

Review Article

School Hygiene Practices and Challenges, a Comparative Review of India and the United States

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Abstract

School hygiene is a critical component of child health, safety, and educational development, as schools provide an important setting for promoting healthy behaviors and preventing communicable diseases. Adequate Water, Sanitation and Hygiene (WASH) facilities, hygiene education, and effective school health policies contribute to improved health outcomes, reduced illness-related absenteeism, and enhanced learning environments. This comparative literature review examined school hygiene policies, practices, infrastructure, implementation strategies, monitoring, challenges, and health-related outcomes in India and the United States. Literature was identified through searches of academic databases, including Google Scholar, PubMed/MEDLINE, and ERIC, and through authoritative governmental and international sources. Peer-reviewed studies, systematic/scoping reviews, and relevant policy and programme documents published between 2010 and 2026 were included and synthesized comparatively across common thematic domains. India primarily focuses on expanding sanitation infrastructure, supply of drinking water, school nutrition, and adolescent health, through national hygiene initiatives targeting several school health and wellness programmes. In contrast, the United States emphasizes integrated school health frameworks, drinking-water quality, and institutional accountability through coordinated public health policies and school-based interventions. Despite these efforts, both countries continue to face persistent challenges related to equitable WASH access, infrastructure maintenance, behavioral compliance, and effective implementation of school hygiene policies. Differences in policy structures and socioeconomic contexts further influence the implementation and monitoring of school hygiene measures. Overall, the reviewed evidence demonstrates that sustainable improvements in school hygiene require coordinated, multisectoral approaches that integrate functional infrastructure, continuous hygiene education, behavioral reinforcement, routine monitoring, and institutional commitment. Strengthening these interconnected components is essential for creating safe, healthy, and inclusive learning environments that support children's long-term health, well-being, and educational outcomes.

Keywords

School, Hygiene, Water, WASH, Education, Health, India, United States

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1. Introduction

Health is widely recognised as a multidimensional concept encompassing physical, mental, and social well-being rather than merely the absence of disease. This holistic perspective, as articulated while constituting the World Health Organization [1], highlights the importance of environments that support healthy growth and development throughout childhood. Among these, schools serve as a critical setting for promoting health, as children spend nearly one-third of their waking hours in educational institutions, where they not only acquire knowledge but also develop lifelong health behaviors and social practices [2, 3]. By providing safe infrastructure, fostering healthy hygiene practices, and integrating health education into the curriculum, schools play a vital role in disease prevention and the overall well-being of children.

School hygiene encompasses the policies, practices, facilities, and behaviors that promote health and prevent disease within educational settings. Its scope includes personal hygiene, handwashing, menstrual hygiene, safe drinking water, sanitation facilities, waste management, food safety, and overall cleanliness of the school environment [3]. Within the broader Water, Sanitation and Hygiene (WASH) framework, these components are interconnected and collectively contribute to maintaining healthy and safe school environments [2, 4].

Although school hygiene has been widely examined within individual national and regional contexts, comparative evidence examining how different policy, governance, infrastructural, and school-health systems influence its implementation remains limited. A comparison of India and the United States provides an opportunity to examine both shared challenges and context-specific approaches across two substantially different socioeconomic, health-system, and governance settings. Such a comparison can help identify common principles for effective school hygiene while highlighting areas where policies and implementation strategies need to be adapted to local contexts.

In India under National Education Policy (NEP) 2020 there is integration of personal, public, and digital hygiene into the core school curriculum, emphasizing a holistic, life-skills-based approach to sanitation, preventive healthcare, and wellness and building lifelong healthy behaviors starting from the foundational years [5].

Globally, about 23% of schools lack sanitation services [6]. In a cross-sectional study of 1,462 students across 50 schools in Sonapat, Haryana, 53.4% were assessed as having poor overall personal hygiene [7]. Studies from other Indian settings have also reported gaps between hygiene knowledge and observed practices [8]. Significant gaps between knowledge and observed practice in a study conducted in a rural district of Assam [8]. Worm infestation rates, a condition directly linked to poor sanitation and hygiene infrastructure among school-aged children, have been reported from central and

northern parts of India ranging from 29.7% to 75.6% in children [9].

Studies from the United States also identify important gaps in school hygiene practices and infrastructure. Approximately 75% of school absences have been attributed to illness [10]. In New Mexico, an inspection of 91 public schools found that 25% of student bathrooms lacked soap and 38% lacked paper towels or hand dryers [11]. In a prospective cohort study in elementary schools, Lau et al. [10] reported a reduction in total absence days during the influenza season from 365 to 309 days following the addition of repetitive hand-hygiene instruction. In a cluster-randomized trial involving 10 elementary schools in Pittsburgh, Pennsylvania, a hand- and respiratory-hygiene intervention was associated with a 52% reduction in laboratory-confirmed influenza A infections and a 26% reduction in total absence episodes [19].

Evidence from school-based hand-hygiene interventions across different countries is suggestive but heterogeneous. Willmott et al. [12], in a systematic review and meta-analysis of 18 cluster-randomized trials in educational settings, reported that individual studies suggested reductions in illness absence and respiratory infection outcomes, although the overall evidence was heterogeneous and largely equivocal.

Evidence suggests that inadequate school hygiene may adversely affect attendance, participation, and educational outcomes. According to Ismail et al. [13], children are susceptible to infections due to frequent participation in school group activities and their often-suboptimal hygiene practices. Frequent infections may affect school attendance, academic performance, and general health. Sickiness is an important contributor to school absenteeism and may adversely affect students' educational progress, particularly in settings where inadequate sanitation and hygiene increase the risk of illness [14]. Research has also revealed that insufficient menstrual hygiene resources can have a profound impact on student attendance and participation [15].

Studies have demonstrated that effective hygiene, including handwashing practices, can reduce the spread of communicable diseases, underscoring the transformative potential of basic hygiene behaviors [13]. Structured hygiene education interventions implemented in Indian government schools have demonstrated significant post-intervention improvements, with handwashing compliance rising from 44% to approximately 72% and overall hygiene practice scores improving by 23-34% following multi-modal school-based programmes [16, 17]. In a cross-sectional study of 440 children in a government school in Kolkata, 86.1% demonstrated the handwashing procedure incorrectly despite generally satisfactory reported hygiene practices [18].

Beyond personal hygiene practices, a comprehensive school hygiene programme encompasses several interconnected components that collectively contribute to infection

prevention and health promotion. Respiratory hygiene, including proper cough etiquette, appropriate use of face masks during outbreaks, and hand hygiene following respiratory secretions, has gained increased importance following the COVID-19 pandemic. Similarly, routine cleaning and disinfection of frequently touched environmental surfaces, safe food handling practices in school canteens, adequate classroom ventilation, and effective waste management are recognized as essential measures for reducing the transmission of infectious diseases within educational settings.

2. Aim of the Review

This review aims to compare school hygiene practices, policies, challenges, and their impact on student health and educational outcomes in India and the United States, with particular attention to the relationship between policy frameworks, infrastructure, monitoring, and compliance in sustaining effective school hygiene.

3. Methodology

3.1. Review Design and Sources

This study used a comparative literature review approach to examine school hygiene policies, practices, infrastructure, implementation strategies, monitoring, challenges, and health outcomes in India and the United States. Literature was gathered through searches of academic databases and through reports and policy documents from established governmental and international organizations.

Academic literature was searched through Google Scholar, PubMed/MEDLINE, and the Education Resources Information Center (ERIC). Grey literature and policy documents were gathered from authoritative sources including the World Health Organization (WHO), United Nations Children's Fund (UNICEF), Centers for Disease Control and Prevention (CDC), U. S. Environmental Protection Agency (EPA), relevant Government of India agencies, the Ministry of Education, and the Ministry of Health and Family Welfare.

3.2. Search Strategy

Searches were conducted using keywords and combinations of terms related to school hygiene, WASH, sanitation, hand hygiene, menstrual hygiene, drinking-water access and quality, hygiene education, school health, hygiene practices, monitoring, absenteeism, and hygiene policies, together with the geographical terms "India" and "United States". Specific programme and policy terms, including "Swachh Bharat Swachh Vidyalaya", were also used where relevant. The initial database searches identified a broad range of potentially relevant literature, which was subsequently screened for relevance to the review objectives, school setting, geographic scope, and

the predefined inclusion and exclusion criteria. The final review included 32 sources that met the established criteria.

3.3. Inclusion Criteria

Sources were included if they: (i) were published between 2010 and 2026; (ii) addressed school hygiene, WASH, school health, or related hygiene policies/programmes in India or the United States; (iii) focused on primary or secondary school settings; (iv) examined at least one relevant area, including hygiene practices, WASH infrastructure, hand hygiene, menstrual hygiene, hygiene education, implementation, monitoring, or health/educational outcomes; and (v) provided information relevant to the objectives of the comparative review.

3.4. Exclusion Criteria

Sources were excluded if they: (i) focused exclusively on hospitals, universities, or other non-school environments; (ii) did not address school hygiene, WASH, school health, or relevant policies/programmes; (iii) did not relate to India or the United States; (iv) were published before 2010; or (v) were not sufficiently relevant to the objectives of the review.

3.5. Comparative Synthesis

The included literature was synthesized through comparison of India and the United States across six major areas: (i) policies and guidelines; (ii) hygiene/WASH infrastructure; (iii) hygiene practices and education; (iv) implementation barriers and institutional accountability; (v) monitoring and evaluation, including digital approaches; and (vi) health and educational outcomes. Peer-reviewed studies were primarily used to examine school hygiene practices, implementation, and interventions, while governmental and institutional reports were used to provide information on policies, guidelines, national programmes, and implementation frameworks. Findings were compared thematically across the two countries, taking into account differences in study settings, populations, evidence types, and policy contexts.

3.6. Nature and Limitations of the Evidence

As this was a comparative literature review rather than a formal systematic review or meta-analysis, formal risk-of-bias assessment and quantitative pooling of findings were not undertaken. The included evidence comprised heterogeneous observational studies, intervention studies, systematic/scoping reviews, and policy or programme documents, differing in study design, population, geographical setting, sample size, outcome measures, and intervention or policy context. Accordingly, quantitative findings and reported associations were interpreted in relation to the context and population of the individual sources and were not treated as directly comparable estimates across the two countries or as nationally representative estimates.

Differences in study context, methodology, and the populations examined were considered when comparing findings between India and the United States.

4. Key Findings

The findings are presented thematically and comparatively across the common domains identified in the methodology. The comparative synthesis focuses on similarities, differences, and context-specific patterns emerging across the evidence from India and the United States, which have been summarized in Table 1.

4.1. Policy Frameworks and National Initiatives

India has adopted a multi-sectoral approach to school hygiene that addresses sanitation infrastructure, hygiene education, school nutrition, and adolescent health. Core national pillars include Swachh Bharat Swachh Vidyalaya (2014), the School Sanitation and Hygiene Education (SSHE) initiative, the PM POSHAN nutrition scheme [21], Rashtriya Kishor Swasthya Karyakram, and the School Health and Wellness Programme under Ayushman Bharat. Ground-level implementation remains highly uneven, transitioning slowly from infrastructure expansion toward behavior change and sustained maintenance. [3, 22].

The United States follows a decentralized approach to school hygiene, guided by federal recommendations but implemented primarily by state and local education authorities. Central frameworks include the Whole School, Whole Community, Whole Child (WSCC) Framework (2014) and specific CDC guidelines [23, 24] encouraging hand hygiene routines and visual reminders for general hygiene and management of infectious diseases. Key legislative and funding support is driven by the Healthy Hunger-Free Kids Act (2010), Green Ribbon Schools Program, CARES Act (2020), American Rescue Plan Act (2021), and the Lead and Copper Rule Improvements [25].

India's framework prioritizes expanding physical facilities and building adolescent health programs, while the United States relies heavily on a combination of federal legislative funding streams and localized accountability.

4.2. Core Challenges

Inadequate WASH Infrastructure remains a significant concern, as India experiences severe regional gaps in basic functional toilets and clean water [3, 9, 22]. In the US, 25% of student bathrooms lack soap as reported by Ramos et al. in a study from the New Mexico study, 38% lack paper towels/dryers [11], and 54% lack free cafeteria water, and had to depend on sold water as reported by Kenny et al and Patel et al [26, 27] from the study conducted in schools at Massachusetts.

Knowledge-Practice Gap is observed as students frequently

pass basic hygiene tests but fail to translate this into daily actions. India exhibits substantial regional challenges in school hygiene, compounded by its large school-going population. Surveys, including a study involving 1,462 students across 50 schools in Haryana, revealed considerable gaps in hygiene knowledge and practices [7]. In India, from a study conducted in the state of Orissa, it was reported that up to 52% of students demonstrate inadequate hygiene knowledge, and 56% show poor handwashing habits in Sonipat and Tamil Nadu based studies [7, 16]. US teachers report a similar behavioral deficit despite active classroom instruction as per the study reported by Lau et al. conducted in Chicago public elementary schools [10].

Institutional disparities are evident as Indian private schools maintain significantly better infrastructure in terms of sanitation facility, cleanliness, availability of WASH services, and overall hygiene practices; than public counterparts [3, 9, 22]. Comparative studies have consistently demonstrated that urban government schools in the country outperform rural counterparts in sanitation infrastructure, yet both remain suboptimal [14, 28]. In the USA inequities are more frequently linked to district-level funding, socioeconomic status, and demographic characteristics. Though some of the water quality-related practices are limited, water availability and education-related practices are more common, the data suggest many schools would benefit from support to implement best practices related to school-drinking water [11, 29].

Weak Policy Implementation is evident as India struggles with turning national policies into functional, clean local assets. The US faces vast variances in compliance and facility upkeep across different states and school districts.

Gender-Specific Barriers are demonstrated as menstrual hygiene management suffers from an acute lack of privacy, clean water, and disposal bins [3, 22]. While India integrates this into adolescent health initiatives [20, 30], menstrual product accessibility remains an active policy battleground in the US, with only 32 out of 50 states enacting relevant policies. Through WHO/UNICEF Joint Monitoring Programme (JMP), schools are encouraged to provide menstrual hygiene support, besides catering to other areas such as safe drinking water, better hand washing and sanitation facilities [4, 6].

Intermittent Education is evident as awareness programs are delivered too intermittently to drive permanent habit changes across the two countries. This is worsened by insufficient teacher training, lack of day-to-day student supervision, and inconsistent administrative oversight [7, 10, 12, 16, 17].

4.3. Digital Approaches to Monitoring School Hygiene

As both countries have identified gaps in knowledge and implementation as key areas of concern, the feasibility of using digital monitoring tools as a potential solution is being explored. In India, the Government of India's Swachh Vidyalaya

Puraskar introduced an incentivizing scheme that demonstrated the feasibility of using an online portal and mobile application to systematically assess key hygiene-related areas in schools, with overall scores and ratings generated automatically. The programme provides a scalable mechanism for standardized data collection, comparison, and identification of

areas requiring improvement. In the United States, a scoping review of 12 studies found that digital interventions, including video-based and interactive tools, showed potential for improving and monitoring hand hygiene practices over short periods, particularly when combined with other educational or behavioral measures [31].

Table 1. Comparative Overview of School Hygiene in India and the United States.

Domain	India	United States
Policy & governance	National programmes emphasise sanitation infrastructure, hygiene education, nutrition and adolescent health; implementation varies across settings.	Decentralised approach with federal frameworks/guidelines and implementation through state/local authorities.
WASH infrastructure	Regional and institutional disparities in access to functional toilets, safe water and WASH facilities.	Deficiencies in soap, hand-drying facilities and access to free drinking water reported in some school settings.
Hygiene practices & education	Gaps between hygiene knowledge and daily practices; effectiveness of education varies by setting and programme.	Gaps in consistent hand-hygiene practices despite school-based instruction.
Implementation & accountability	Key challenges include translating national policies into sustained local implementation, maintenance and behavioural change.	Variation in implementation, facility upkeep and accountability across states and school districts.
Equity & gender-related challenges	Differences between public/private and urban/rural schools; menstrual hygiene affected by infrastructure, privacy and disposal facilities.	Inequities associated with socioeconomic and district-level differences; menstrual-product access remains a policy concern.
Monitoring & digital approaches	Swachh Vidyalaya Puraskar demonstrates the feasibility of online/mobile assessment and standardised scoring.	Digital interventions show potential for supporting hand-hygiene education and monitoring, although evidence remains limited.

5. Discussion

The comparative contribution of this review lies in bringing together evidence from two different school-health and governance contexts across common hygiene domains. The review highlights both common challenges and context-specific differences in school hygiene policies and implementation between India and the United States. The heterogeneity of study designs, populations, settings, and outcome measures limits direct comparison and transferability of individual findings. Accordingly, policy lessons should be adapted to local institutional, socioeconomic, and infrastructural contexts rather than transferred unchanged between countries.

The reviewed literature consistently demonstrates that school hygiene is influenced by the interaction of infrastructure, hygiene education, institutional support, and behavioral practices rather than by any single intervention. Across the reviewed Indian studies Keerthana et al., and Ranga and Majra consistently reported that although students possessed varying

levels of hygiene awareness, appropriate hygiene practices remained inadequate [7, 16]. These findings corroborate those reported by Lau et al. in the United States, where data collected from teachers suggest that hand hygiene standards vary greatly from school to school, and hand hygiene practices to be inconsistent despite school-based hygiene education [10]. Furthermore, the intervention studies conducted by Stebbins et al. and synthesized by Willmott et al. reinforce these observations by demonstrating that improvements in hygiene behavior were achieved only when educational interventions were accompanied by continuous reinforcement and institutional support [12, 19]. Collectively, these findings indicate that hygiene knowledge should be viewed as an important prerequisite rather than a sufficient determinant of sustained behavioral change.

The influence of school infrastructure on hygiene outcomes is also evident across the reviewed literature. The disparities have been reported by Dakhode et al., Patel et al., and Puri and Gulati regarding sanitation facilities, access to safe drinking water [3, 9, 22], and handwashing infrastructure in Indian schools, along with the observations of Cradock et al., Kenney et al. and Ramos et al., who reported deficiencies related to

drinking water accessibility despite existing infrastructure, significant differences in water-quality, and deficiencies in the availability of soap and handwashing supplies across U. S. school [11, 27, 29]. Taken together, these studies suggest that infrastructure availability alone does not ensure effective hygiene practices unless supported by routine maintenance, equitable access, and regular monitoring. Although the nature of infrastructure challenges differs between India and the United States, the reviewed evidence consistently identifies infrastructure as one of the strongest determinants of hygiene behavior in school settings.

The effectiveness of school-based hygiene interventions is another recurring theme across the reviewed studies. The improvements reported by Keerthana et al., and Murali and Nandan [16, 17], are in agreement with the findings of Stebbins et al. and the systematic review conducted by Willmott et al., both of which demonstrated that structured hygiene interventions significantly improve hand hygiene practices and reduce illness-related absenteeism among schoolchildren [12, 19]. These findings collectively reinforce the conclusion that hygiene education is most effective when delivered within a comprehensive school health framework that integrates behavioral reinforcement, teacher participation, adequate WASH infrastructure, and regular monitoring.

The reviewed policy literature further demonstrates that both India and the United States have adopted comprehensive but distinct approaches towards improving school hygiene. Programmes including Swachh Bharat Swachh Vidyalaya (Ministry of Human Resource Development 2014), SSHE (Ministry of Drinking Water and Sanitation 2011), PM POSHAN [21], RKSK [20], and the School Health and Wellness Programme collectively address sanitation infrastructure, hygiene education, nutrition, and adolescent health within the Indian school system. These initiatives complement one another by addressing different but interconnected dimensions of school hygiene. In comparison, the WSCC framework [32], CDC school health guidance, and water-quality regulations adopted in the United States similarly emphasize coordinated action involving schools, health systems, and communities. Although the implementation strategies differ, the reviewed evidence consistently suggests that sustained improvements depend on effective policy implementation, institutional accountability [3, 22, 29], continuous monitoring, and long-term maintenance rather than policy formulation alone.

The initiatives undertaken in both countries [32] to apply digital tools suggest that digital monitoring could complement conventional periodic hygiene assessments by enabling more standardized, frequent, and potentially real-time documentation of hygiene practices and facilitating feedback to schools. Integration of digital assessment with objective indicators, such as cleaning verification and periodic microbiological assessment, could provide a more comprehensive and evidence-based approach to monitoring school hygiene. However, longitudinal studies are needed to establish whether such systems result in sustained improvements in hygiene practices and

health outcomes.

6. Conclusion

This review is subject to limitations arising from the heterogeneity of study designs, populations, geographical settings, and outcome measures, which restrict direct cross-country comparison and generalizability of individual findings.

School hygiene plays a fundamental role in safeguarding children's health, promoting healthy behaviors, reducing the transmission of communicable diseases, and creating safe learning environments. This comparative review highlights that although India and the United States differ in their educational systems, policy frameworks, and socioeconomic contexts, both countries recognize the importance of integrating hygiene, sanitation, health education, and supportive school environments to improve children's health and educational outcomes. The reviewed literature demonstrates that access to functional Water, Sanitation and Hygiene (WASH) facilities, hygiene education, behavioral reinforcement, and effective policy implementation are interdependent components of successful school hygiene programmes.

Despite differences in policy structures and implementation approaches, both countries continue to face challenges related to equitable WASH access, infrastructure maintenance, consistent hygiene practices, behavioral compliance, and effective implementation. Sustainable improvements therefore require coordinated, multisectoral approaches that combine functional infrastructure, continuous hygiene education, behavioral reinforcement, effective implementation, and routine monitoring.

Abbreviations

WHO	World Health Organization
WASH	Water, Sanitation and Hygiene
UNICEF	United Nations Children's Fund
ERIC	Education Resources Information Center
NEP	National Education Policy
CDC	Centers for Disease Control and Prevention
SSHE	School Sanitation and Hygiene Education
RKSK	Rashtriya Kishor Swasthya Karyakram
WSCC	Whole School, Whole Community, Whole Child
SSHE	School Sanitation and Hygiene Education

Author Contributions

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Formal Analysis, Methodology, Supervision, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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