

# Assessment of Water, Sanitation, and Hygiene in South-East Asia: A Systematic Review

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## ABSTRACT

**Introduction:** Water, Sanitation and Hygiene (WASH) can be used as an indicator for the assessment of the health of a country. Without WASH facilities, it is very difficult for the sustenance of health and well-being of the people.

**Aim:** This systematic review tries to bring out various nuances of practices on WASH and their intervention in the South-East Asia Region (SEAR).

**Materials and Methods:** In the present systematic review, searches were made systematically in scholarly sources like Google Scholar, PubMed and Science Direct to unearth data from January 2005 to February 2020 with a language restriction to English for all the published articles. The literature search was conducted from March to May, 2020. The full-text articles (accessible) were retrieved from each of the searches and a few of the papers which appeared to be relevant were obtained for review. Articles were included from both urban and rural set-ups. Irrelevant topics and headings were excluded. The final review included 15 articles.

**Results:** The area of SEAR has a different level of practice and outcomes on WASH. The studies show that low-quality WASH practices in Bangladesh, India and Sri Lanka contribute to

public health issues. The studies on the health impact of WASH from many countries like Indonesia, Myanmar, Sri Lanka and Timor-Leste are also found to be inadequate in the maintenance of health. The report mentioned about many diseases like gastroenteritis, stunting and helminthes infection among many people in the community. The source of drinking water and drinking water quality needs to be assessed according to the recommendation of studies across the SEAR region. Two infectious diseases recently emerged such as Soil Transmitted Helminths (STH) and *Escherichia coli* contamination due to inadequate WASH practices.

**Conclusion:** The diarrhoeal diseases and sanitation related issues are numerous in the entire region. Diverse consumption of sanitary practices and drinking water is seen in India, as reported in one study; whereas open defecation has not been eliminated as reported in another study, where 32% of households are still defecating openly. Health impacts due to the lack of proper WASH practices are still a rising concern. Special attention is required for underprivileged areas like slums and rural areas. The involvement of the government in providing WASH facilities to underprivileged people is very significant.

**Keywords:** Drinking water, Hand hygiene, Health outcome, Hand washing, Sanitation

## INTRODUCTION

Water, sanitation and Hygiene (WASH) is a parameter to assess the country on health and hygiene [1]. Inadequate sanitation and lack of hygiene are considered as factors of grave concern with a bearing on health of common people [2]. Lu Z et al., reported that United Nations has set Sustainable Development Goals to provide safe here after WASH practice in low and middle-income countries by 2030 [3]. The incremental increase of WASH facilities fails to ensure complete coverage across the world [4]. In many countries, diseases of waterborne infections are still found to be a cause of concern, which causes many people to fall ill or even die [5]. Diarrhoea-related illnesses account for 4.1 percent of the global disease burden, which claims the lives of 1.8 million people, the majority of whom are children under the age of five [1].

According to a document by World Health Organisation (WHO) the concepts of “safer water, better health” states that with the mere improvement of WASH, almost 10% reduction in the global burden of disease across the world and in South-East Asia Region (SEAR) it could be 8.4% [6]. In SEAR, almost 1.1 million children die from diarrhoeal diseases [7]. The South-East Asia Region (SEAR) has already met its drinking water target set by the Millennium Development Goals; nonetheless, the safety of drinking water quality remains a concern. Many countries in the region are still trailing behind in terms of sanitation. Therefore, this study has investigated

the assessment of WASH practices and their impact on health in SEAR.

## MATERIALS AND METHODS

This systematic review performed a literature search in Google Scholar, PubMed and Science Direct databases for journal articles published between January 2005 and February 2020. The titles of the scientific papers, abstracts and keywords were inspected by using relevant terms mentioned in [Table/Fig-1]. When performing searches, terms were separated by the Boolean terms OR and AND. First relevant articles were exported to Mendeley reference software. Only peer-reviewed journal articles were included in the study. Searches were limited to English language and location SEAR. The literature search was conducted from March to May 30, 2020.

**Inclusion criteria:** The articles, reviews and original research with complete text on clearly defined WASH practices and health outcomes, or data about the function and use of the WASH practices of the South-East Asia region, both urban and rural settings, published from the year January 2005 to February 2020 were included in the review with the language restricted to English.

**Exclusion criteria:** Grey literature and organisational literature or articles on any other region other than SEAR, those on irrelevant topic and headings were excluded from the study. The practices

| Sl. No. | Database       | Search keywords  |
|---------|----------------|--|
| 1.      | PubMed         | (safe drinking water practices) OR (drinking water quality) OR ((unsafe drinking water) AND (Poor toilet use) OR (inadequate sanitation) AND (hand hygiene) OR (WASH practices) AND (health impacts) OR (disease burden due to WASH) OR (disease association) OR (risk factors) AND (South-east Asia)) |
| 2.      | Google scholar | All in the title: "South-east Asia" "Drinking water quality" OR "safe drinking water" OR "drinking water practices" AND "Sanitation" OR "Toilet use" AND "hygiene practices" OR "hand washing" OR "WASH practices" AND "Health Impacts" OR "disease burden"  |
| 3.      | Science direct | ("Drinking Water quality" OR "safe drinking water practices") AND ("Sanitation" OR "Toilet use") AND ("frequent hand washing practices" OR "WASH practices") AND ("Health impacts" OR "disease burden" OR risk factors due to WASH") AND ("South-east Asia")   |

**[Table/Fig-1]:** Search database and keywords.  
Source: Author's estimation

and health impact, the specifications included and excluded are shown in [Table/Fig-2].

| Search area  | Year and type of article    | Study area                 | Inclusion  | Exclusion  |
|--|-----------------------------|----------------------------|--|--|
| Impact of WASH practices on health                                 | Journal article (2005-2020) | South-east Asian countries | It specifies the inadequate WASH practices associated with risk factors and various health outcomes                | Studies focus on only diseases with no association with WASH, Not related to any diseases or health impacts              |
| Nature of WASH practices   | Journal article (2005-2020) | South-east Asian countries | It specifies the assessment of WASH practices in both rural and urban settings                                     | Studies focused on intervention only or behaviour Knowledge and gap or WASH management No clearly defined WASH practices |
| Adoption of methods to assess the WASH practices and health impact | Journal article (2005-2020) | South-east Asian countries | It specifies the various methodologies used in the studies on the assessment of both practices and health outcomes | The study focuses on descriptive study design  |

**[Table/Fig-2]:** Inclusion and exclusion criteria in the search strategy.  
Source: Author's representation

### Selection Procedure of Articles

A three step screening process was developed to identify the studies that show the assessment of WASH practices and their impacts on health outcomes in SEAR. Initially, in the identification, articles considered the relevance of WASH and wash practices. In primary screening, the articles were reviewed as per fulfilling the study objective with all the keywords where only the title was scanned. In the secondary screening, the articles were reviewed as per the inclusion and exclusion criteria where both title and abstract were scanned. In the tertiary screening, the articles finally reviewed were full text and in the final review, the eligible full-text article directly addressed the research questions. All the eligible papers were selected that address the WASH practices and their health impacts.

### Data Extraction

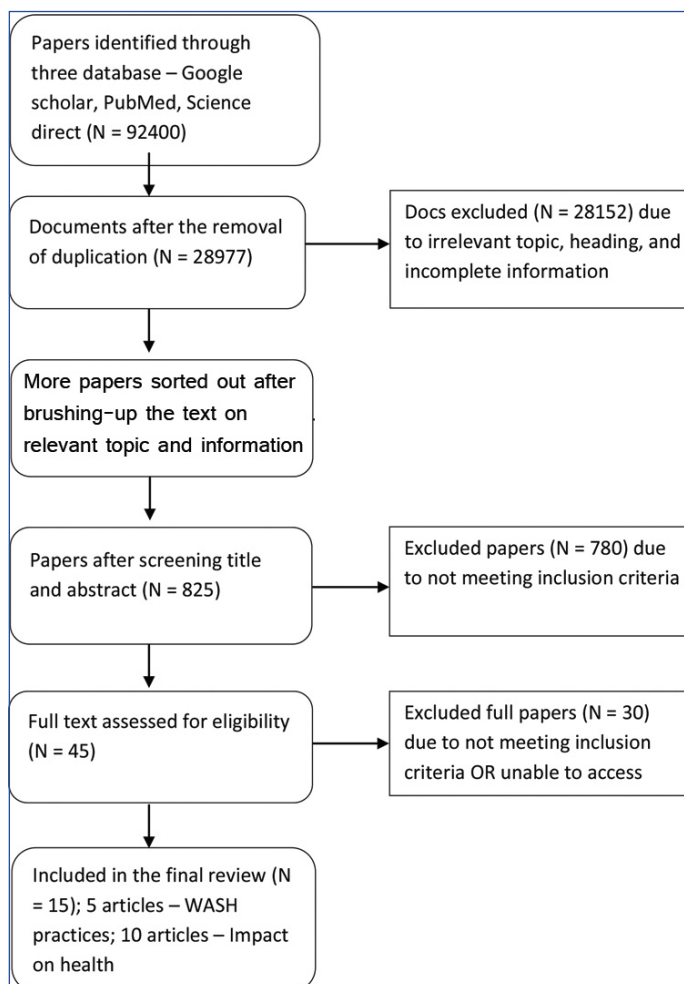
Data extraction was created for the 15 identified research studies. Data were extracted from the selected articles employed in the review. The studies were divided and initially extracted as per the objective of the study. Study design, methodology, sample and outcome (see supplementary materials) were extracted. There were no restrictions on the settings whether it's rural or urban in South-east Asia. A future direction to improve the health conditions in every study is also described. The data extraction form was revised, refined and capture data concisely.

### Risk of Bias Assessment

The risk of bias was assessed using the Cochrane risk of bias assessment tool [8].

### RESULTS

The result section is based on a literature search procedure that has been presented through a PRISMA diagram and the literature is extracted based on three themes-nature of wash practices; methodology adopted to assess the WASH practices; evaluation of any health impacts associated with inadequate WASH practices [Table/Fig-3].



**[Table/Fig-3]:** PRISMA diagram for literature search for review of Water, Sanitation, and Hygiene (WASH) practices and health impacts.

The [Table/Fig-4] shows a literature search for a review of WASH practices and health impacts in SEAR published between 2005 and 2020. A total of 15 articles were retrieved from the search as per the eligibility criteria which are included in this review. Five countries (Indonesia, Nepal, India, and Bangladesh) constituting five articles represented access to safe drinking water, toilet usage and hand washing practices in those studies. Two articles from India represented WASH practices and eight of the countries (Indonesia, Vietnam, Thailand, Sri Lanka, Myanmar, India, Laos, and Timor-Leste) constitute 10 articles about the health impacts and risk factors that can contribute to diseases and the disease-associated due to inadequate sanitation, water and hygiene practices of which Laos and Thailand reported one study. The [Table/Fig-4] shows the methodology adopted to assess the WASH practice in SEAR. We have found that most of the study is based on a primary survey using simple random sampling [2,9-22].

### Nature of WASH Practices and Health Outcomes

The [Table/Fig-5] presents the nature of WASH practices and health outcomes of selected studies in SEAR [2,9-22].

| Author and year of publication      | Study location       | Study design             | Sample size   | Data collection tool                     | Sampling method  |
|-------------------------------------|----------------------|--------------------------|---|--|--|
| Greenland K et al., (2013) [9]      | Indonesia            | Formative research study | 27 others   | Direct observation (video recording)     | Simple random sampling                                       |
| Acharya P et al., (2015) [10]       | Nepal                | Cross-sectional          | 374 women   | Interview                                | Multistage systematic random sampling                        |
| Tripathy RM. et al., (2017) [11]    | India                | Cross-sectional          | 400 women   | Questionnaire                            | Simple random sampling                                       |
| Shammi M and Morshed M, (2013) [12] | Bangladesh           | Research study           | 2 upazilas, 5 villages  | Semi-structured open-ended questionnaire | Multistage sampling  |
| Weaver ER et al., (2016) [13]       | Myanmar              | Cross-sectional          | 2,082 students from 116 schools                                   | Observation and questionnaire            | Multistage cluster sample                                    |
| Torlesse H et al., (2016) [14]      | Indonesia            | Cross sectional          | 1366 children   | Structure questionnaire                  | Multistage cluster sampling                                  |
| Otsuka Y et al., (2019) [15]        | Indonesia            | Cross-sectional          | 228 pairs of children and caretakers                              | Direct observations and a questionnaire  | Simple random sampling                                       |
| Adhikary M and Pal C, (2019) [16]   | Kolkata City, India  | Primary survey           | 232 children  | Structured questionnaire & PI            | Simple random sampling                                       |
| Rah JH et al., (2015) [17]          | Rural India          | Cross-sectional          | 109 903 children under 5 & 2650 children under 2 years            | Interview                                | Stratified cluster sampling & multistage stratified sampling |
| Vannavong N et al., (2018) [18]     | Laos City, Thailand  | Cross-sectional          | 215 and 130 households in Laos 272 and 139 households in Thailand | Interview and observations               | A systematic random sampling                                 |
| Hlaing ZN et al., (2016) [19]       | Myanmar              | Cross-sectional          | 364 household respondents   | Interview                                | Simple random sampling                                       |
| Campbell SJ et al., (2016) [20]     | Timor-Leste          | Randomize control trial  | 23 villages   | Questionnaire                            | Random sampling  |
| Fowsul Ameer ML (2017) [21]         | Sri Lanka            | Primary survey           | 100 persons and RDHS report                                       | Questionnaire and GD                     | Purposive sampling   |
| Pham-Duc P et al., (2014) [2]       | Vietnam              | Case-control study       | 867 adults, 405 households  | Questionnaire and PI                     | Simple random sampling                                       |
| Bhar D et al., (2017) [22]          | Siliguri City, India | Cross-sectional          | 796 slums   | Questionnaire                            | Cluster sampling   |

**[Table/Fig-4]:** Methodology adopted for the assessment of WASH practices [2,9-22].

Source: Author's representation; PI: Personal interview; GD: Group discussion

| Author and year of publication      | Study area  | Study design            | Study setting       | Focus area     | Study outcome   |
|-------------------------------------|-------------|-------------------------|---------------------|----------------|---|
| Shammi M and Morshed M, (2013) [12] | Bangladesh  | Research study          | Rural               | WASH practices | WASH practices were satisfactory however there was a lack of monitoring at school |
| Bhar D et al., (2017) [22]          | India       | Cross-sectional         | Urban               | WASH practices | The diverse pattern of water consumption and sanitation practices                 |
| Acharya P et al., (2015) [10]       | Nepal       | Cross-sectional         | Urban               | WASH practices | Satisfactory hygiene  |
| Tripathy RM et al., (2017) [11]     | India       | Cross-sectional         | Urban               | WASH practices | Less satisfactory since 32% of households still defecate openly                   |
| Greenland K et al., (2013) [9]      | Indonesia   | Formative research      | Rural and urban     | WASH practices | Infrequent handwashing practices  |
| Torlesse H et al., (2016) [14]      | Indonesia   | Cross-sectional         | Rural and urban     | Health impact  | Stunting due to unhygienic condition  |
| Weaver ER et al., (2016) [13]       | Myanmar     | Cross-sectional         | Urban               | Health impact  | Diarrhea and vomiting   |
| Adhikary M and Pal C, (2019) [16]   | India       | Survey                  | Urban               | Health impact  | Acute watery diarrhea   |
| Fowsul Ameer ML, (2017) [21]        | Sri Lanka   | Survey                  | Coastal areas       | Health impact  | Waterborne disease  |
| Hlaing ZN et al., (2016) [19]       | Myanmar     | Cross-sectional         | Urban               | Health impact  | Gastrointestinal disease  |
| Vannavong N et al., (2018) [18]     | Thailand    | Cross-sectional         | Sub-urban and rural | Health impact  | Gastrointestinal disease and diarrhea   |
| Pham-Duc P et al., (2014) [2]       | Vietnam     | Case-control study      | Urban               | Health impact  | Gastrointestinal disease and diarrhea   |
| Rah JH et al., (2015) [17]          | India       | Cross-sectional         | Rural               | Health impact  | Stunting  |
| Otsuka Y et al., (2019) [15]        | Indonesia   | Cross-sectional         | Urban               | Health impact  | Stunting and increased risk of diarrhea   |
| Campbell SJ et al., (2016) [20]     | Timor-Leste | Randomise control trial | Rural               | Health impact  | Soil helminthes infection due to fecal contamination                              |

**[Table/Fig-5]:** Nature of WASH practices in SEAR [2,9-22].

Source: Author's representation

**Indonesia:** Hand washing practices were found to be infrequent despite available facilities. Risk factors were associated with diarrhoea due to lack of handwashing stations, minimal presence of septic tank toilets and poor use of toilets [9].

**Nepal:** It is found that most of the people (96.3%) are using the latrine for defecation. Whereas, many of the respondents (74%) use improvised toilets without sharing. The handwashing with soap is limited to only 71.4% of respondents. The study also confirms that 70.1% of people use to brush their teeth once. Nearly 64.2% of households do not use any sophisticated methods for cleaning portable drinking water [10].

**India (West Bengal State):** There are various types of water consumption and sanitation practices patterns dominant in the urban slums of Siliguri. According to the concerned study, 733

(92.1%) of the slum dwellers use better drinking water sources; the public tap (71%) plays a big role as the primary source of water. The report also confirms that 54.9% of families use improved and 45.1% of use unimproved portable water resources for food preparation and/or handwashing. There is evidence of two-thirds of the families (65.7%) use sophisticated sanitation facilities, of which the use of a flush facility consists of 47.5% in comparison to 18.2% using an improved pit latrine [22].

**India:** The public taps play an important role as a source of drinking water which is closely followed by the dug wells and ponds. The use of latrines was found in relatively low households of around 73.5%. Among all the members of the household only 66.8% use latrines, the rest 33.2% still depend on open defecation. The hand washing practice was done by 86.5% of respondents associated with before

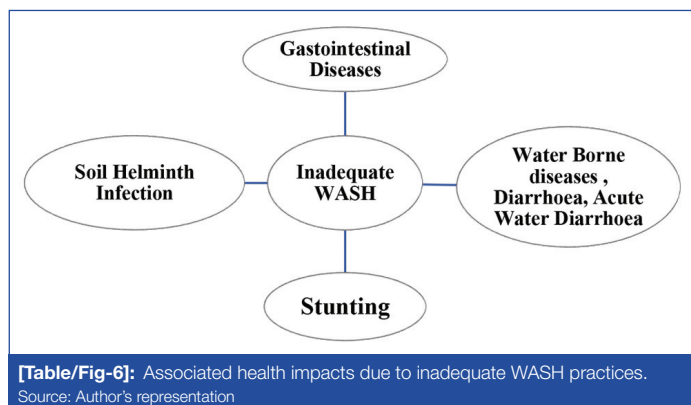
and after consumption of food and only 78.3% practiced hand washing in association with feeding the child [16].

**Bangladesh:** The main source of drinking water found to be tube well among that 96% of platforms were found to be cemented. However, the main crisis was due to problems with iron and arsenic which make the water unsuitable [12].

Overall WASH practices analysis, the authors found four insights. First, accelerating action by the local administration needs to be incorporated to improve water quality. Second, various hygiene awareness programs should be conducted with the direct involvement of the community [10]. Third, emphasis should be given to health education to improve people's behaviour [11]. Fourth, awareness through digital media should be strengthened in rural areas [12].

### Inadequate WASH Practices and Associated Health Impact

The [Table/Fig-6] shows associated health impacts due to inadequate WASH practices in SEAR. The study has found the most frequently occurring diseases which include gastrointestinal, stunting, waterborne disease and soil helminth infection. A detailed discussion of health impacts (country-specific) has been presented in [Table/Fig-5].



**Myanmar:** The major risk factors found with diarrhoea is lack of hand washing facilities, lack of access to septic tank toilets and poor use of toilet [13].

**Vietnam:** The factors like wastewater and excreta in agricultural practices cause diarrhoea among adults. The prevalence of gastrointestinal diseases is associated with the consumption of wastewater irrigated vegetables. Lack of personal hygiene and unsafe food and water causes severe episodes of diarrhoeal diseases among adults [2].

**Indonesia:** There was close symmetry between the use of sanitation methods and child stunting in parts of Indonesia. The households having lack access to improved latrines were found to be reporting more stunting cases. The WASH interventions into a broader multispectral approach are needed to achieve the results [14].

**Indonesia:** The use of a towel after hand washing proved to be an effective method to eliminate the bacteria on hands. The matters like improvement of drinking water are required for better results [15].

**Kolkata, India:** Acute Watery Diarrhoea (AWD) was very much prevalent among the children; around 51% and 72% of other members of the family suffer from AWD. The severity of the diarrhoeal disease can be controlled by 40% by the rotavirus vaccine and most importantly awareness of the waterborne disease plays a major role [16].

**Rural India:** The evidence of poor sanitation causing more likely of child stunting is found in rural India. Whereas the cases of open

defecation are found to be burdensome causing child stunting. Well-targeted nutrition-sensitive interventions are the order of the day to overcome the situation [17].

**Laos and Thailand:** In suburban Laos, the factors like use of household materials, types of storing water containers and unavailability of toilets are correlated with dangerous organisms like *Escherichia coli* (*E. coli*). The high level of *E. coli* in the two villages in Laos and rural Thailand was found to be a risk factor for diarrhoeal diseases. Massive steps need to be taken for the provision of improvised toilet facilities to reduce the burden of diseases [18].

**Myanmar:** The prevalence of gastrointestinal disease was found in 83 (22.8%) households and non disease in 281 (77.2%) households. The households focusing on non tube water were 6.5 times more in comparison to others in connection with the occurrence of gastrointestinal diseases than those who use tube water [19].

**Timor-Leste:** The community-based assessment shows that factors in Timor-Leste are Soil Transmitted Helminths (STH) infections in the area of high STH. High STH is endemic with a poor level of WASH. Improper disposal of human excreta is associated with a major driver of STH transmission which is reported due to poor sanitation infrastructure [20].

**Sri Lanka:** The flooding period force the ground water sources to be affected heavily and causes diseases. The agents causing the water-borne diseases increase due to improper drainage systems in the coastal areas, which leads to the breeding ground for dengue [21].

## DISCUSSION

### Status of Assessment of WASH Practices

The status of WASH in various countries can be defined through the assessment of practices. Water has a profound effect on health. The source of drinking water, and drinking water quality needs to be assessed. The practice of regular handwashing with soap is found to be the most cost-effective in maintaining good health and reducing diseases across the world [5]. The Millennium Development Goals (MDGs) are on track in maximum countries of South-east Asia. The diverse pattern of water consumption is seen in the reported study in West Bengal. Still, there is a lack of drinking water treatment in Nepal reported in the study [7]. Hand washing was found to be infrequent in a study conducted in Indonesia. Overall handwashing practices were satisfactory [8]. Three of the studies have found out public tap was the main source of drinking water whereas two studies reported groundwater was the main source. People still lack basic sanitary services in slums although utilisation of drinking water has been increasing globally in various slums [11]. Overall WASH practices are satisfactory although full attainment has not been achieved yet in some regions of South-east Asia.

### Infectious Diseases Due to Inadequate WASH

Two infectious diseases recently emerged such as STH and *E. Coli* contamination due to inadequate WASH practices. Across the globe, the issue of STHs is a concern for people. This may be due to the poor nature of human behaviours in society along with inadequate water sources [21]. Evidence found that handwashing with soap is a protective factor for *Ascaris* and STH generally [23,24].

Stunting is a risk factor for the death of a child, which again affects cognitive and motor development leading to a low level of performance in study. This can cause overnutrition and noncommunicable diseases along with a low level of productivity. In 2013, Indonesia had the fifth highest burden of stunted

children despite being a low-middle-income country [15]. The study conducted in Indonesia reports that provincial estimates on household access to improved latrines correlated inversely with the percentage of the stunted child. Many papers report that at a household level in India and Africa, the sanitation facility is found to be associated with the factors like child nutrition [16,17]. The correlation between WASH and nutritional status needs to be investigated in Indonesia with scientific studies.

The diseases of diarrhoeal origin especially protozoan and bacterial infections are very high. To improve the health system, there is a need for improvement of WASH. The focus on addressing public health issues varies across countries. The evidence generated by WASH studies could be incorporated into the regional public health policies. Hence, the governments have to be vigilant according to the inputs of micro-level studies in their countries.

The priorities in rural and urban areas are quite different, so as far as the WASH activities and diseases are concerned, in urban areas the infection is found to be virulent and quickly spreading, especially in the rainy season. Whereas, there is a prevalence of endemic diarrhoeal diseases in rural pockets due to low-levels of hygiene and sanitation activities. The urban areas having more facilities for healthcare usually combat the situation promptly. The rural areas need sustained effort for awareness and intervention to gain the desired results.

The role of media in the awareness and promotion of WASH plays a very significant role. Intensive education and awareness campaigns need to be done to ensure people understand the need for safe water and sanitation. More investigation on improving WASH and various related infections and proper monitoring and evaluation need to be incorporated.

## CONCLUSION(S)

The SEAR has shown tremendous progress toward WASH activities. Maldives, Singapore, Malaysia, the Philippines and the Democratic People of Korea are in the utmost number in progress toward WASH. Whereas Timor-Leste has shown poor performance of WASH since 2000. Diverse sanitary practices and drinking water is seen in India as open defecation has not been eliminated and 32% of households are still defecating openly. Health impacts due to the lack of proper WASH practices are still a rising concern. Special attention is required for underprivileged areas like slums and rural areas. The involvement of the government in providing WASH facilities to underprivileged people is very significant. Involvement of policies and programmes on adequate Information, Education and Communication (IEC) activities are very much needed for effective WASH strategy implementation.

**Authors' contribution:** All the authors have contributed in designing of the study. Authors Deepak Kumar Behera and Kalolini D Samant initiate the process of ideation. Deepak Kumar Behera, Kalolini D Samant and Ranjit Kumar Dehury work on the analysis and findings of the study. Deepak Kumar Behera and Kalolini D Samant make the primary draft with a compilation of the study. Deepak Kumar Behera and Ranjit Kumar Dehury verified the data and make improvements. All the authors approved the manuscript.

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