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Public Health Risks Associated with Municipal Solid Waste Dumping Sites: A Review with Special Reference to Bishnupur Govind, Muzaffarpur, Bihar

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Abstract

Dumping of municipal solid waste (MSW) has emerged as a significant environmental health issue, particularly in low- and middle-income environments where mixed waste is often disposed of without proper segregation, leachate management, gas capture, or fire suppression. This review summarizes the literature on the health hazards of open dumping and inadequately controlled landfilling, with particular attention to Bishnupur Govind, a peri-urban area near Muzaffarpur, Bihar. The chapter uses a narrative review methodology that relies on key reviews, epidemiological studies, occupational health studies, environmental studies, and policy documents. The primary exposure routes in the literature are contaminated water and soil, bioaerosols and dust, proliferation of vectors, direct dermal contact, mixed waste injuries, and smoke inhalation in open burning. The most compelling evidence is related to respiratory symptoms, gastrointestinal illness, skin and eye irritation, injuries, occupational morbidity and wider nuisance burdens among waste workers and communities living around dumpsites. The long-term effects like cancers and adverse reproductive effects are harder to estimate consistently, but systematic reviews indicate that precautionary management is justified where waste is managed in an unsafe manner. The Indian experience is no exception to the world trend: poor segregation, reliance on open dumping, poor occupational protection, and risks of contamination still determine the vulnerability of communities. In this regard, Bishnupor Govind is a place-based prism through which the broader literature can be viewed in the context of local planning, surveillance, and future field research.

Keywords*: municipal solid waste, dumpsite, public health, environmental exposure, waste workers, Muzaffarpur, Bihar*

1. Introduction

Municipal solid waste management is not just an engineering or sanitation issue anymore, but also a health issue. The amount of global municipal solid waste has already surpassed 2 billion tonnes per year, and several international evaluations indicate that the amount will increase significantly by mid-century unless consumption habits and waste systems are altered significantly (Kaza et al., 2018; World Health Organization [WHO], 2025). The load is not evenly spread. Most of the waste is usually collected and managed in high-income settings, whereas in low-income settings, significant gaps in collection, treatment, and ultimate disposal persist. According to UNEP and ISWA (2024), in less-developed countries less than 40 percent of municipal solid waste is picked up, and significant portions of waste are burned, discarded, or released into the open environment. In these situations, waste is not just out of place, but it is a chronic source of exposure that may impair air, water, soil, food environments, and daily living conditions.

The dumpsites are of public health importance because of the variety of hazards they pose. Foul odour, vermin, smoke, dust and leachate may be produced by mixed waste that includes food residues, plastics, sanitary waste, sharp objects, ash, chemicals and intermittently hazardous materials. These risks work in complex biological, chemical, and social mechanisms. WHO (2025) highlights that poor municipal solid waste management may pollute the environmental media, provide breeding habitats to insects and rodents, and expose waste workers, the surrounding communities, children, and pregnant women to biological, chemical, physical, and psychological hazards. Previous reviews have made similar conclusions, stating that waste practices are to be viewed as a subset of the overall social production of disease, particularly when the disposal sites are situated in the vicinity of low-income settlements and environmental regulations are lax (Giusti, 2009; Porta et al., 2009).

The public health aspect of waste is particularly significant in India, as urbanization has exceeded the shift to the full scientific management of waste. The last 20 years of reviews have consistently characterized mixed collection, incomplete segregation, limited processing capacity, and the long-standing use of open dumping or poorly designed disposal sites in most cities (Sharholy et al., 2008; Kumar et al., 2009; Gupta et al., 2015; Kumar and Agrawal, 2020). The Solid Waste Management Rules, 2016 established a more robust regulatory framework, yet enforcement is still uneven among states and urban local authorities. It is against this backdrop that the current review analyses the health hazards of the municipal solid waste dumping sites and interprets the literature with particular reference to Bishnupur Govind near Muzaffarpur, Bihar. It is not intended to present primary field findings, but to develop a strong conceptual and policy chapter that can be used in future empirical studies in the Muzaffarpur context.

2. Review method and extent

This is a narrative review, not a formal meta-analysis. It is based on significant review articles, epidemiological and occupational health research, environmental research, and institutional reports pertinent to municipal solid waste dumping, open disposal, landfilling, open burning, waste work, and community exposure. English-language literature published since 2004 was prioritized that covered one or more of the following areas: (a) exposure pathways around dumpsites, (b) health outcomes among local residents, (c) occupational health among waste workers and waste pickers, (d) water and soil contamination near disposal sites, and (e) Indian policy and implementation issues. The global and policy context was framed using authoritative institutional sources in the form of WHO, the World Bank, UNEP and the Government of India.

Since the chapter is a review with a local application, the discussion of the Bishnupur Govind is not data-driven but interpretive. The publicly available data on the waste management system of Muzaffarpur, in particular, the reported waste production and the decentralized waste programs in the city, are integrated with the broader literature to demonstrate why peri-urban settlements around the disposal sites should be given special attention in terms of public health (Centre for Science and Environment [CSE], 2018). Research that focused solely on unrelated waste streams, e.g. biomedical waste or e-waste without a municipal disposal interface, was not highlighted unless it elucidated particular exposure mechanisms of interest to mixed municipal dumping.

3. Access roads connecting municipal solid waste dumpsites and community health

Open dumpsites pose risk in a multi-pathway, not a single toxic exposure. Mixed waste organic fractions contain moisture and nutrients that support the growth of microorganisms and the breeding of flies, mosquitoes, cockroaches, rodents, stray animals and other nuisance vectors. In places where waste is exposed, stagnant water gathers, scavenging animals scatter waste, and pathogens may be transferred between waste surfaces and food, household surfaces, and shallow water sources. WHO (2025) lists the breeding of vectors and microbial contamination as the key risks of poor waste management, whereas Giusti (2009) and Siddiqua et al. (2022) demonstrate that uncontrolled dumping usually results in the burden of gastrointestinal disorders, skin irritation, fever, and overall morbidity in the exposed population.

The second route is chemical and physico-chemical contamination. Waste decomposition leachate may

introduce organic pollutants, nutrients, pathogens, and heavy metals into nearby soil and groundwater. This process is particularly significant when the disposal occurs on bare land, around ponds or drains, or on shallow aquifers. Indian data on municipal waste disposal in Silchar, Assam indicates that the quality of groundwater and soil around the site can be significantly impaired by the process, which supports the long-standing belief that leachate is one of the most insidious but most significant products of open dumping (Choudhury et al., 2021). This contamination does not necessarily lead to an immediately identifiable waste disease, but it establishes chronic exposure conditions to households that rely on local hand pumps, wells, or surface water.

Another significant issue is airborne exposure. Handling of waste, unloading of trucks, decomposition, and disruption of dry waste surfaces may emit dust and bioaerosols; exposure profile is significantly more intense when waste is placed on fire or spontaneously smoulders. WHO (2025) emphasizes open burning and uncontrolled combustion as significant sources of particulate matter and toxic substances, such as dioxins and furans. An overview of domestic and open waste burning also finds that open burning is still common in most developing contexts and is linked with a great deal of uncertainty in emission inventories specifically due to its informal and intermittent nature (Ramadan et al., 2022). In terms of public health, the most important thing is simple: the surrounding of dumpsites can be not only impacted by the passive presence of waste, but also by the occasional occurrence of smoke and odour that can worsen respiratory and ocular symptoms.

Risk is further increased by direct occupational contact. Waste is handled by municipal workers, sorters, transport workers and informal waste pickers at close proximity and in many cases without proper gloves, masks, boots, vaccination, and wash facilities. Systematic and narrative reviews outline a general hazard profile which encompasses cuts and punctures, musculoskeletal strain, dermatitis, respiratory complaints, gastrointestinal illness, and exposure to heavy metals and hazardous residues (Poole and Basu, 2017; Vinti et al., 2021). The waste system thus generates exposure gradients: workers and informal recyclers are at the top of direct contact, with nearby residents having a combination of household, neighbourhood, and environmental exposure.

Lastly, dumpsites cause social and psychological damages that are not usually detected by traditional environmental monitoring. The chronic smell, sight of waste heaps, stigma of living near a dump, fear of contamination, decreased outdoor activity, and insecurity of scavenging areas can undermine well-being despite a particular disease pathway being hard to isolate. In its definition of the health impacts of poor solid waste management, WHO (2025) specifically mentions psychological risks. This wider prism is significant in peri-urban India, where communities living close to disposal sites can be subjected to externalized costs of urban consumption without the corresponding protection, infrastructure, or compensation.

Table 1. *Major exposure pathways linking dumpsites and community health*

Exposure pathway	Environmental mechanism	Likely public-health outcomes	Illustrative sources
Leachate and runoff	Unlined or poorly controlled waste releases contaminants into groundwater, ponds, drains, and soil	Diarrhoeal disease, skin irritation, chronic toxic exposure, unsafe drinking water	Siddiqua et al. (2022); Choudhury et al. (2021)
Bioaerosols, dust, and odour	Waste handling and decomposition release dust, microbial fragments, and odorous gases	Respiratory symptoms, eye irritation, headache, reduced well-being	Poole & Basu (2017); WHO (2025)
Vector proliferation	Open organic waste and stagnant water favour flies, mosquitoes, rodents, and stray animals	Febrile illness, enteric contamination, nuisance burden	Giusti (2009); WHO (2025)
Open burning and landfill fires	Combustion of mixed waste generates smoke, particulate matter, and toxic compounds	Cough, breathlessness, eye irritation, long-term toxic risk	Ramadan et al. (2022); WHO (2025)
Direct occupational contact	Manual handling of mixed waste, sharps, fecal residues,	Injuries, dermatitis, musculoskeletal strain, infections	Ravindra et al. (2016); Thakur et al. (2018);

	and contaminated recyclables		Chokhandre et al. (2017)
Social and psychological nuisance	Persistent odour, stigma, fear of contamination, and reduced outdoor activity	Stress, sleep disturbance, diminished quality of life	Porta et al. (2009); WHO (2025)

Note. Author synthesis based on the cited literature

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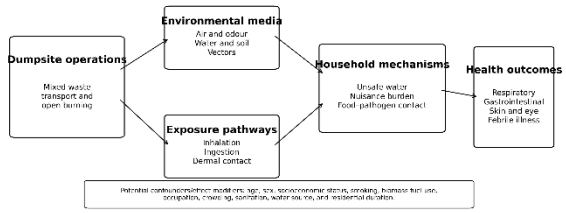

Figure 1. *Conceptual framework linking dumpsite operations, exposure pathways, and health outcomes*

4. What the international literature shows

International review literature consistently shows that the health consequences of poor waste management are real, but not always easy to quantify with precision. Porta et al. (2009), in a systematic review of epidemiological studies, found evidence suggestive of adverse effects associated with waste management facilities, including some reproductive and respiratory outcomes, while also noting important methodological limitations such as exposure misclassification and heterogeneous study designs. More recently, Vinti et al. (2021) reviewed the health effects associated with municipal solid waste management across different stages of the system and concluded that adverse health outcomes are reported among both workers and communities exposed to inadequate waste handling, recycling, and disposal.

Broader environmental reviews reinforce this conclusion. Ferronato and Torretta (2019) argue that waste mismanagement in developing countries produces a chain of public health and environmental harms because collection gaps, open dumping, and uncontrolled burning remain structurally embedded in many cities. Siddiqua et al. (2022) similarly show that landfilling and open dumping can pollute soil, groundwater, and air, with potential consequences that range from acute irritation and enteric illness to chronic exposure to hazardous compounds. The WHO report on solid waste and health adds an important systems perspective by emphasizing that risks are not confined to one site type or one social group; rather, they accumulate along the entire municipal solid waste chain, with the most intense harms concentrated among waste workers, informal recyclers, and people living close to disposal or processing sites (WHO, 2025).

The occupational literature adds further depth. Poole and Basu (2017), reviewing illness in the waste and recycling sector, identified elevated injury rates and increased respiratory, gastrointestinal, and skin complaints in several settings. These findings matter for dumpsite-adjacent communities because the same agents that affect workers - bioaerosols, heavy metals, dust, smoke, and decomposing organic matter - can also move beyond the formal workplace boundary. The international evidence therefore supports a precautionary stance: even when the strength of association varies by outcome, open or poorly managed waste disposal should be treated as a legitimate public health hazard rather than a narrowly aesthetic or municipal inconvenience.

Table 2. *Selected review-level international evidence on solid waste and health*

Study	Type and scope	Main implication for public health
Porta et al. (2009)	Systematic review of epidemiological studies on waste-management facilities	Evidence suggests adverse health effects in some settings, but exposure assessment remains methodologically challenging.
Vinti et al. (2021)	Systematic review of municipal solid waste management and adverse health outcomes	Adverse outcomes are reported across the waste chain, especially where management is inadequate and exposure is direct or prolonged.
Ferronato & Torretta (2019)	Global review focused on developing countries	Waste mismanagement is strongly linked with open dumping, burning, and preventable environmental health risks.

Siddiqua et al. (2022)	Review of landfilling and open dumping impacts	Open dumping can contaminate soil, water, and air and should be treated as both an environmental and health problem.
Poole & Basu (2017)	Systematic review of occupational illness in the waste and recycling sector	Workers in the sector face higher burdens of injury, respiratory, gastrointestinal, and skin complaints.
WHO (2025)	Global synthesis report on solid waste and human health	Public health risks are concentrated among workers, informal recyclers, and communities living near waste-management sites.
UNEP & ISWA (2024)	Global waste outlook and systems assessment	Collection and control gaps in lower-income settings sustain high community exposure to uncontrolled waste.

Note. The table summarizes the dominant message of each source rather than every detail reported in the original study.

5. Evidence from India

Indian scholarship reflects the global image and emphasizes the institutional issues of the country. The reviews by Sharholy et al. (2008), Kumar et al. (2009), and Gupta et al. (2015) present the municipal solid waste management in India as a system that was historically marked by mixed waste collection, lack of segregation, strained municipal budgets, lack of treatment facilities, and reliance on open dumps. Subsequent reviews affirm that there has been an improvement in policy design and technological choices, yet implementation is still disjointed across cities and towns (Kumar et al., 2017; Sharma and Jain, 2019; Kumar and Agrawal, 2020; Pal and Bhatia, 2022). In terms of public health, this implies that exposure is frequently not just determined by the waste itself, but by deficits in governance - haphazard collection, inappropriate transport, absence of sanitary landfills, and ineffective monitoring.

Some of the most clear empirical evidence of harm can be found in occupational studies in India. Ray et al. (2004) reported respiratory and general health impairment in ragpickers in Delhi, and respiratory and other clinical impairment in workers working in an open landfill site (Ray et al. 2005). Ravindra et al. (2016) identified occupational exposure in municipal solid waste workers in Chandigarh, with a focus on the gaps in personal protective measures and work conditions. Thakur et al. (2018) in Himachal Pradesh and Venkataraman et al. (2022) in Puducherry found that municipal waste workers were exposed to various occupational hazards and respiratory morbidity and obstructive lung function among municipal waste handlers, respectively. Chokhandre et al. (2017) also demonstrated that waste pickers in Mumbai had a high morbidity and economic burden, which highlights the interplay between occupational exposure and poverty.

There is also concern about community exposure supported by environmental investigations. The Silchar research by Choudhury et al. (2021) showed that unscientific municipal waste management degraded groundwater and soil around a disposal site, which is consistent with previous Indian reviews on leachate, untreated organics, and mixed-waste dumping. Combined, Indian studies show that the health hazards surrounding dumpsites cannot be viewed as isolated incidents. They are the logical result of partial segregation, dumping of legacies, poor occupational safety, and lack of separation between disposal operations and human communities.

The policy has progressed, but implementation is decisive. The Solid Waste Management Rules, 2016 mandate source segregation, scientific treatment, and less hazardous handling of municipal waste, and acknowledge the necessity to incorporate waste pickers and informal workers into more structured systems (Ministry of Environment, Forest and Climate Change [MoEFCC], 2016). However, the literature time and again demonstrates that paper-based rules do not necessarily result in decreased exposure. Public health protection depends on whether municipalities can prevent open dumping and burning, control leachate, provide safe worker conditions, and maintain regular collection and processing over time.

Table 3. *Selected Indian evidence and its implications for public health protection*

Indian evidence	Context	Public-health significance
Sharholy et al. (2008)	Review of Indian cities	Showed that inadequate collection, treatment, and disposal were already creating urban environmental health pressure.

Kumar et al. (2009)	Status assessment across Indian city classes	Demonstrated systemic gaps in scientific municipal solid waste management across diverse urban categories.
Gupta et al. (2015)	National review	Reinforced that mixed waste and open dumping remain major barriers to safe public health outcomes.
Kumar et al. (2017); Kumar & Agrawal (2020); Pal & Bhatia (2022)	Recent India-focused reviews	Document continuing implementation gaps despite improved policy and technical options.
Ray et al. (2004)	Ragpickers in Delhi	Found respiratory and general health impairments among highly exposed informal workers.
Ray et al. (2005)	Open landfill workers in Delhi	Documented respiratory and clinical impairment associated with open-landfill employment.
Ravindra et al. (2016); Thakur et al. (2018); Venkataraman et al. (2022)	Municipal waste workers in Chandigarh, Himachal Pradesh, and Puducherry	Provide consistent evidence of occupational exposure, inadequate protection, and respiratory or other morbidity.
Chokhandre et al. (2017)	Waste pickers in Mumbai	Linked waste work to substantial morbidity and economic burden.
Choudhury et al. (2021)	Soil and groundwater near a disposal site in Assam	Supports concern that community health risk also operates through environmental contamination, not only direct contact.
MoEFCC (2016)	Solid Waste Management Rules, 2016	Provides the regulatory basis for segregation, safer disposal, and protection of public health, but implementation is decisive.

Note. Selected studies are illustrative rather than exhaustive; emphasis is placed on evidence most relevant to dumpsite-related public health.

6. Special reference to Bishnupur Govind, Muzaffarpur, Bihar

Muzaffarpur offers a useful local lens for interpreting the national literature. A CSE (2018) report on decentralized solid waste management in Muzaffarpur notes that the city generates about 170 metric tons of waste per day, with per capita generation close to 300 grams. The report also documents efforts to improve source segregation and composting, showing that the city is not outside the larger Indian transition toward more decentralized and resource-oriented waste management. However, the existence of generation pressure and the need for transport, processing, and final disposal mean that peri-urban communities around disposal corridors or dump locations remain relevant from a public health perspective.

Within this broader setting, Bishnupur Govind near Muzaffarpur can be treated as a place-based reference point for reviewing risk rather than as a source of claimed primary results. The literature reviewed in this chapter suggests that if a peri-urban settlement is located near a municipal dumping site, the most likely public health concerns would include odour nuisance, vector proliferation, household contact with contaminated soil or water, smoke episodes linked to open burning, and heightened vulnerability among children, older adults, and waste-exposed workers. The strongest rationale for future local inquiry would therefore be to document exposure gradients by distance, drinking-water source, occupational linkages to waste work, and self-reported respiratory, gastrointestinal, dermatological, and febrile illness patterns.

Figure 2 presents a suggested exposure-zoning framework for future studies around Bishnupur Govind. Such a design would allow researchers to compare households in high, intermediate, and relatively unexposed zones while also integrating groundwater points, drainage channels, waste transport routes, and sensitive receptors such as schools or health sub-centres. The value of this "special reference" approach is that it translates abstract global and national evidence into a district-level research agenda that is both epidemiologically coherent and policy relevant for Bihar.

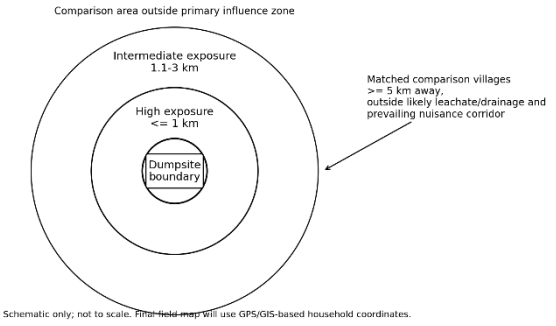

Figure 2. *Suggested exposure-zoning framework for future field studies around a dumpsite-affected settlement*

Note. Schematic only and not to scale. The figure is included as a review-derived design aid for future empirical work in Bishnupur Govind.

7. Policy implications and future research

The review has quite a few implications. Preventing a disease from happening in the first place should be the first goal in public health. The separation of domestic hazardous waste from other solid waste reduces contamination of the municipal waste stream and limits worker exposure, vector breeding and uncontrolled burning. Disposal methods are just as important as collection methods. Carrying a mixed waste stream to an open site, lacking leachate, daily cover, run-off and drainage management, fire prevention, distance buffers, etc, merely transfers the risk from the city centre to close by. Third, waste governance should make occupational health its third pillar and not an afterthought. Basic public health measures like personal protective equipment, vaccination, hand-washing facilities, routine health checks and the formal inclusion of waste pickers cannot be considered optional labour benefits (Poole & Basu, 2017; Thakur et al., 2018).

Routine environmental and health surveillance is equally important for peri-urban communities such as Muzaffarpur. Authorities of the municipality and district health should include groundwater testing, odour and smoke complaints system, vector monitoring, and risk communication in neighbourhoods near disposal sites. Health systems can assist by helping add waste-related questions to outreach that focuses on communities. They can also help recognize that clusters of respiratory irritation; clusters of diarrhoeal disease; clusters of skin complaints, or clusters of repeated fever near dumpsites could indicate an environmental exposure problem rather than only a household hygiene problem. The evaluation by the WHO (2025) states that the health sector has been inadequately involved in solid waste governance. The Indian case study supports that evaluation.

In addition, the review identifies research gaps. Evidence gathered from medium-sized cities and peri-urban villages are much weaker. Longitudinal studies are uncommon, mental-health and psychosocial dimensions remain underexplored, and many studies are without precise exposure mapping. Future work in relation to Bishnupur Govind and similar sites in Bihar needs to combine household health surveys, GIS-based distance analysis, worker interviews, groundwater and soil testing and documentation of open-burning events. Because dumpsite risk is simultaneously material, social, and institutional, a mixed-methods design would be especially useful.

8. conclusion

Municipal solid waste dumping sites are public health environments, not simply final disposal sites. The literature suggests that open dumping and badly managed landfilling bring worker and community exposure to a cocktail or mix of biological, chemical, physical and psychosocial hazards. The most robust data relates to respiratory symptoms, gastrointestinal disease, skin and eyes, injury, occupational morbidity, and nuisance-related reductions in well-being.

In India, uncontrolled dumping is worsened by inadequate segregation, uneven implementation of waste rules and continued reliance on open disposal in various settings.

The review refers to Bishnupur Govind situated near Muzaffarpur. Moreover, it suggests a clear agenda for action which includes prevention of mixed dumping, protection of workers, monitoring institutional water and air pathways as well as distance-based exposure. For scholarships, the chapter shows how a locally anchored review can link global evidence to district planning. This reinforces a simple message for policy: safer solid waste management is a preventive public health intervention, and communities living near dumpsites should be seen as priority populations for environmental health protection.

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