covered a number of contexts.	Positive relationship between increased access to sanitation and reduced stunting.
Geruso and Spears (2017) (70)	India – country wide	The study aim was to understand better the Muslim-Hindu mortality gap; why neighbourhoods disproportionately inhabited by Muslims are better places for the health of (both Muslim and Hindu) children	1992 - 2006	Quasi-experimental studies using secondary data from three rounds of the National Family Health Survey (NFHS) of India: 1992/1993, 1998/1999, and 2005/2006	Strong	N/A	The data suggests that reducing mean open defecation by 10 percentage points (one quarter of a standard deviation across localities) would reduce IMR by 6 deaths per thousand, or about 8% of the mean mortality rate

Study	Location	Objective	Study period	Methodology	Study Strength	Change in sanitation coverage/usage/OD	Health impacts Red text indicates no significant impact
Ministry of Women and Child Development (2014) (71)	29 States in India	The survey aimed to strengthen the data system on children and women.	2013-2014	Rapid Survey on Children (RSOC)-	Weak This reports data as a mean for the 29 states; no assessment of impact of sanitation interventions, insufficient data on local context.	42 percent of the survey households were using an improved toilet.	Prevalence of diarrhoea estimated at 6.5 percent, and 8.6 percent for acute respiratory infections, for children under 5

b) Studies in other countries, global studies

Study	Location	Objective	Study period	Methodology	Study strength	Change in sanitation coverage/usage/OD	Health impacts (Red text indicates no significant impact)
Coffey et al (2017) (17)	Nepal	The study examined the impact of sanitation on children haemoglobin levels.	2006-2011	2006 and 2011 DHS cohorts analysis; difference in difference regressions; Nepal data and international comparisons	Strong	OD decreased from 50 percent to 35 percent.	Children exposed to worse community sanitation displayed higher anaemia incidence.
Pickering et al, (2015) (13)	Koulikoro District in Mali	The study aimed to assess for the effect that CLTS has on child health.	2011	Cluster-randomised controlled trial.	Medium Medium The study sample size was constrained by the number of treatment villages the implementers thought was feasible to undertake the intervention	33 percent reduction in open defecation. Access to private latrines in intervention villages was 65 percent; access in non-intervention villages was 30 percent	6 percentage points reduction in the likelihood of stunting for children under 5 years. No impact on diarrhoea.

Study	Location	Objective	Study period	Methodology	Study strength	Change in sanitation coverage/usage/OD	Health impacts (Red text indicates no significant impact)
					during the study timeline.		
Alzua et al, (2015) (24)	Koulikoro District in Mali	The objective of the study was to evaluate health and non-health program impacts of CLTS.	Baseline data 2011; endline study 2013	Cluster-randomised trial	Medium As above	33 percent reduction in open defecation. Access to private latrines in intervention villages was 65 percent; access in non-intervention villages was 30 percent.	The CLTS program reduced stunting by 13 percent among children under five and reduced the risk of severe stunting by 26 percent and being severely underweight by 35 percent. No impact on diarrhoea.
Harris et al (2017) (27)	Koulikoro District in Mali	This study investigated the effect of community sanitation coverage on child health and drinking water quality as opposed to individual household sanitation.	2011	Regression analysis	Medium Due to scale of study, see above	In this study, the level of sanitation access of surrounding households was more important than private latrine access for protecting water quality and child health.	. Child height-for-age had a significant and positive linear relationship with **community** latrine coverage, while child weight-for-age and household water quality had nonlinear relationships that

Study	Location	Objective	Study period	Methodology	Study strength	Change in sanitation coverage/usage/OD	Health impacts (Red text indicates no significant impact)
							levelled off above 60% coverage. Child growth and water quality were not associated with **individual** household latrine ownership.
Carter et al (2017) (25)	Global	The study firstly investigates if a certain level of sanitation usage and hygiene practice is needed to achieve a measurable health impact. Secondly whether sanitation and hygiene interventions with no water supply are likely to have significant health benefits.		Analysis of secondary data	Medium	Sanitation coverage of 75 percent.	35 percent increase in health benefits (benefits not specified).
Larsen et al (2017) (12)	Global	The study aims to determine the impact of community-level sanitation access on child health	1990-2015, various dates.	Meta-analysis of 301 two stage demographic health surveys	Strong	1-30 percent access to community sanitation and household access.	36 percent children stunted. 68 percent children with any anaemia.

Study	Location	Objective	Study period	Methodology	Study strength	Change in sanitation coverage/usage/OD	Health impacts (Red text indicates no significant impact)
		for children with and without household sanitation access.		and multiple indicator cluster surveys undertaken between 1990 and 2015.			18 percent children with diarrhoea in last two weeks.
						61-99 percent access to community sanitation, and household access.	32 percent children stunted.
							59 percent children with any anaemia.
							19 percent children with diarrhoea in last two weeks
Strunz et al (2014) (10)	Global, LMICs 94 studies	The study examines the associations of improved WASH on infection with Soil Transmitted Helminths.	Not stated	Systematic review and meta-analysis of five randomized controlled trials, and 89 cross-sectional studies	Strong	Not stated.	Pooled estimates from all meta-analyses, except for two, indicated at least a 33% reduction in odds of infection associated with individual WASH practices or access
Prüss-Ustün A. et al (2014)	145 low, middle and high-	The study aimed to estimate the burden of diarrhoeal diseases from exposure to	2012 (estimates)	Analysis of secondary data	Strong	58 percent of households were estimated to use an	In children under 5 years old, 5.5 percent of deaths in the age

Study	Location	Objective	Study period	Methodology	Study strength	Change in sanitation coverage/usage/OD	Health impacts (Red text indicates no significant impact)
(9)	income countries	inadequate water, sanitation and hand hygiene in low- and middle-income settings and provide an overview of the impact on other diseases.				improved sanitation facility.	group could have been prevented. Deaths associated at global level with diarrhoea attributable to inadequate water and sanitation and inadequate hand hygiene are estimated at 842 000 deaths, which represents 1.5 percent of the global disease burden in 2012.
Esrey et al (1991) (1)	144 studies in lower and middle income countries and the USA	The purpose of this review was to look at the effect that improved water supply and sanitation facilities had on ascariasis, diarrhea, dracunculiasis, hookworm infection, schistosomiasis, and trachoma.	Pre 1991	Review and analysis of 144 studies	Medium	Not stated	Median reduction in morbidity for diarrhea, trachoma, and ascariasis induced by water supplies and/or sanitation was 26 percent.

Annexure 2

Impact of sanitation on other parameters contributing to improve the quality of life (non-health)

Notes:

- The longer, review type documents drawn upon in this exercise, such as the chapter reviewed in Hutton and Chase (2016), refer to older studies, the references for which are provided in the 'notes' column as appropriate
- Negative findings are highlighted in red

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
WSP (2011) The Economic Impacts of Inadequate Sanitation in India. (37)	India	This study sought to measure the economic impacts of inadequate sanitation in India. It suggests that a package of comprehensive sanitation and hygiene interventions	Methodology of the study included disaggregating the economic impacts of inadequate sanitation into the categories of health, domestic water, access/time and tourism impacts. National data for these sub categories were compiled from	Medium Conservative assumptions used in valuation. No discussion of limitations, bias etc.	Unspecified.	Access time due to inadequate sanitation costs ($10.73 bill). Cost of additional time spent for accessing shared toilets or open defecation sites; absence of children (mainly girls) from school and women from their workplaces. HH access ($10544 million) School access ($66 million) Workplace access ($132 million)	The study estimates that the total economic impacts of inadequate sanitation in India amounts to Rs. 2.44 trillion (US$53.8 billion) a year1—this was the equivalent of 6.4 percent of India's GDP in 2006.

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
		can help avoid all the adverse impacts of inadequate sanitation related to water, welfare, and tourism losses.	secondary sources and attribution factors used to estimate the impacts figures. Then economic valuation was carried out.			Tourism costs of inadequate sanitation ($12 bill) Potential loss of tourism revenues and economic impacts of gastrointestinal illnesses among foreign tourists. Lost tourism ($110 million) International tourist illness ($154 million)	This study estimates a potential gain of about Rs. 1.48 trillion (US$32.6 billion, which was the equivalent of 3.9 percent of GDP in 2006). This signifies a potential gain of Rs. 1,321 (US$29) per capita.
						Domestic-water related impacts ($4.21 bill) HH treatment, drinking water ($2471 million) Bottled Water consumption ($132 million) Piped water ($397 million) Cost of fetching ($1235 million)	
Caruso et al. (2017) Understanding and defining sanitation insecurity: women's gendered experiences of	Odisha, India	The goal of this research was to understand women's lived experiences of sanitation by documenting their concerns, developing a	Free-List Interviews and eight focus group discussions in a rural population in Odisha, India to identify women's sanitation concerns	Medium Triangulation of methods and data validation occurred but mixed-caste FGDs were	For interview participants, 54percent had a toilet within their household compound. For FGD participants,	Non-partner violence, shame/embarrassment, inability to meet social expectations and interference of responsibilities, fear of rape. There is a need for employing coping strategies (withholding food/water,	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
urination, defecation and menstruation in rural Odisha, India (39)		definition of *sanitation insecurity* among women in low-income settings, and to develop a conceptual model to explain the factors that contribute to their experiences.	and to build an understanding of sanitation insecurity.	conducted and. no men, children or urban people included.	59percent had a toilet within their household compound.	holding urges, interrupting the process).	
Hutton and Chase (2017) Water Supply, Sanitation, and Hygiene (chapter 9) (33)	Global	Chapter looks at impacts of poor WASH and effectiveness of interventions and their effects. It cites other work as examples.	N/A	Weak No detail about the cited study's methods, raw data etc.	Unspecified	Increase in comfort, safety, dignity, convenience (Social welfare consequences) but these are hard to quantify.	A general observation
	Global		Citation of another study (see notes column)		Unspecified	As the distance to the water source increases, the time that women could spend on income-generating activities, household chores, and child care decreases.	Ilahi and Grimard (2000) (35)
	Global		Citation of another study (see notes column)		Unspecified	Increased time savings in water quality leading to improved gender equality.	Koolwal and Van de Walle (2013) (34)

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
	6 countries in South East Asia		Citation of another study (see notes column)		Unspecified	Rural households that owned their own latrine saved from 4 to 20 minutes of travel time per trip.	Hutton et al. (2014) (32)
	India		Citation of another study (see notes column)		Unspecified	8 percent increase in enrolment among pubescent-age boys and girls and a 12 percent increase among younger children of both genders, following a national government program to build toilets in schools.	Adukia (2014) (48) Access to improved WASH services in schools and workplaces contributes to school attendance, school performance.
	Philippines		Citation of another study (see notes column)		Unspecified	In the coastal areas of the Philippines, water pollution was estimated to cost US$26 million per year in lost fish catch and degraded coral reefs Water pollution of recreational areas affects the tourism industry, thus lowering visit rates or causing gastrointestinal illness or both.	World Bank (2009) (72)

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
	Nepal	Looking for high quality evidence to back up the claim that MHM is a hindrance to girl's education.	RCT		Unspecified	Menses, and poor menstrual hygiene technology in particular, has no effect on absenteeism of girls; girls miss less than one school day a year on average because of menstruation. Girls may avoid going to school while they are menstruating, not because they lack management methods but because they lack proper facilities for managing menses.	Oster and Thornton (2011) (53) Jasper and Bartram (2012) (49)
	Global		Citation of other studies assessing the economic benefits of improved water supply and sanitation (see notes column).		Unspecified	Health economic benefits and convenience time savings occur (costs related to diseases, such as health care, productivity losses, and premature mortality, saved travel and waiting time from having nearby private toilet).	Hutton (2013) and Whittington et al. (2009) (30, 73)
Hutton and Chase (2016)	Global	The aim of the paper was to summarize	The paper is a review looking at the global	Medium Evidence	Unspecified	Lack of WASH can have an economic impact of up to 7percent of GDP	General observation in abstract

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
The Knowledge Base for Achieving the Sustainable Development Goal Targets on Water Supply, Sanitation and Hygiene (29)	Global	global evidence on WASH and to recommend future focus areas for research and policy.	knowledge base on WASH.	was sourced from published synthesized reviews, such as systematic reviews, meta-analyses and literature reviews. Evidence was critically assessed to determine the quality of methods and robustness of results.	Unspecified	Contribution to improved school attendance and performance.	General observation
	Global		Citation of another study (see notes column)		Unspecified	Increased comfort, safety, dignity, status and convenience. Reduced risk of theft or assault, including rape.	Hutton et al. (2014) (32)
	Global				Unspecified	Broader, improved impacts on the environment.	
			A table compiles data from various sources.		Unspecified	Cost of poor sanitation is 2percent of GDP in East Asia and the Pacific and sub-Saharan Africa. In South Asia it is 4percent.	
Pickering et al. (2015) Effect of a community-led sanitation intervention on child	Mali (Koulikoro district)	The aim of this study was to explore the effectiveness of a CLTS intervention on coverage and quality of household	Cluster-randomised trial to assess a CLTS programme implemented by the Government of Mali.. The study population included households in rural villages (clusters)	Medium The study sample size was constrained by the number of	Access to private latrines was almost twice as high in intervention villages (1373 [65percent] of 2120 *vs* 661	9.9percent more women feel safe at night in the CLTS than the control group.	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
diarrhoea and child growth in rural Mali: a cluster-randomised controlled trial (13)		sanitation facility, defecation behaviour, and child health in a rural setting in sub-Saharan Africa. Prior to it, latrine coverage was less than 60percent.	and every household had to have at least one child aged younger than 10 years.	treatment villages the implementers thought was feasible to undertake the intervention during the study timeline.	[35percent] of 1911 households.		
Alzua et al. (2015) Final report: Impact evaluation of community-led total sanitation (CLTS) in rural Mali (24)	Mali	Exploring the impact of CLTS	A cluster-randomized controlled trial among 121 villages randomly selected in the region of Koulikoro in order to evaluate health and non-health program impacts.	Medium (as per previous document)	33 percent reduction in open defecation, Access to private latrines in intervention villages was increased by 30percent to 65percent.	Reduction in the percentage of women experiencing any sort of harassment (2 percentage point increase in this indicator)	
						Marginal, statistically significant increase in school attendance for children aged 5-12.	
						Statistically significant effect on missing school days for children 10-13 years (they miss an average of 1.4 and 1.9 days).	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
						Working adults spend more hours working (0.39 extra) but this is not statistically significant.	
			A series of experimental games were conducted to measure the role of cooperation in the success of CLTS, at both baseline and follow up. All games were incentivized using valued items (rather than cash).			Pro-social behaviour increased in these communities, and cooperation improved.	
Lawson and Spears (2016) (74)	India – country wide			Strong Quasi-experimental studies using secondary data	100 percent reduction in OD [estimated]	Increase in NPV of future wages by more than $1800 for an average male worker	
World Bank (2017)	India: Bihar, Jharkhand and Uttar Pradesh.	This study aimed to explore whether women 'Natural	Case study research, including engagement of 450 women in FGDs, and 35 in depth interviews exploring	Medium/ weak Case study examples but	Unspecified	Women have more opportunities for entrepreneurship. Women trained as masons and constructing toilets in	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
Women's Leadership in SBM-G (45)		Leaders' are seen to have emerged and to be prominent in the spread of SBM-G, and what the motivating factors and processes through which leadership emerges and spreads are.	women's participation in the programme and the leadership roles they have taken on during SBM.	possible bias on selection of women, and also may not be representative of states in question.		Simdega, Jharkhand, and as contractors.	
				Weak		More women in (SBM) leadership roles with social recognition, such as Swacchagrahis who lead triggering and mahila nigrani samitis (surveillance committees).	
						Women have increased bargaining power within households.	
						Women have expanded spheres of influence	
UNICEF India (2017) Financial and Economic Impacts of the Swachh Bharat	India (rural)	UNICEF was requested by the Ministry of Drinking Water and Sanitation to conduct a study to assess	UNICEF implemented an independent survey on a sample of 18,376 respondents representing 10,051 rural households,	Medium Given the short timeframe of the study, it was not possible to	Figures at both 100percent useage and 85percent useage were used. Differences in	Medical costs averted: financial savings from paying less medical costs based on reductions in illness episodes: At 100percent toilet use: average INR 8,024 per	The results indicate very strongly that household toilets have a range of important benefits, as perceived by households, covering convenience, privacy,

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
Mission (Clean India Mission) (36)		the economic impacts (benefits) of the Swachh Bharat Mission (Gramin). The study aims to measure the household and community costs and benefits of improved sanitation and hygiene implemented under the Swachh Bharat Mission, and to compare these in cost-benefit analysis. Costs include both financial and non-financial (in-kind) contributions of different parties.	randomly selected from 550 Gram Panchayats across 12 states accounting for 90percent of open defecation in India. Standard economic modelling methods for estimating the efficiency of interventions, and cost-benefit ratios were presented. results are presented by wealth quintiles using the asset index methodology, to assess how SBM(G) affects different population groups.	conduct an impact evaluation of SBM to separate out the benefits of SBM over time from those that would have been achieved without SBM. Given the uncertainties in many of the model variables, a sensitivity analysis was conducted to explore the impact of using different values for a few	wealth (over five quintiles) were considered.	household per year, and INR 6,599 for the poorest quintile At 85percent toilet use: average INR 5,296 per household per year, and INR 4,355 for the poorest quintile	safety and status aspects.
						Value of time savings: reduced time lost from sickness and seeking a place for open defecation At 100percent toilet use: average INR 24,646 per household per year and 21,466 for the poorest quintile. At 85percent toilet use: average INR 20,200 per household per year, and INR 17,431 for the poorest quintile	In conclusion, this study has shown that the Swachh Bharat Mission (Gramin) is highly cost-beneficial from both a financial and an economic perspective.
						Value of saved lives: economic value of saved lives due to lower mortality rates: At 100percent toilet use: average INR	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
		The study considered 4 types of benefit that accrue to households from having a household toilet and using it.		input variables into the economic model.		17,622 per household per year and 20,184 for the poorest quintile At 85percent toilet use: average INR 11,631 per household per year, and INR 13,321 for the poorest quintile	
						Property value: At 100percent toilet use: INR 18,991 per household was estimated as the average increase in property value from having a toilet, and 11,757 for the poorest quintile. This is the same for at 85percent use. In the cost-benefit analysis, a one-off cash benefit of this value is assumed to accrue at the end of a 10 year period.	
						When costs and benefits are compared over a 10-year time period7, and when 100percent of households in	Benefit-cost ratios are higher for poorer households than for

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
						a community use a toilet, the financial savings exceed the financial costs to the household by 1.7 times, on average. For the poorest households, the value is higher at 2.4 times. When also considering time impact and lives saved, the saving is 4.7 times and 7 times.	richer ones. With larger family sizes and more children, this is higher.
						Intangible benefits of owning a latrine (percent that strongly agree): Convenience of nearby latrine: 90percent Convenience at night or in rains: 90percent Convenience for menstruation: 85percent Convenience to elderly: 89percent Privacy: 85percent Improves status: 82percent Safety for women/girls: 88percent	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
Coffey and Spears (2017) Where India Goes (18)	India (Uttar Pradesh)	The authors were living and working in UP, researching about poor early-life health and stunting in children, and the challenges of raising a baby.	Two children of the same age, living in nearby villages and from similar castes were compared from birth. Over 3 years, one of the authors visited the two boys at undefined intervals and recorded their height in centimetres. She also conducted a cognitive test, asking the children to identify basic objects and their use, and engaging in basic conversation.	Strong Studies based on analyses e.g. difference in difference analysis of DHS data, regression; primary data collection and analysis.	Unspecified.	Increase in height in child (one child 9cm taller than the other) Improved cognitive development (the taller child could speak and identify objects, the other not so much)	P. 112, 146 of the book. But note this was more than just sanitation: also, nutrition (the latter stopped breastfeeding earlier).
Mills and Cumming (2016) The Impact of WASH on Key Health & Social	Global	The paper looks at 10 areas that UNICEF have suggested could be impacted by	Each case/example is assessed, and it is stated whether the relationship seems to have been supported by weak or firm evidence	Weak	Unspecified.	Weak evidence of the effect on WASH interventions on psychosocial stress, but suggestive evidence that inadequate WASH can affect VAWG and psychosocial stress.	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
Outcomes: Review of Evidence. (44)	Global	WASH and reviews the evidence against them based on case studies.	using three categories ‘good’, ‘suggestive’ and ‘weak’. It is not a systematic review. There is then some more detailed discussion. See notes column for citations of some of the studies.		Unspecified.	Suggestive evidence of the effect of MHM on urogenital infections and school absenteeism.	
	Global				Unspecified.	Evidence from empirical studies on the effect of WASH interventions on school attendance remains limited.	
	Global				Unspecified.	Good evidence to suggest that WASH can affect school absenteeism through a number of mechanisms. Suggestive evidence as to the effect of WASH interventions on school absenteeism.	
	Global				Unspecified.	Suggestive evidence that inaccessible WASH provision has a negative effect on the lives of people with a disability. Suggestive evidence that well-designed, inclusively delivered, accessible WASH interventions can be effective in removing some of the	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
						external barriers facing people with disabilities and need not cost more.	
	Kenya		Uses data from the 2008/2009 Kenya Demographic and Health Survey to explore the quantitative relationship between access to sanitation and experiences of violence.		Some practicing OD, others not	The odds of women experiencing non-partner violence in the last 12 twelve months in disorganized neighbourhoods were 13 times greater for women practicing open defecation compared to women who reported using a sanitation facility. Conversely, there was no significant change in the odds of violence associated with sanitation facilities in neighbourhoods with higher cohesion.	Winter and Barchi (2015) (40)
	Dhaka				Unspecified.	Access to basic services including water services did not have a significant relationship with self-reported quality of life.	Gruebner et al. (2012) (75)

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
	Rural India				81 percent vs. 53 percent household toilet coverage.	Toilet owners were 28 percentage points more likely to report that: Women and girls feel safe while defecating during the day or night compared with households without private toilets. Overall, the intervention increased the perception of privacy and safety for women and girls during defecation by 13 percentage points compared with controls (72percent vs. 59percent).	Arnold et al. (2010) (41)
	DRC				Unspecified.	Almost two-thirds of women said that they could express their views and actively participate in decision-making in the community; community mechanisms were put in place to discourage early marriage; and domestic violence reportedly decreased.	PPSSP & Tearfund, (2011) (43)
	Kenya		Custer randomized controlled feasibility study to evaluate		Some had sanitation/ MHM	Girls using cups or pads reported being	Mason et al (2015) (42)

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
			the success of an MHM intervention and the potential effect on school attendance		facilities, others did not	free of embarrassing leakage, odour, and dislodged items, and only girls using traditional materials reported school absenteeism and impaired concentration.	
	Nyanza Province	tested the effect of WASH interventions on pupil absence, diarrhoeal disease and reinfection with STH	Cluster, randomized trial in schools		Some schools had sanitation facilities, others did not	Water treatment and hygiene promotion interventions reduced absenteeism by 39percent but adding a sanitation /latrine element caused only a marginal further reduction.	Willmott et al. (2015) (76)
FANSA and WSSCC (2015) Leave no one Behind: Voices of Women, Adolescent Girls, Elderly, Persons with Disabilities and Sanitation workforce.	Nai Seemapuri, New Delhi,	This report sought to act as a consultation process for addressing equity and inclusion in sanitation and hygiene though the engagement of vulnerable and marginalised groups.	Eighteen consultation meetings were held across 6 states with participants from different marginalised groups. 999 people participated in these meetings, including 260 women and adolescent girls, 182	Weak	Unspecified	Community members reported a decrease in the incidents of sexual harassment at this toilet complex after maintenance people started to look after and man the complex.	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
(63)			elderly people and persons with disabilities.				
Montgomery et al. (2012) Sanitary Pad Interventions for Girls' Education in Ghana: A Pilot Study (50)	Ghana	This study aimed to investigate the relationship between the availability of (1) sanitary pads-and-education and (2) education alone, on school attendance among girls aged 12–18 in Ghana.	A sample of 120 school girls aged between 12-18 participated in a non-randomized trial which had three levels of treatment: provision of pads with puberty education, puberty education alone or control (no pads or education).		39 girls received pads in peri urban areas and 21 in rural areas. 25 girls only received pads and 35 were in the control group.	The total improvement through pads with education intervention after 5 months was a 9% increase in attendance. After 3 months, providing pads with education significantly improved attendance among participants. The changes in attendance at the end of the trial, after 5 months, were found to be significant by site over time. With puberty education alone resulting in a similar attendance level.	
Njuguna el al. (2008) The sustainability and impact of school sanitation, water and hygiene	Naorobi, Mombasa and Kwale, Kenya	This study investigated impact and sustainability of school interventions for water, sanitation and hygiene	Research was carried out in 100 schools. In each school a range of data collection methods was used: interviews with teachers, observations of school facilities,		Schools had varying inputs in terms of construction of water, sanitation or handwashing facilities or training of	Girls were absent less in schools where there was more handwashing and a very high toilet use. The association suggests that in one way or another, the successful implementation of the WASH package in a school can significantly reduce girls' absenteeism, a	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
education in Kenya (46)		education (WASH).	observations of handwashing practices of 1000 children, classroom voting by 4900 children and small group discussions with children in 16 schools.		teachers and children.	substantial and highly desirable impact from the project.	
Garn et al. (2016) Estimating the Effect of School Water, Sanitation, and Hygiene Improvements on Pupil Health Outcomes. (47)	Nyanza province, Kenya	The primary goal of this study was to estimate the causal effects of school-level adherence to interventions on pupil diarrhoea and soil-transmitted helminth infection.	Cluster randomised trial in 185 schools in Nyanza province. Schools were divided into water availability groups, which were then randomized separately into either water, sanitation, and hygiene intervention arms or a control arm.		Schools were divided into water availability groups, which were then randomized separately into either water, sanitation, and hygiene intervention arms or a control arm.	In the water-scarce group, there was evidence of a reduced prevalence of diarrhoea among pupils attending schools that adhered to two or to three intervention components, compared with what the prevalence would have been had the same schools instead adhered to zero components or one. In the water-available group, there was no evidence of reduced diarrhoea with better adherence. For the soil-transmitted helminth infection and intensity outcomes, point estimates	

Study	Location	Study objective	Methodology	Strength of findings	Coverage	Impact	Notes
						in the preventive direction were often observed with increasing intervention adherence, but primarily among girls, and the confidence intervals were often very wide.	
Jasper and Bartram (2012) (49)	Various, global	The goal was to characterize the impacts of water and sanitation inadequacies in the academic environment.	Published peer reviewed literature was screened and articles that documented the provision of water and sanitation at schools were considered.		Forty-one peer-reviewed papers met the criteria of exploring the effects of the availability of water and/or sanitation facilities in educational settings.	A reported decrease in diarrheal and gastrointestinal diseases with increased access to adequate sanitation facilities in schools. Ensuring ready access to safe drinking water, and hygienic toilets that offer privacy to users has great potential to beneficially impact children's health.	

Criteria for assessing the strength of the studies

Strong	Medium	Weak
Clear statement and definition of the problem to be investigated	Clear statement and definition of the problem to be investigated	Clear statement and definition of the problem to be investigated
Robust methodology based on experimental or quasi experimental methodology	Robust methodology based on triangulated qualitative methodology	Weak qualitative/unspecified methodology
Statement of study bias and study limitation	Statement of bias and study limitation.	Validity and generalisability of findings weak
Valid and generalisable findings	Valid findings, with limited generalisability	

Annexure 3

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