

Review Article

Infectious and respiratory vulnerability among elderly women in urban slums in India: the role of informal work and social disadvantage

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ABSTRACT

Elderly women working in the informal sector of urban slums in India are highly vulnerable due to the combined effects of ageing, poverty, hazardous occupations, and limited access to healthcare. This review examined published evidence on infectious disease risks in this population, focusing on respiratory health and the influence of social determinants. The evidence showed that biomass fuel exposure, ambient air pollution, overcrowding, poor ventilation, inadequate sanitation, and unsafe waste handling substantially increased respiratory and infectious disease risks. Women engaged in ragpicking and similar occupations faced additional hazards from direct contact with unsegregated municipal and biomedical waste, lack of personal protective equipment, prolonged work hours, anemia, addiction, and social insecurity. Studies also reported a high burden of chronic respiratory disease, recurrent respiratory symptoms, tuberculosis associated with biomass smoke, multi-morbidity, and delayed healthcare seeking due to financial constraints, poor health literacy, limited healthcare access, dissatisfaction with public services, and misattribution of symptoms to ageing. Overall, infectious disease vulnerability is driven by interacting biological, environmental, occupational, and social factors. Targeted policies should prioritize clean household energy, safer waste management, improved slum conditions, accessible geriatric and primary healthcare, and community-based screening and support for socially disadvantaged older women.

Keywords: Informal workforce, Urban slums, Infectious diseases, Respiratory health, Social vulnerability, Biomass fuel, Ragpickers

INTRODUCTION

Urban slums in India represent a setting where environmental exposure, poverty, overcrowding, poor sanitation, unsafe occupations, and weak access to healthcare often overlap. Within this setting, women in the informal workforce appear especially vulnerable because they are commonly exposed to household smoke, ambient pollution, waste-related occupational hazards, nutritional deprivation, and delayed care-seeking. In the

reviewed literature, women living in slum environments were shown to experience both indoor and outdoor respiratory risk, particularly when cooking in poorly ventilated dwellings and residing near heavy traffic or industrial zones. Altered lung function and respiratory symptoms were documented among adult women exposed to combined household and ambient air pollution in a Delhi slum setting, while biomass fuel use was also found to be significantly associated with pulmonary tuberculosis in another Indian study, suggesting that household air pollution may contribute not only to

respiratory morbidity but also to infectious respiratory disease.^{1,2}

Women engaged in informal waste work constituted another high-risk group within urban poor communities. The included studies on ragpickers showed a mixture of occupational, reproductive, nutritional, and social disadvantages, with respiratory infection, fever, anemia, addiction, poor hygiene, and unsafe working conditions being common concerns. Waste pickers exposed to unsegregated municipal and biomedical waste had a higher burden of upper and lower respiratory symptoms, along with impaired lung function and inflammatory changes in sputum. These findings suggest that the health burden in informal women workers was shaped not only by poverty, but also by repeated daily exposure to hazardous work environments without organized occupational protection.^{3,4}

The problem becomes more complex in older women living in slum communities. Chronic morbidity was reported to be highly prevalent among slum-dwelling elderly, and health-seeking was influenced by money, living arrangement, and the belief that illness was simply age-related. More recent studies from Gujarat and Kolkata showed that older adults in slums carried a substantial burden of multimorbidity, with respiratory disease forming part of broader clusters linked to poverty, low literacy, poor social support, widowhood, and limited healthcare access. These findings indicate that in such settings respiratory and infectious problems do not occur in isolation, but are embedded within a larger pattern of chronic illness, frailty, and social deprivation.⁵⁻⁷

Access to healthcare was another central issue across the reviewed literature. Poor housing, unsafe water and sanitation, indoor air pollution, long waiting time, affordability problems, dissatisfaction with government services, and greater reliance on private providers were all shown to affect healthcare utilization among slum residents.

Similar barriers were also seen in elderly participants and women ragpickers, where cost, loss of wages, and low priority to symptoms delayed appropriate care. These reviewed studies indicate that infectious disease risk among elderly women in the informal workforce in urban slums is not explained by a single exposure. Rather, it appears to emerge from the interaction of polluted living environments, unsafe livelihoods, nutritional and social disadvantage, and fragmented healthcare access.

On this background, the present review was undertaken to synthesize the available evidence on infectious disease risks, with special emphasis on respiratory health and social vulnerability among elderly women in the informal workforce living in urban slums in India.^{3,5,8}

RESPIRATORY HEALTH BURDEN AMONG WOMEN LIVING AND WORKING IN URBAN SLUMS

Respiratory health burden in urban slum populations did not appear as one isolated clinical problem. It was seen in different forms across the included studies, ranging from chronic respiratory symptoms and altered lung function to pulmonary tuberculosis and recurrent respiratory infections. Adult women living in a polluted Delhi slum showed a clear burden of respiratory complaints such as dyspnea, chronic cough, chronic phlegm, and wheeze, along with a measurable proportion having reduced lung function values.¹ Many of these women were exposed not to one source alone, but to a combination of heavy ambient pollution and poorly ventilated indoor cooking conditions. Because of this, the overall respiratory burden appeared cumulative rather than separate.¹ The characteristics of the included studies are summarized in Table 1.

The same pattern became more serious when household smoke was linked with infectious disease. Biomass fuel exposure was associated with pulmonary tuberculosis in the Chandigarh case-control study, and the risk remained significant even after adjustment for other factors. This finding is important because cooking smoke in poor households is often treated as a routine part of daily life, yet the reviewed evidence suggested that such exposure may have consequences beyond irritation and chronic airway symptoms. Indoor smoke, kitchen structure, family smoking habits, and background poverty appeared to act together in shaping respiratory risk, so vulnerability in slum women extended beyond cough and breathlessness to serious infectious respiratory disease.²

The occupational side was equally striking. Among women ragpickers in Mumbai, respiratory tract infections, chronic cough, and past history of tuberculosis-related illness were reported, and morbidity differed significantly according to the area of waste collection. Women working in dumpsites and street-side waste picking seemed to face a harsher exposure profile because of repeated contact with mixed waste, poor hygiene conditions, anemia, addiction, and long work duration. Although spirometry was not used in that study, the pattern was still enough to show that respiratory illness in this group was not accidental, but closely related to the conditions in which the work was carried out.³

This occupational effect was seen more sharply in the Delhi ragpicker study. Ragpickers had much higher upper and lower respiratory symptoms than controls, and lung function values were significantly lower. Even among nonsmokers, respiratory symptoms and lung function decrement remained more frequent in ragpickers, making the occupational role still more convincing. In addition, inflammatory changes in sputum and poorer general health were documented in the exposed group. Waste

picking therefore appeared to be associated not only with subjective complaints, but also with measurable respiratory impairment and airway inflammation,

suggesting that work in unprotected waste environments may create a daily respiratory burden that builds over time.⁴

Table 1: Characteristics of included studies

References	Study design	Location/setting	Population	Sample (n)	Study period	Primary objective
Arora et al¹	Cross-sectional	Vishwas Nagar slum, East Delhi, near Anand Vihar Inter State Bus Terminus.	Adult women aged 18-59 years residing in slum for at least 1 year.	500 consented; 299 with valid spirometry	Jan-Dec 2015	Prevalence of altered lung function and associated environmental risk factors.
Lakshmi et al²	Case-control	Urban, rural and slum areas, Chandigarh Union Territory	Adult women aged 20-64 years; sputum-positive pulmonary tuberculosis cases and controls.	126 cases; 252 controls	Apr 2006-Mar 2007	Association between biomass fuel use and pulmonary tuberculosis.
Uplap et al³	Interventional study	Deonar, Mumbai, nongovernmental organization field office near largest dumping ground.	Women ragpickers who were members of a nongovernmental organization.	168	Oct 2003-Apr 2005	Morbidity profile, reproductive health, and health-seeking behaviour of women ragpickers.
Ray et al⁴	Cross-sectional comparative study	Garbage dumps and landfill site at Okhla, East Delhi	Ragpickers and controls matched for age, sex, and socioeconomic conditions.	98 ragpickers; 60 controls	Apr-May 2003	Respiratory and general health impairments of ragpickers.
Barua et al⁵	Community-based cross-sectional	Five notified urban slums, Jorhat district, Assam	Elderly aged 60 years and above, permanent residents; both sexes.	125	Aug 2015-Jan 2016	Morbidity profile and health-seeking behaviour of elderly slum dwellers.
Yogesh et al⁶	Community-based cross-sectional	Urban slum in Gujarat, India	Older adults aged 65 years and above selected by multistage random sampling.	800	Apr-Dec 2023	Prevalence of multimorbidity and its association with health literacy and quality of life.
Ghosh et al⁷	Community-based cross-sectional	Kolkata Municipal Corporation wards 7, 8, 15, 27 and 28, urban Kolkata, West Bengal	Women aged 60 years and above; Hindu only; door-to-door survey.	500	Feb-Apr 2019	Prevalence and patterns of multimorbidity in slum-dwelling older women.
Banerjee et al⁸	Cross-sectional survey using rapid appraisal techniques	Landevadi slum, Bhosari, near Pune, and surrounding rural areas, Maharashtra	Both sexes and all ages from urban slum and rural areas, including under-five children.	865	Oct-Dec 2010	Access to and utilization of health services among slum dwellers.

In elderly slum residents, respiratory burden was present but was often hidden within a wider picture of chronic morbidity. Chronic lung disease was reported in a substantial proportion of elderly participants in Assam, and tuberculosis was also noted in that study population.⁵ In Gujarat, respiratory disease appeared as part of multimorbidity clusters among older adults living in urban slums, while the Kolkata study reported asthma or chronic obstructive pulmonary disease, persistent fever or common cold, and throat infection within a very high multimorbidity setting among older women.^{6,7} These findings suggest that in later life respiratory morbidity in slum populations may not always appear as a single diagnosed condition. It is often mixed with musculoskeletal disease, cardiovascular problems, weakness, poor nutrition, and reduced social support, and therefore may remain under-recognized until it becomes more disabling.⁵⁻⁷

The rapid assessment study from Maharashtra also showed that communicable respiratory burden remained present in poor slum settings, with respiratory infections and tuberculosis being reported in the study population, and respiratory infection episodes also affecting under-five children.⁸ When this evidence is read together, one point becomes clear. Women living and working in urban slums were exposed to a combination of polluted air, overcrowded housing, unsafe cooking conditions, occupational dust and waste, delayed treatment, and poor structural support. Because of this overlap, respiratory disease in these communities should not be viewed only

as a medical diagnosis. It reflected the larger social and environmental conditions in which these women were living and earning.^{3,4,8}

INFECTIOUS DISEASE RISKS IN URBAN SLUM SETTINGS

The reviewed studies showed that infectious disease risk in urban slum populations was shaped by daily living conditions rather than by a single medical factor. Poor housing, overcrowding, indoor smoke, unsafe waste exposure, low income, and delayed treatment appeared repeatedly across the literature. These conditions created a setting in which respiratory infection, tuberculosis, febrile illness, skin disease, and gastrointestinal infection could persist together, especially among poor women and older adults.^{2,3,5,8}

Tuberculosis was one of the clearest infectious outcomes identified in the included studies. Women exposed to biomass fuel had higher odds of pulmonary tuberculosis than those using liquefied petroleum gas, and the association remained significant after adjustment for other factors. Family tuberculosis history and smoking exposure inside the household further strengthened this pattern. This study was important because it moved the discussion beyond general smoke exposure and showed a direct link between household fuel conditions and a major infectious respiratory disease.² The reported respiratory and infectious findings of the included studies are summarized in Table 2.

Table 2: Reported respiratory and infectious findings in included studies

References	Respiratory conditions identified	Key quantitative findings	Lung function or spirometry data	Infectious disease relevance
Arora et al¹	Dyspnoea, chronic cough, chronic phlegm, wheeze; obstructive and restrictive impairment.	Reduced forced expiratory volume in 1 second to forced vital capacity ratio in 5%; low forced vital capacity in 26.8%; low forced expiratory volume in 1 second in 17.4%. Dyspnoea 14.2%, chronic cough 5.6%, chronic phlegm 2.4%, wheeze 2.6%.	Mean forced expiratory volume in 1 second was 5.2–18.3% below predicted and mean forced vital capacity was 17.4–26.7% below predicted. Smoking odds ratio 4.619; history of respiratory disease odds ratio 3.479.	Respiratory morbidity linked to ambient and household air pollution.
Lakshmi et al²	Pulmonary tuberculosis	Biomass fuel exposure in 20.6% of tuberculosis cases versus 12.3% of controls. Unadjusted odds ratio 2.33; adjusted odds ratio 3.14. Family tuberculosis history odds ratio 2.52.	Spirometry not done; diagnosis based on sputum-positive pulmonary tuberculosis.	Direct infectious outcome associated with biomass fuel exposure.
Uplap et al³	Respiratory tract infections, chronic cough, past tuberculosis.	Morbidity differed by work area (chi-square 27.8, $p < 0.001$). Past respiratory tract infection in 14.5% of	Spirometry not done; symptom and clinical assessment based.	Respiratory and infectious morbidity in women exposed to mixed waste

Continued.

References	Respiratory conditions identified	Key quantitative findings	Lung function or spirometry data	Infectious disease relevance
		street-side rag pickers; past Koch's disease in 5.45%; respiratory infections including chronic cough and recurrent cough or cold in 7.8% of dumpsite rag pickers.		handling.
Ray et al ⁴	Upper and lower respiratory symptoms including sinusitis, running nose, sore throat, cough, wheeze, and chest discomfort.	Upper respiratory symptoms 75.5% in ragpickers versus 46.7% in controls; lower respiratory symptoms 81.6% versus 43.3%. In nonsmokers, respiratory symptoms 94% versus 56% and lung function decrement 52% versus 34%.	Forced vital capacity, forced expiratory volume in 1 second to forced vital capacity ratio, and peak expiratory flow rate were all significantly lower in ragpickers than controls.	Marked occupational respiratory morbidity and airway inflammation in waste pickers.
Barua et al ⁵	Chronic lung diseases; tuberculosis.	At least one chronic morbidity in 78.4%. Chronic lung disease in 31.2%. Tuberculosis reported in 15 cases; printed percentage in the paper appears inconsistent.	Spirometry not done.	Tuberculosis and chronic lung disease formed part of morbidity burden in elderly slum residents.
Yogesh et al ⁶	Respiratory disease as part of multimorbidity clusters.	Multimorbidity present in 62.5%. Respiratory disease plus heart disease cluster seen in 12% of multimorbid participants.	Spirometry not done.	Respiratory disease contributed to multimorbidity burden in older slum residents.
Ghosh et al ⁷	Asthma or chronic obstructive pulmonary disease; persistent fever or common cold; throat infection.	Multimorbidity prevalence 95.8%. Asthma or chronic obstructive pulmonary disease in 6.8%; persistent fever or common cold in 32%; throat infection in 0.6%.	Spirometry not done; morbidity clinically diagnosed with cross-verification.	Recurrent respiratory complaints formed part of high multimorbidity burden.
Banerjee et al ⁸	Respiratory infections; tuberculosis; acute febrile illnesses.	Respiratory infections 3%, tuberculosis 1%, acute febrile illness 23.4%. In under-five children, respiratory infections occurred in more than 15% over the previous 6 months.	Spirometry not done.	Ongoing communicable respiratory burden and tuberculosis in underprivileged slum settings.

Among ragpickers, the infectious picture was broader and more occupational. The Mumbai study reported respiratory tract infections, chronic cough, fever, and past tuberculosis-related illness in women handling mixed waste.³ The Delhi ragpicker study added that exposure to unsegregated municipal and biomedical waste was associated with marked respiratory symptoms, inflammatory sputum changes, dermatitis, diarrhea, unhealthy gums, and frequent cuts and pricks. This combination is important because it suggests that waste-picking women and other informal workers may face

repeated infectious exposure not only through inhalation, but also through skin contact, minor injuries, poor hand hygiene, and eating in unsafe surroundings.^{3,4} In older slum residents, infection was often seen within a larger morbidity burden. In Assam, chronic lung disease and tuberculosis were both reported among elderly participants, and many had multiple chronic conditions at the same time.⁵ In Kolkata, persistent fever or common cold and throat infection were present within a very high multimorbidity setting among older women.⁷ These findings suggest that in elderly slum women, infection

may not present as a separate event with early treatment. It may instead remain mixed with frailty, chronic disease, poor nutrition, and low health awareness, making both recognition and management more difficult.^{5,7}

The rapid epidemiological assessment from Maharashtra also showed that communicable illness remained an important part of slum health burden. Acute febrile illnesses formed a large proportion of self-reported disease, while respiratory infections and tuberculosis were also present in the surveyed population.⁸ In under-five children, respiratory infection episodes were common, and government care was used much less often than private care. Although this study was not limited to older women, it still helped show the wider infectious environment of slum households in which elderly women live and work. When the household itself remains exposed to unsafe water, poor sanitation, indoor smoke, and delayed care, infectious risk becomes shared across generations.⁸ Overall, the reviewed literature showed that infectious disease risk in urban slum settings was strongly linked with social vulnerability. Women in informal work, especially those involved in waste handling or cooking in smoke-filled homes, were repeatedly exposed to conditions favoring infection. In old age, this risk appeared to become more layered because respiratory and

febrile illnesses were then superimposed on multimorbidity, dependence, widowhood, and barriers to healthcare. Thus, the infectious burden described in these studies was not only biological. It reflected the interaction of environment, occupation, poverty, and weak access to timely care.^{2,3,5,7,8}

OCCUPATIONAL AND ENVIRONMENTAL VULNERABILITY IN THE INFORMAL WORKFORCE

The reviewed studies repeatedly showed that occupational and environmental risks were closely linked in slum populations. For many women in the informal workforce, the workplace and the home were not separate exposure zones. A woman could spend part of the day in a polluted slum dwelling, then move into waste-related work, roadside labour, or domestic work in another exposed setting, and then return to the same poorly ventilated home. Because of this overlap, the burden of illness described in the included studies should be understood as cumulative. It was not simply a matter of one bad workplace or one unhealthy kitchen. The problem was continuous exposure across the day.^{1,3,4,8} The major exposures and vulnerable subgroups identified in the included studies are summarized in Table 3.

Table 3: Major exposures and vulnerable subgroups reported in included studies

References	Primary exposures identified	Exposure type	Reported risk estimates or key exposure findings	Vulnerable subgroup identified
Arora et al¹	Ambient air pollution, biomass fuel use, tobacco smoking, overcrowding, poor ventilation, long duration of residence	Environmental and household air pollution	Smoking was associated with abnormal forced expiratory volume in 1 second (odds ratio 4.619, 95% confidence interval 1.075–19.851). Women residing for more than 15 years had higher odds of abnormal forced expiratory volume in 1 second. Among biomass fuel users, abnormal forced expiratory volume in 1 second was 20.4% and abnormal forced vital capacity was 31.8%.	Adult slum women aged 18–59 years, mainly from lower socioeconomic groups, many cooking inside poorly ventilated homes.
Lakshmi et al²	Biomass fuel combustion, indoor kitchen, smoker in family, family tuberculosis history, illiteracy	Biomass and indoor air pollution	Biomass fuel versus liquefied petroleum gas: unadjusted odds ratio 2.33; adjusted odds ratio 3.14. Family tuberculosis history increased risk.	Adult women, mostly housewives, many from slum areas, with low literacy and low income.
Uplap et al³	Waste handling, dumpsite work, poverty, addiction, anemia, long work duration	Occupational and socioeconomic	Morbidity differed significantly by work area (chi-square 27.8, $p < 0.001$). Mean duration in ragpicking was 20.04 years. Addiction history was present in 67.26%. Most participants were anemic.	Women ragpickers, especially street-side and dumpsite workers, from lower socioeconomic groups.

Continued.

References	Primary exposures identified	Exposure type	Reported risk estimates or key exposure findings	Vulnerable subgroup identified
Ray et al⁴	Unsegregated solid waste and biomedical waste, no protective devices, bare-hand waste contact, long daily exposure, poor hygiene	Occupational and environmental	Odds ratio for lower respiratory symptoms was 3.10. Odds ratio for lung function impairment was 2.49. Lung impairment was seen in 81% with more than 5 years of work versus 41% with 5 years or less.	Ragpickers with long occupational exposure and no protective devices.
Barua et al⁵	Advanced age, illiteracy, financial dependence, low socioeconomic status, living alone	Socioeconomic and age-related	Living arrangement was the only factor significantly associated with health-seeking behavior (chi-square 6.28, p=0.043). Financial dependence was 64.8%.	Elderly slum residents, especially women, widowed or dependent elderly, and those living alone.
Yogesh et al⁶	Older age, female sex, widowhood, no formal education, lower socioeconomic status, physical inactivity, lack of social support, poor health literacy, limited healthcare access	Socioeconomic, age-related, and behavioral	Older age, female sex, widowhood, no formal education, lower socioeconomic status, physical inactivity, lack of social support, and limited healthcare access all increased the likelihood of multimorbidity. Higher health literacy was protective.	Older adults aged 65 years and above in urban slum, especially women, widowed, inactive, less educated, and those with poor access.
Ghosh et al⁷	Advancing age, poverty, non-literacy, widowhood, unemployment, slum residence	Socioeconomic and age-related	Multimorbidity prevalence was 95.8%. All oldest-old women had two or more morbidities. Mean number of morbidities was 5.74±2.61.	Slum-dwelling older women, especially oldest-old, widowed, non-literate, and economically deprived.
Banerjee et al⁸	Poor housing, lack of toilets, indoor air pollution from solid fuels, no separate kitchen, low income, poor physical access to government care.	Environmental and socioeconomic	Twenty-five percent reported the nearest government facility was more than 5 km away versus 3% for private practitioner. Dissatisfaction was higher with government care than private care. Indoor air pollution exposure was 35% overall.	Slum dwellers and rural poor living in poor housing, low-income families, and undernourished households.

Among the reviewed papers, ragpickers were the clearest example of occupational vulnerability. In Mumbai, women ragpickers worked in conditions marked by mixed waste exposure, low wages, addiction, poor nutrition, and absence of structured occupational protection. Morbidity differed significantly by area of rag collection, suggesting that the nature of exposure mattered.³ In Delhi, ragpickers handling unsegregated municipal and biomedical waste had markedly higher respiratory symptoms, impaired lung function, skin problems, frequent diarrhea, and evidence of airway inflammation. The study also described lack of gloves, masks, and proper footwear, with many workers using bare hands while collecting waste. This is important because it shows that the health burden was not only due to poverty in general. It was tied to the specific conditions of informal waste work.⁴

Environmental exposure in slum settlements added another layer. In the Delhi women's study, the residential area was already surrounded by major pollution sources, including traffic and nearby industrial activity. Many women cooked inside the living room, ventilation was poor, and exposure to biomass fuel still existed in a section of households. So even before occupational work was considered, there was a substantial baseline respiratory load. When such home exposure is added to physically demanding and unprotected work, the chance of long-term respiratory and infectious problems becomes greater.¹ The Maharashtra assessment also showed poor housing, lack of sanitary toilets, no separate kitchen in many households, and indoor air pollution from solid fuels, again indicating that environmental disadvantage was built into daily life.⁸

The included studies on older adults also help in understanding vulnerability from a longer time perspective. In Gujarat and Kolkata, older slum residents, especially women, carried heavy multimorbidity burdens linked with poverty, widowhood, low literacy, and weak social support. Though these studies were not occupational surveys in the same way as the ragpicker papers, they suggest what may happen after years of living and working in deprived conditions. Respiratory disease, weakness, musculoskeletal complaints, and cardiovascular problems appeared together rather than separately. This pattern supports the idea that vulnerability in the informal workforce is not only immediate. It accumulates over time and becomes more visible in later life.^{6,7}

Another point that comes out from the literature is that informal work rarely offers social protection. The ragpicker studies described workers without formal employer accountability, without occupational health monitoring, and without reliable safety measures. In such conditions, even common illness can become prolonged because rest, treatment, or temporary loss of work all carry economic cost. This makes exposure more dangerous. A worker continues in the same hazardous setting while already symptomatic, and the illness then becomes chronic or recurrent. That cycle is one of the main reasons why occupational and environmental vulnerability in slum women should be viewed together rather than separately. The workplace generates exposure,

but poverty and lack of protection keep that exposure active.^{3,4} Overall, the reviewed evidence suggested that women in the informal workforce were affected by a double burden.

They were exposed to harmful environmental conditions at home and unsafe occupational conditions outside it. In many cases the same woman was also the main cook, caregiver, and income earner. This made respiratory illness, infection, and delayed recovery more likely. Thus, occupational and environmental vulnerability in urban slums should not be treated as two separate themes. In the reviewed studies, they were part of the same everyday reality.^{1,3,4,8}

SOCIAL DETERMINANTS AND BARRIERS TO HEALTHCARE ACCESS

The reviewed studies showed that illness in slum populations was shaped as much by social conditions as by direct exposure. Low income, illiteracy, widowhood, dependence on family, poor housing, and weak social support repeatedly appeared in the included papers. These were not merely background variables. They influenced when symptoms were noticed, whether treatment was sought, and how long illness continued before care was taken.^{5,8} The social vulnerability indicators, healthcare barriers, and policy gaps reported in the included studies are summarized in Table 4.

Table 4: Social vulnerability, healthcare barriers, and policy gaps reported in included studies

References	Social vulnerability indicators	Healthcare access barriers	Health-seeking behaviour	Policy or intervention gap identified
Arora et al¹	Slum residence in highly polluted area; high illiteracy; majority from lower socioeconomic groups; cooking inside living room was common	Poor household ventilation and combined indoor and outdoor exposure; no routine community lung screening reported.	Women were primary cooks and many also worked outside home, increasing cumulative exposure.	Cleaner fuel access, improved kitchen ventilation, and community lung function screening.
Lakshmi et al²	Low income, illiteracy, biomass dependence, overcrowding, household smoke exposure	Indoor kitchen, smoker in family, and family tuberculosis exposure increased risk.	Mostly housewives and primary cooks, with prolonged exposure to biomass smoke	Cleaner cooking fuel, separate kitchens, and linkage of tuberculosis control with household air-pollution reduction.
Uplap et al³	Poverty, no formal employer, anemia, addiction, early marriage, workplace harassment	Visiting hospital meant loss of wages; no occupational health cover; nongovernmental organization support was central.	Municipal hospital was preferred by 42.9%; some used traditional care or home remedies.	Recognition of ragpicking as occupation, provision of protective equipment, social security, and regular occupational health services.

Continued.

References	Social vulnerability indicators	Healthcare access barriers	Health-seeking behaviour	Policy or intervention gap identified
Ray et al⁴	Illiteracy, poor income, no protective devices, unsafe landfill work, poor hygiene, long work hours	No occupational monitoring or organized protection; exposure to unsegregated waste including biomedical waste	Long-term waste work under unsafe conditions; meals were often taken without proper handwashing.	Strict waste segregation, enforcement of protective devices, health surveillance, and safer waste disposal systems.
Barua et al⁵	Financial dependence, widowhood or separation, living alone, lower socioeconomic status, female illiteracy	Lack of money, distance, no escort to hospital, and belief that illness was age-related	Among elderly with morbidity, 83.7% sought treatment; government facility use was 48.7%; self-medication was common.	Slum-based geriatric services, affordable medicines, and outreach to elderly living alone.
Yogesh et al⁶	Multimorbidity, low education, physical inactivity, low social support, limited healthcare access	Distance, inability to pay, transport problems, and lack of social support	Poor health literacy and lower social support were linked with worse multimorbidity burden.	Integrated geriatric primary care, health-literacy programmes, and financial or social support for older adults.
Ghosh et al⁷	Non-literacy, widowhood, unemployment, low expenditure, slum residence, oldest-old vulnerability	Under-diagnosis and lack of awareness were acknowledged; multimorbidity burden was complex	Care needs were likely fragmented and reactive rather than integrated.	Patient-centred multimorbidity care, integrated community models, and improved geriatric support in slum areas.
Banerjee et al⁸	Poor housing, lack of toilets, low income, undernutrition, indoor air pollution	Long waiting time, affordability, poor quality, inconvenient timing, and distance	More than 60% sought private care for own illness; 74% used private care for child illness.	Strengthening public primary care, better drug availability, and improvements in water, sanitation, and access.

Among elderly slum residents, financial dependence and social isolation were especially important. In the Assam study, many elderly participants were fully dependent on family, some were living alone, and living arrangement was the only factor significantly associated with health-seeking behaviour. Lack of money, distance from health services, absence of someone to accompany the patient, and the belief that illness was simply part of ageing were all reported as reasons for not seeking care. This is important because it shows that delayed treatment in older people was not always due to negligence alone. It was often tied to practical dependency and social position within the household.⁵ The Gujarat study added another dimension by showing that lower education, poor health literacy, physical inactivity, weak social support, and limited healthcare access were all linked with multimorbidity in older adults living in urban slums. In

that study, health literacy appeared protective, while limited access increased the likelihood of multimorbidity. This matters because low literacy and poor support do not just affect knowledge. They also reduce confidence in seeking early care, understanding treatment, continuing follow-up, and managing multiple illnesses over time. Thus, healthcare barriers in slums were not only geographical or financial. They were also informational and social.⁶

The Kolkata study among older slum-dwelling women showed a similarly difficult social context, with high non-literacy, widowhood, unemployment, and low monthly expenditure. The authors also noted that under-diagnosis and under-reporting of morbidities may occur because of inappropriate health-seeking and lack of awareness. This is important in elderly women because disease may

remain unrecognized until it becomes severe or functionally disabling. In a setting where multiple illnesses are already common, delayed diagnosis makes the burden still heavier.⁷ Healthcare access barriers were even more directly described in the Maharashtra rapid assessment study. That paper reported poor housing, lack of sanitation, indoor air pollution, and a clear preference for private care despite financial hardship. Waiting time, affordability, poor quality of care, inconvenient timings, and distance were all identified as barriers to government health services. People living in slums and nearby poor areas were therefore not simply choosing private treatment by preference alone. In many cases they were moving away from public services because those services were difficult to access or unsatisfactory to use. This has obvious consequences for chronic respiratory disease, tuberculosis, and recurrent infection, because delays and fragmented treatment become more likely in such a system.⁸

Similar patterns were seen in women ragpickers. In the Mumbai study, visiting hospital often meant losing daily wages, and municipal care was therefore reserved for more serious or chronic illness. Some women used traditional remedies or delayed care, while occupational health support remained absent. This shows how economic insecurity can directly shape treatment behaviour. A symptomatic woman may continue working because the cost of missing one day's earnings is too high. In such conditions, even a minor respiratory or infectious illness can become prolonged.³

Across the reviewed literature, the common message was clear. Social vulnerability and healthcare barriers were deeply intertwined. Women and older adults in slums were not only exposed to harmful environments; they were also less able to convert illness into timely and effective care. Poverty, low literacy, dependence, weak support, and dissatisfaction with public services all reduced the chance of early diagnosis and sustained treatment. Therefore, the healthcare problem in these populations was not merely shortage of facilities. It was a wider problem of access, acceptability, affordability, and social capacity to seek care at the right time.^{3,5-8}

DISCUSSION

The reviewed studies together suggest that infectious and respiratory health risk among elderly women in the informal workforce in urban slums is best understood as a layered problem rather than a single disease problem. Household smoke, ambient pollution, unsafe waste exposure, poor nutrition, overcrowding, low literacy, delayed care-seeking, widowhood, and weak health systems were not acting separately in the literature. They were repeatedly seen in combination. Because of this, the burden described in the reviewed papers was broader than simple prevalence of cough, tuberculosis, or chronic lung disease. It reflected a lived environment in which

exposure, vulnerability, and limited care were all linked.¹⁻⁸

One strong theme in the reviewed evidence was that respiratory risk began inside the household itself. The Delhi slum study showed altered lung function and respiratory symptoms in women exposed to poor ventilation, smoke, and heavy surrounding pollution. The Chandigarh case-control study then extended this by showing a significant association between biomass fuel exposure and pulmonary tuberculosis. When read together, these two studies make an important point. In poor urban settings, household air pollution cannot be treated only as a source of discomfort or chronic irritation. It may contribute both to non-infectious respiratory impairment and to infectious respiratory disease. This gives household energy use a much more central place in public health discussion than it is often given.^{1,2}

Another major theme was occupational exposure. The ragpicker studies showed that unsafe waste work created a repeated respiratory and infectious burden through inhalation, skin contact, injuries, poor hygiene, and absence of protective devices. In women ragpickers, the burden also overlapped with anemia, addiction, early marriage, and irregular care. This combination is important because it shows that occupational risk in the informal sector is not only a matter of workplace hazard. It is intensified by low bargaining power, lack of formal employer responsibility, and the daily need to keep working despite illness. For women, especially those already socially and economically vulnerable, this produces a form of chronic exposure that is difficult to interrupt.^{3,4}

The elderly dimension adds another layer. The studies from Assam, Gujarat, and Kolkata showed that in later life respiratory problems and infections were often embedded within multimorbidity, dependency, widowhood, low education, and low social support. In older women, illness was therefore less likely to appear as a single disease with a clear treatment pathway. It was more often part of a cluster of weakness, chronic disease, repeated symptoms, and poor access to care. That helps explain why under-recognition is likely in such populations. When breathlessness, cough, body pain, poor mobility, and financial dependence all exist together, respiratory illness can remain under-treated for long periods.⁵⁻⁷

The reviewed studies also draw attention to healthcare behaviour. The barriers reported in Assam, Mumbai, and Maharashtra were not minor ones. Cost, distance, long waiting time, loss of daily wages, lack of escorts, and dissatisfaction with public care all affected treatment decisions. In elderly people, symptoms were also sometimes normalised as age-related. These findings suggest that delayed treatment in slum populations is not simply a matter of poor awareness. It is often a rational

response to difficult living conditions, weak social support, and limited trust in available services. This point matters because interventions based only on advice or awareness may fail if the practical barriers remain unchanged.^{3,5,8} At the same time, the literature reviewed here also has clear limitations. The included studies were heterogeneous in design, population, and outcome measures. Some were community-based, some occupational, and one was a case-control study focused specifically on tuberculosis. Not all studies were restricted to elderly women, and some included general slum populations or both sexes. Spirometry was available only in a few studies, while in others respiratory and infectious burden was based on symptoms, self-report, or clinical assessment. Because of this, direct comparison across studies is limited. Still, the broad pattern was consistent enough to support an overall interpretation: women living and working in slum settings faced compounded respiratory and infectious risk when environmental, occupational, and social disadvantages overlapped.^{1,2,5,6,8}

Finally, these reviewed evidence supports a practical interpretation. Infectious disease risk in elderly women of the informal workforce in urban slums is not only a biomedical issue and not only an exposure issue. It is also a structural issue. Clean household fuel, safer waste systems, basic occupational protection, better housing, community-based geriatric screening, and accessible primary care are all connected parts of the same response. When these remain fragmented, the burden continues to collect in the same vulnerable women over time.

CONCLUSION

The reviewed literature showed that infectious and respiratory health risks in urban slum settings were closely linked with poverty, unsafe living conditions, informal work, and weak access to care. Among women in the informal workforce, especially those exposed to household smoke or waste handling, respiratory symptoms, chronic lung disease, tuberculosis-related risk, and recurrent infections were repeatedly reported across studies. In older slum residents, these problems were further complicated by multimorbidity, widowhood, financial dependence, low literacy, and delayed treatment-seeking.

Overall, the evidence suggested that the burden in this population was not produced by one exposure alone. It emerged from the combined effect of indoor and outdoor air pollution, unsafe occupational environments, overcrowded and poorly ventilated homes, poor nutrition, low social support, and barriers to affordable and timely healthcare. Thus, elderly women in the informal workforce living in urban slums represented a particularly vulnerable group in whom respiratory and infectious risk was shaped by environmental, occupational, biological, and social disadvantage acting together. Focused attention toward clean household energy, safer informal work

conditions, improved primary and geriatric care access, and community-based support systems is likely to be important if this burden is to be reduced.

Future directions

Future research should give more direct attention to elderly women in the informal workforce, because most available studies included either broader slum populations or mixed age groups. More community-based studies with clear respiratory, infectious, and occupational outcome measures would help define the burden better. There is also a need for studies that combine clinical assessment with lung function testing, exposure history, and healthcare-use patterns in the same population. At the service level, the reviewed evidence points toward practical areas for action. Clean cooking fuel access, improved household ventilation, waste segregation, basic occupational protection for informal waste workers, affordable medicines, and outreach services for elderly women living alone or with poor support should be given priority. Better integration of respiratory screening, tuberculosis control, geriatric care, and community health education may be more useful than handling these issues as separate programmes. In slum settings, disease control is unlikely to improve fully unless the environmental and social conditions producing repeated exposure are addressed alongside medical care.

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