IJBAF, October, 2023, 11(10): 105-116

ISSN: 2320 – 0774

International Journal of Biotechnology and Allied Fields (IJBAF)

www.ijbaf.com

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ASSESSING PUBLIC HEALTH AND SANITATION STATUS TO PROMOTE PREVENTIVE HEALTHCARE IN INDIA

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Received 8th July 2023; Revised 9th Aug. 2023; Accepted 27th Sept. 2023; Available online 1st Oct. 2023

ABSTRACT

A proper sanitation promotes both public health and environmental hygiene, improves the quality of life in a community, and boosts up a country's economy. In an impoverished nation like India, inadequate sanitation primarily manifests itself as a lack of toilet in residential houses, forcing its members to defecate in the open. Also, using unclean public washrooms stands instrumental in the transmission of urinary tract infections, if toilet seat sanitizers are not applied beforehand. Consuming uncovered and unhygienically-prepared food items from itinerant street vendors, as well as fecally-contaminated drinking water, are pivotal in disease transmission in India, frequently leading to severe gastrointestinal disturbances. Poor sanitation thus translates into financial losses from the direct expense of treating various ailments, as well as lost income from decreased or lost production connected to poor hygiene. Through this review analysis, we hope to identify the persisting grave loopholes in India's hygiene sector, as in cases of street- and shop-vended foods like fruits, fruit-juices and *khoa,* public toilets and packaged drinking water and groundwater, and find avenues for implementing preventive healthcare, laying the groundwork for its impeding economic impact to be mitigated sooner.

Keywords public health; public washrooms; sanitation, street vendors; toilet seat sanitizers; urinary tract infections

1. INTRODUCTION

One of the most crucial parameters of a healthy human community is sanitation. It promotes longevity of human race, preserves health, and has been shown to have direct boosting effects on a country's economy. Three billion people worldwide, including hundreds of millions of school-aged children, lack access to soap-based handwashing facilities, despite COVID-19 super-stressing on the paramount importance of hand hygiene **[1]**. Those residing in rural areas, urban slums, disaster-prone regions and low-income nations are most vulnerable and impacted in this regard **[1]**.

To cite the actual data, 663 million people lack access to basic water sources, 2.4 billion people lack access to basic sanitation (7 out of 10 in rural areas), and 946 million people still defecate in the open (9 out of 10 live in rural areas) **[2]**. Diarrhea is the second largest cause of mortality in children under the age of five years, with clean water and sanitation being the major preventative measure **[2]**.

Sustainable development and personal prosperity may fall prey to poor sanitation. The right to education is in jeopardy when kids, particularly females, do not have access to private, respectable restrooms in their educational settings **[3]**. Waste containment may be insufficient even in communities with toilets **[3]**. Waste may come into contact with people and be released into the environment, if the washrooms are difficult to clean, or are not constructed or maintained to securely hold, transport and treat human excreta, for example **[3]**. Adults who miss employment due to illnessescontracted through any unhygienic transmission of pathogens might land up in serious financial crunch **[3]**. All these aftermaths make long-term social and economic development of a country practically unattainable **[3]**.

One important purpose of sanitation is to decrease human exposure to notorious pathogens in a responsible way. The Joint Monitoring Programme (JMP) requires all drinking water to be safely maintained with a minimum of fecal contamination under the specified threshold value **[1]**. The 1854 London Cholera pandemic was a watershed moment in recognizing the relationship between sanitation and disease **[1]**. Dr. John Snow and Henry Whitehead found how cholera propagated by polluted water, because those who were ill, utilized a certain pump for their drinking water supplies. Human excrement polluted much of London's water supply at that time **[1]**.

Recent comprehensive analyses indicated that sanitation reduces diarrheal sickness by 30-

40%, and lowers the chance of infection with soil-transmitted helminths **[4, 5]**. Although sanitation may improve malnutrition, stunting and cognitive development, most research has focused on the effects of diarrheal illness in children under the age of five years **[6]**.

In rural India, one of the only and biggest randomized controlled trials (RCTs) for sanitation was carried out with 50 villages receiving a latrine intervention and building project, and 50 villages receiving no such intervention **[7]**. While the villages with sanitation intervention had a much higher latrine coverage (9% to 63%) than the control villages (8% to 12%), there was no statistically significant difference in diarrheal illness prevalence, soil-transmitted helminth infection, or child malnutrition **[7]**. There were no apparent health differences, since more than one-third of homes in the intervention neighborhoods lacked a latrine **[7]**. However, as a thumb rule, residences without latrines may pollute the surrounding environment and water sources more, thereby impacting the health of households in the same community with latrines as well **[8]**.

2. PUBLIC HEALTH AND SANITATION STATUS IN INDIA

2.1 Street- and Shop-Vended Foods

In a country like India, especially in the city of Kolkata, owing to the excessively humid weather, a consequently high discomfort index, and hugely exhausting lifestyle, consuming food from itinerant street vendors and roadside stalls and shops is very common, particularly during lunch, evening tiffin and dinner hours.

2.1.1 Fruits sold by street vendors

Cucumbers (*Cucumis sativus*) are one of the most frequently consumed food items sold by roadside food sellers. These sellers often peel the cucumbers, cut them and leave them out uncovered for an extended period of time. Cucumbers are perishable, and removal of the epidermal layer and cutting it exposes it to a variety of microorganisms **[9]**. Hence, by the time they are consumed, they are heavily infested with a variety of microorganisms, including pathogenic bacteria like *Salmonella*, *Shigella* and *Vibrio* **[9]**. This may lead to several mild or severe health problems such as abdominal cramps, diarrhea and dehydration **[9]**. A study conducted on 25 such cut cucumber samples has detected fecal coliforms like *Escherichia coli*, along with enteric pathogens like *Salmonella* and *Vibrio cholerae* **[9]**. This necessitates immediate addressal to the basic problems in mass sanitation of street-vended fruits, as consumption of such contaminated cucumbers can lead to massive gastroenteritis, particularly in children **[9]**. Another study,

based in North-East Nigeria, focused on the effect of the consumption of guavas and oranges that are sold from roadsides **[10]**. As compared to hawkers from markets selling fruits, those sold by roadside sellers reported a much higher content of *Staphylococcus aureus* and *E. coli* **[10]**. As the nasal passages of humans are one of the most dominant areas of *S. aureus* growth, lack of due personal hygiene and the use of soiled bare hands during the handling of these fruits are some major reasons behind the presence of this organism in fruits **[10]**.

2.1.2 Fruit juices sold by street vendors

During scorching summers, people often consume fruit juices from roadsides, and these tend to be more contaminated than the raw fruits themselves **[11]**. Almost 97% of fruit juices that were tested at the National Institute of Nutrition, Hyderabad, India were found to be contaminated with fecal coliforms and *Shigella* spp. **[11]**. Amongst the components added to such juices, in most cases, ice is the most infested with microorganisms **[11]**. Besides problems with unclean fruits that have not been washed properly or washed with already-contaminated water before being peeled, sliced and sold, ice made from microbially-contaminated water may also lead to fatal waterborne diseases like cholera, typhoid, jaundice and hepatitis **[11]**.

2.1.3Khoa-based sweets sold from shops

Khoa is one of the most popular bases used for making such sweets. Similar to most fruits, *khoa* is also considered to be highly perishable **[12]**. Its high moisture content makes it quite suitable for the growth of different kinds of microorganisms **[12]**. In some of the hot and humid places of India, like Kolkata, microbial contamination of *khoa* is promoted by the high relative humidity and a temperature ambient for the growth of microorganisms in general **[12]**. Various bacteria including *Streptococcus* spp., *Lactobacillus* spp., *Serratia* spp., and drug-resistant fecal coliforms such as *E. coli* are often known to contaminate *khoa* **[12]**. In a research study conducted on twenty-six *khoa* samples sold from different sweet shops all over Kolkata and its adjoining areas, a heavy load of bacteria was reported in almost all of them, including some of the potentially most harmful food-borne pathogens, like *S. aureus*, *E. coli* and *V. cholerae* **[12]**. *E. coli* isolated from many of the samples were resistant to both ampicillin and tetracycline, two of the routinely used antibiotics **[12]**. In these days of super-swift escalation in antibiotic resistance, it becomes imperative to limit the spread of antibiotic-resistance genes (ARGs) through such contaminated *khoa*-based sweets.

2.2 Public Toilets

The rapid increase in housing and public transportation has not been matched by the availability of accessible and functional bathroom facilities **[13]**. Official estimates show that 6% of urban families in India do not have toilets at home, and therefore rely solely on public facilities and community toilets **[13]**. In addition, 13% of urban households do not have access to a toilet, at home or in public, and are hence forced to defecate in the open **[13]**. While both the men's and women's toilet facilities frequently exhibit a lack of cleanliness, the procedure is unquestionably hazardous, unsanitary, and taxing, especially for women, owing to the frequent and close personal contact with the facilities **[14]**. Typically, public restrooms are built on a shoestring budget, and use low-cost materials **[14]**. Construction materials such as tiles, paint, waterproofing coatings, and fittings such as water closets (WCs), urinals, wash basins and taps are therefore, often of very poor quality **[14]**. These elements, without a doubt, hasten the deterioration of the space **[14]**.

2.2.1 Current advancements in construction and usage

Dr. Bindeshwar Pathak initiated the '*Sulabh Shauchalaya*' movement in 1970 in an effort to provide good grade public sanitation **[14]**. Although the vision of this organization has been admirable, the majority of the sanitation complexes it has built, particularly in urban areas, have ended up being shoddy, largely as a result of the use of dated fixtures and materials **[14]**. In the same line, a little over 27 years ago, the Bruhat Bengaluru Mahanagara Palike introduced the Nirmala Toilet Complexes in an effort to provide the city of Bangalore with hygienic public sanitation facilities **[15]**. The common Bangalore people now dreads using this chain of pay-and-use restrooms, despite the fact that it was once thought to be a wise solution **[14]**. The renowned Bangalore-based architecture firm, Architecture Paradigm's Nirmala Toilet Complex, is an exception to this rule **[15]**. The design of this restroom distinguishes it boldly from others, and contributes to its usefulness **[14]**. Any unpleasant odor that might otherwise linger inside the constructed structure is eliminated, thanks to features like the butterfly roof and a courtyard in the middle of the linear structure **[15]**. The Greater Hyderabad Municipal Corporation has cooperated with IXORA FM, a Hyderabad-based firm, to establish Loo Café, a 170 sq. ft. building that includes men's, women's, and differently able person's lavatory, a Wi-Fi facility, and a charging station **[16]**. The construction is composed of

fire-proof and insect-free pre-fabricated wood, which promotes safety and cleanliness **[16]**. The lavatories have been fitted with gadgets that let the firm monitor, and adjust, aspects like energy usage and air circulation **[14]**. The Loo café also offers all its services for free, and the funding to keep this complex running comes from an adjacent café where each item costs a little more than 30 rupees only **[16]**. Similarly, the Municipal Corporation of Greater Mumbai joined forces with JSW Realty to build a public sanitation facility along the city's Marine Drive, on a sea-facing boulevard that attracts thousands of visitors every day **[17]**. Series architects designed this facility, which is S-shaped in layout **[17]**. People from both genders enter the facility from the opposite sides of the 'S,' assuring privacy **[17]**. The curved roof creates a deep overhang and is outfitted with solar panels to power the toilets **[14]**. A Norwegian Vacuum-based technology is used in the toilets there to hygienically store and reuse about 90% of the flush water **[17]**. During the monsoon season, the façade is built of Corten sheets, which shield the building from the salty air and the brutal pummeling of the sea waves **[17]**. Rohan Chavan, a Mumbai-based architect, built 'The Light Box', a public amenity for women located along Thane's Eastern Express route, in another attempt to provide improved sanitation **[18]**. The structure is composed of a shipping container and two restrooms: one for the disabled, and a nursing area **[18]**. Light streams gracefully through the canopy of a tree incorporated into the center court, which has been built to accommodate a variety of activities such as exhibition, talks, awareness campaigns, and so on **[14]**. This structure's overall appearance, as well as its architecture, such as the nursing chamber and interactive open court, makes it attractive and user-friendly, resulting in a healthy place **[18]**.

'PAUSE' is another amenity created by Rohan Chavan on the Mumbai-Goa route **[14]**. Although it was created largely for truck drivers, the entrance for women, senior persons, and those with physical disabilities is on the opposite end of the building from the men's zone **[14]**. There are four cubicles, a nursing station, washbasins, and a sanitary napkin dispenser in the ladies' washroom, while the men's area has washbasins, four cubicles, and eight urinals, one of which is meant for use by a kid **[14]**. Open areas are a prelude to both portions, providing for ample light and air circulation **[14]**. A gap has been created between the two portions for the convenience of truck drivers, with a separate entry **[14]**. The Pune Municipal Corporation, 3S, and Indus worked closely and designed

the "TI" toilets to address two issues: unsanitary public restrooms for women, and the disposal of obsolete buses, which contributes to landfill volume when they might be utilized for much longer **[19]**. Old public buses were stripped of rusted and broken parts, and entirely restored, extending the vehicle's lifespan by around ten years **[19]**. These buses were outfitted with exceptionally germ-free and hygienic restrooms for women, complete with a computerized feedback screen, sanitary napkin vending machines and disposal bins, diaper changing stations, and basic supplies **[19]**. A full-time attendant is on hand to oversee the cleanliness of this one-of-a-kind facility **[19]**.

2.2.2 Prevention strategies promising a reduced urinary tract infection (UTI) rate

Toilet seat sanitizers (TSSs) are a relatively new concept in terms of washroom sanitation and public health hygiene, and they are now actively produced, marketed, and sold **[20]**. When sprayed from a particular distance, they clean and deodorise, and promise to eradicate 99.9% of uropathogens **[20]**. While exhibiting relatively better performances than sanitizers consisting of natural essential oils (*Eucalyptus globulus* oil and Tea-tree oil respectively), sanitizers containing primary chemical components like benzalkonium chloride and isopropyl alcohol as the main ingredients, show comparable efficiencies to each other, with a mean efficiency range of 97.88% to 99.52% (20). Besides this, use of water-proof, clean funnels that help women in urinating by avoiding direct contact with toilet seats in western-style lavatories, have shown sufficient prevention capacity from public toilet-derived urinary tract infections (UTIs) (20).

2.3 Packaged Drinking Water and Groundwater

Toxic chemicals and pathogens often contaminate water at the distribution points, after it has already been treated in the municipal drinking water- and sewage-treatment plants (WTPs and STPs, respectively) **[21]**. They may also contaminate the water at the source itself **[21]**. There are multiple such sources of contamination including, but not limited to, fertilizers, pesticides, cracks in water pipes, rocks or soils that have leached arsenic, lead, radon, or uranium into the groundwater and sewer overflows **[21]**. Chemical contaminants like lead and copper are also commonly found in tap water **[21]**. Besides, many notorious pathogens like *Legionella* spp., Norovirus, Rotavirus, *Shigella* spp., *Giardia* spp., and Hepatitis A virus are often found to contaminate drinking water **[21]**. Considering packaged water for drinking purposes as the

safest is often paradoxical, as disease outbreaks are also associated with it, although rare **[21]**. Increasing number of bottling plants even in questionable geographical localities bring suspicion to the source of the high-quality water **[22]**. The lack of good manufacturing practices (GMPs) in these industries often results in wide variations in the microbial quality of bottled water **[22]**. Additionally, since bottled water is consumed without being processed, it tends to contain high loads of total heterotrophic bacteria (THB), including possible opportunistic pathogens, especially those which are antibiotic-resistant **[22]**. *Cryptosporidium* spp. can be found in bottled water and individuals with weakened immune systems such as patients who are diabetic, have HIV/AIDS, underwent a surgery, or are undergoing chemotherapy, are required to be cautious while consuming such bottled drinking water **[21]**. Despite improved methods in maintaining the quality of consumable water, microorganisms are still quite capable of spoiling it, and as a result, safety continues to be an issue, as contaminated packaged drinking water can cause gastrointestinal illnesses, reproductive problems, and even neurological disorders **[21]**. In West Bengal particularly, where there is an abundance of groundwater reserves, there is also an immediate need to monitor its utilization. High levels of fluoride and arsenic make this groundwater's accessibility and usability highly questionable. Almost 65% of all Indian states are exposed to fluoride risks from chemically-contaminated water **[23]**. Symptoms such as yellowing teeth, damaged joints, and bone deformities are often associated with years of consumption of such high levels of fluoride **[23]**. Additionally, the presence of arsenic leads to the development of arsenicosis, a disease that lacks any effective treatment **[23]**. Consumption of arsenic-free water at the early stages of the ailment is the only way to efficiently deal with this problem **[23]**. However, an increase in societal practices based on education-derived public awareness and proper hygiene often alleviates some of the issues stemming from the contamination of water. Water quality and health, both were taken care of, ever since the inception of the Clean India (*Swachh Bharat*) Mission in 2014 **[24]**. This has led to improvements in the construction of lavatory facilities all over the country **[24]**.

3. CONCLUSION

Sanitation, besides most definitely affecting one's health, also hugely affects the productivity of that individual and increases their expenditure on healthcare. A lack of hygiene is known to cause significant

expenses and employment losses in the industrial, health, agricultural, and tourism sectors. A World Bank Study on the economic impact of poor hygiene and sanitation in India showed that the country lost nearly 6.4% of its GDP due to inadequate sanitation **[25]**. Transformative intervention is hence necessary from the Government, along with increased accountability. Creating mass awareness among the public at large, and collaborating with private sectors to fund other sectors of WASH (safe drinking water, sanitation, and hygiene), is of utmost importance now. Overall, disease incidences will be expected to reduce by a combination of improved sanitation, hygiene, water and waste management, as well as efficient self-hygiene practices. Although sanitary infrastructure may well be expensive, the return on investment and employment development is substantially higher. The Organization for Economic Co-operation and Development (OECD) (2011) stated that providing basic water and sanitation in underdeveloped nations has a 7:1 benefit: cost ratio. While the efforts necessary have been commendable, the installation of a latrine does not necessarily guarantee usage, as other members of the household, particularly youngsters, may still urinate in the open **[26]**. Furthermore, poor sanitation positioning and design without adequate fecal sludge management or wastewater treatment facilities may pollute the neighborhood and lower water quality as a result **[26]**.

4. ACKNOWLEDGEMENTS

The author expresses his deepest gratitude to Rev. Dr. Dominic Savio, S.J., Principal, St. Xavier's College (Autonomous), Kolkata for his constant motivation and support.

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