



ORIGINAL RESEARCH PAPER

Community Medicine

SEASONAL INFLUENCES ON URBAN
SANITATION CHALLENGES IN CHANDIGARH: A
FIVE-YEAR OBSERVATIONAL ANALYSIS
(2019–2023)

KEY WORDS:

Prof. N. K. Goel	Professor, Department of Community Medicine, Government Medical College and Hospital ,Chandigarh,India.
Dr. Meenu Kalia	Assistant Professor, Department of Community Medicine, Government Medical College and Hospital ,Chandigarh,India.
Deepika Yadav*	Postgraduate Junior Resident, Department of Community Medicine, Government Medical College and Hospital, Chandigarh, India. *Corresponding Author

ABSTRACT

Environmental sanitation problems such as pipeline seepage, stagnant water accumulation, improper waste disposal, and unattended waste bins are important public health concerns in urban settings. This study examined seasonal and yearly patterns of sanitation-related problems in Chandigarh. A prospective observational study was conducted from January 2019 to December 2023 at Government Medical College and Hospital (GMCH-32), Chandigarh, and its associated field practice areas. Monthly field surveys documented four sanitation-related problems, and data were aggregated by season and year using descriptive and time-series analysis. A total of 481 episodes were documented. Stagnant water was most frequent (209; 43.5%), followed by water leakage (172; 35.7%), unattended waste bins (59; 12.3%), and improper waste disposal (41; 8.5%). Monsoon accounted for the largest share of episodes (171; 35.6%), while summer had the highest proportion of improper waste-disposal episodes. The highest annual total occurred in 2021 (133; 27.7%). Sanitation problems showed clear seasonal and yearly variation, supporting targeted pre-monsoon infrastructure maintenance, strengthened summer waste management, continuous surveillance, and service-continuity planning.

INTRODUCTION

Environmental sanitation is an important determinant of public health and includes safe water supply, effective waste disposal, drainage, and sewage management. Inadequate sanitation can increase exposure to environmental hazards and infectious diseases, whereas safely managed sanitation is essential for protecting health and well-being (World Health Organization [WHO], 2018). Rapid urbanisation can place increasing pressure on water, sanitation, drainage, and solid-waste management systems. Environmental conditions, infrastructure limitations, and inadequate service capacity may contribute to persistent sanitation challenges in urban areas (WHO,2018;WHO,2019).

Chandigarh is a planned Union Territory in northern India, but municipal solid-waste management continues to present challenges across waste generation, collection, transportation, treatment, and disposal (Ravindra et al., 2015). Seasonal climatic variation may further influence sanitation systems through changes in rainfall, drainage requirements, and infrastructure stress. Climate-resilient sanitation planning is therefore important for reducing environmental and health risks associated with climatic variability (Patz , 2014;WHO,2019).

The field practice areas associated with GMCH-32 include densely populated communities in which sanitation infrastructure may be vulnerable to seasonal stress. Continuous environmental surveillance can help identify temporal patterns and guide preventive interventions. The COVID-19 pandemic and associated restrictions affected routine community and municipal activities in many settings; however, because municipal service disruption and other potential confounders were not directly measured in this study, temporal changes cannot be attributed exclusively to the pandemic.

The present study aimed to examine seasonal and yearly trends in pipeline seepage/water leakage, stagnant water accumulation, improper waste disposal, and unattended waste bins in GMCH-32 and its associated field practice areas in Chandigarh from 2019 to 2023.

MATERIALS AND METHODS

Study Area and Design

The study was conducted at Government Medical College and Hospital (GMCH-32), Chandigarh, and its associated field practice areas under the Department of Community Medicine. A prospective observational study was conducted from January 2019 to December 2023. Four sanitation-related problems were assessed: pipeline seepage/water leakage, stagnant water accumulation, improper waste disposal, and unattended waste bins.

Data Collection

Data were obtained from routine field surveys conducted by trained community health workers under the supervision of the Department of Community Medicine, GMCH-32. Observations were recorded using standardised forms and subsequently digitised. Field supervisors cross-verified records for completeness and consistency.

Data Analysis

Observations were aggregated monthly and annually. Seasons were defined as winter (December–February), summer (March–May), monsoon (June–September), and post-monsoon (October–November). Frequencies and percentages described the distribution of episodes. Seasonal and yearly patterns were examined using descriptive and time-series analysis in R software version 4.3.1.

RESULTS

A total of 481 sanitation-related episodes were documented. Stagnant water accumulation was the most frequent problem, accounting for 209 episodes (43.5%), followed by water leakage (172; 35.7%), unattended waste bins (59; 12.3%), and improper waste disposal (41; 8.5%).

Seasonal Distribution

The monsoon season accounted for the largest proportion of all episodes, with 171 (35.6%). Water leakage was particularly frequent during the monsoon, with 69 episodes (40.1% of all water-leakage episodes). Stagnant water also showed a monsoon peak, with 70 episodes (33.5% of all stagnant-water episodes). Summer accounted for 121 episodes (25.2%) and had the highest proportion of improper waste disposal (14;

34.1%) and a substantial contribution to unattended waste bins (16; 27.1%). Post-monsoon and winter accounted for 114 (23.7%) and 66 (13.7%) episodes, respectively.

Table 1. Seasonal Distribution of Sanitation-related Episodes, 2019–2023

Season	Water leakage	Stagnant water	Improper waste disposal	Unattended waste bins	Total
Winter	21 (12.2%)	31 (14.8%)	9 (22.0%)	5 (8.5%)	66 (13.7%)
Summer	40 (23.2%)	51 (24.4%)	14 (34.1%)	16 (27.1%)	121 (25.2%)
Monsoon	69 (40.1%)	70 (33.5%)	8 (19.5%)	24 (40.7%)	171 (35.6%)
Post-monsoon	42 (24.4%)	57 (27.3%)	7 (17.1%)	8 (13.6%)	114 (23.7%)
Total	172 (100%)	209 (100%)	41 (100%)	59 (100%)	481 (100%)

Yearly Distribution

The annual distribution demonstrated considerable variation. The highest number of episodes was recorded in 2021, with 133 (27.7%), followed by 2020 with 111 (23.1%) and 2022 with 88 (18.3%). The lowest number was recorded in 2023, with 58 (12.1%). In 2021, summer and monsoon accounted for 39 (29.3%) and 48 (36.1%) episodes, respectively. Water leakage was highest in 2021 (50 episodes; 29.1%), while stagnant water accumulation was highest in 2021 (54; 25.8%) and 2022 (50; 23.9%).

Table 2. Yearly Distribution of Sanitation-related Episodes by Season, 2019–2023

Year	Winter	Summer	Monsoon	Post-monsoon	Total
2019	10 (11.0%)	22 (24.2%)	36 (39.6%)	23 (25.3%)	91 (18.9%)
2020	18 (16.2%)	29 (26.1%)	38 (34.2%)	26 (23.4%)	111 (23.1%)
2021	14 (10.5%)	39 (29.3%)	48 (36.1%)	32 (24.1%)	133 (27.7%)
2022	17 (19.3%)	24 (27.3%)	33 (37.5%)	14 (15.9%)	88 (18.3%)
2023	7 (12.1%)	7 (12.1%)	16 (27.6%)	28 (48.3%)	58 (12.1%)
Total	66	121	171	114	481

DISCUSSION

This five-year observational analysis demonstrated distinct seasonal variation in sanitation-related problems in Chandigarh. Water-related problems were concentrated during the monsoon, whereas waste-management problems showed greater representation during summer. The monsoon accounted for 40.1% of water-leakage episodes and 33.5% of stagnant-water episodes. Increased rainfall and associated drainage pressures may contribute to seasonal sanitation vulnerabilities, consistent with the importance of climate-resilient sanitation planning (Patz, 2014; WHO, 2019).

Stagnant water represents an environmental health concern because suitable water-holding habitats can support mosquito breeding. WHO recommends integrated approaches involving vector surveillance, environmental management, community engagement, and coordinated vector-control activities (WHO, 2017). The summer season accounted for the highest proportion of improper waste-disposal episodes (34.1%). Chandigarh-specific evidence has identified challenges across municipal solid-waste management, highlighting the importance of effective collection, transportation, treatment, and disposal systems (Ravindra, 2015).

The annual distribution showed the highest number of recorded episodes in 2021. This occurred during the period

following the COVID-19 pandemic and associated restrictions; however, the study did not directly measure municipal service disruption, population mobility, rainfall, infrastructure maintenance, or other potential confounders. Therefore, a causal relationship with the pandemic cannot be established. The reduction in recorded episodes by 2023 is also noteworthy, but its reason cannot be established from the available data. The relatively high proportion of post-monsoon episodes in 2023 supports continued surveillance after the main monsoon period.

Implications and Recommendations

Pre-monsoon preparedness: strengthen inspection and maintenance of pipelines and drainage systems before the monsoon.

- Summer waste management: strengthen waste collection, monitoring, segregation, and community awareness during March–May.
- Infrastructure improvement: address recurrent leakage and drainage problems through planned maintenance and phased improvement.
- Continuous surveillance: maintain routine environmental sanitation surveillance for early identification and correction of hazards.
- Integrated vector control: incorporate persistent stagnant-water areas into environmental surveillance and vector-control activities (WHO, 2017).
- Community participation: integrate community engagement into waste-management and environmental health activities.
- Service-continuity planning: develop contingency plans to maintain essential sanitation services during pandemics and other major disruptions.

Limitations

The study relied on routine field-survey records and may therefore have underestimated sanitation episodes because of incomplete reporting or documentation. Detailed meteorological variables, including rainfall intensity and temperature, were not incorporated, limiting assessment of specific climatic determinants. Municipal service-delivery indicators and population mobility were also not directly measured. The study was conducted in GMCH-32 and its associated field practice areas and may not be fully generalisable to all areas of Chandigarh. Future studies should integrate meteorological, socioeconomic, infrastructural, service-delivery, and vector-surveillance data.

CONCLUSION

Sanitation-related problems in Chandigarh demonstrated clear seasonal and yearly variation over the five-year observation period. Monsoon months were associated with a greater burden of water leakage and stagnant water accumulation, whereas summer showed a higher proportion of improper waste disposal. The annual increase observed in 2021 occurred during the period following COVID-19-related restrictions, but causality cannot be established from the present data. Seasonal preparedness, infrastructure maintenance, strengthened waste collection, continuous environmental surveillance, integrated vector control, and community participation may help reduce environmental sanitation risks and support urban public health.

REFERENCES

1. Ministry of Housing and Urban Affairs, Government of India. (2016). *Manual on municipal solid waste management*.
2. Patz JA, Frumkin, H., Holloway, T., Vimont, D. J., & Haines, A. (2014). Climate change: Challenges and opportunities for global health. *JAMA*, 312(15), 1565–1580. <https://doi.org/10.1001/jama.2014.13186>
3. Kumar, K., Kaur, K., & Mor, S. (2015). System analysis of municipal solid waste management in Chandigarh and minimization practices for cleaner emissions. *Journal of Cleaner Production*, 89, 251–256. <https://doi.org/10.1016/j.jclepro.2014.10.036>
4. World Health Organization. (2017). *Global vector control response 2017–2030*.
5. World Health Organization. (2018). *Guidelines on sanitation and health*.
6. World Health Organization. (2019). *Climate, sanitation and health: Discussion paper*.

7. World Health Organization. (2020). *Global vector control response: Progress in planning and implementation*.
8. World Health Organization. (2024). *Vector-borne diseases*.