

Street vending and waste picking in developing countries: a long-standing hazardous occupational activity of the urban poor

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Uncontrolled urbanization in developing countries has led to widespread urban poverty and increased susceptibility to environmental exposures owing to the hazardous occupational activities of the urban poor. Street vending and waste picking are the dominant works undertaken by the urban poor, and besides the physical hazards, it also exposes them to several pathogens and high levels of air pollutants present in the outdoor environment. The situation has severe consequences for the health of the workers. Eliminating these occupational activities from the urban landscape of developing countries should therefore receive urgent attention from the global health community and governments. In this article, we provide evidence to support this policy recommendation by documenting exposure experiences of the workers, the associated adverse health effects, whilst also outlining measures for addressing the problem sustainably. We conclude that with the adoption of the sustainable development goals (SDG), governments now have a commitment to address poverty and the associated occupational health hazards experienced by the poor through their choices to help achieve the health-related SDG target (3.9) of substantially reducing the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination by 2030.

Keywords: Developing countries, Occupational activity, Street vending, Urban poor, Waste picking

Introduction

A major challenge in developing countries is uncontrolled urbanization and the accompanying urban poverty. The growth of cities of developing countries in both population and geography has led to the spread of urban poverty and inequality.^{1,2} Sub-Saharan Africa (SSA) is the most rapidly urbanizing region accompanied by increasing levels of poverty in urban areas. In SSA, about 40% of urban residents earn less than \$1/day, and approximately 70% earn less than \$2/day.^{1,3} The highest number of urban poor live in South Asia.¹ Of the world's urban residents earning less than \$1/day, close to half (46%) are found in this region.³

The urban poor face multiple challenges including limited employment opportunities, forcing many into informal employment, which hovers around 70% in economically developing countries.^{4,5} In SSA and South Asia, non-agricultural jobs including street vending and waste picking make up over 80% of the informal economy.⁶ According to

Asiedu and Agyei-Mensah,⁷ in developing countries, limitations to formal sector employment owing to national and global policy shifts and the increasing migration of rural dwellers to urban areas have led to increased street vending in urban areas. A synthesis of case studies on street vending conducted in six African cities reported that street vending is widespread, and the source of employment and income for many urban dwellers.⁸ da Silva et al. also report that unemployment and poverty coupled with proliferating amounts of solid waste, and a growing global market for recycled materials, have created conditions for rapid expansion of the work of collecting and selling trash in developing countries.⁹

The occupational activities of the urban poor expose them to physical hazards, pathogens, and environmental pollutants. According to World Health Organization (WHO),¹⁰ hazardous working conditions and substandard forms of employment result in considerable burden of ill-health and injuries, thereby presenting substantial costs to health systems and national economies as well as perpetuating poverty. There is therefore the need to eliminate street vending and waste picking from economically

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developing countries. This article provides evidence to support this policy recommendation by documenting exposure experiences and associated adverse health outcomes of the workers. The article is especially relevant as a result of the recent adoption of the sustainable development goals (SDGs). Long-standing hazardous occupational activities of the urban poor need the attention of the global health community and governments of developing countries. This paper provides sustainable suggestions for addressing the problem.

Exposure experiences of street vendors and associated adverse health outcomes

A systematic review summarizing the available evidence on ambient air pollution exposures among street vendors¹¹ reviewed 13 studies (Table 1) and found the workers to be exposed to high levels of several ambient (mostly traffic-related) air pollutants including polycyclic aromatic hydrocarbons (PAHs), benzene and other volatile organic compounds, particulate matter (PM), ozone, carbon monoxide, nitrogen dioxide (NO₂), sulfur dioxide, and lead at the vending site. The review reported that average benzene exposure levels among street vendors ranged from 32 to 83.7 µg/m³. Benzene is carcinogenic to humans and there is no safe level of exposure.¹² However, the concentration of airborne benzene associated with an excess lifetime leukemia risk of 1/10000 is 17 µg/m³.¹² Average PM_{2.5} exposure levels among street vendors were 70.94 µg/m³, exceeding the WHO 24-h PM_{2.5} air quality guidelines of 25 µg/m³. The review reported PAH exposure levels among street vendors to be 103 µg/m³ (10,3000 ng/m³). Some PAHs are potent carcinogens with the most potent being benzo[a]pyrene (BaP). There are no guidelines for PAH, but according to WHO,¹² the concentration of BaP producing excess lifetime cancer risk of 1/10000 is 1.2 ng/m³. The review also reported elevated urinary PAH metabolites (1-hydroxypyrene).

Regarding associated adverse health effects, the review¹¹ reported that studies evaluating biomarkers of early biologic effects observed levels of DNA adducts and highly DNA-damaged cells among street vendors to be significantly high. The review indicated the studies are suggestive of possible development of diseases such as cancer later in life among the workers. According to the review, street vending was also associated with increased risk of sore throat, cold, cough, eye irritation, dizziness, hearing impairment, and musculoskeletal problems. Adverse reproductive outcomes including infertility, miscarriage, low birth weight, and preterm birth have also been reported among street vendors.^{13,14}

Exposure experiences of waste pickers and associated adverse health outcomes

A systematic search of PubMed and Scopus databases identified six studies^{15–20} that provide evidence of the environmental exposures and associated common illnesses of

waste pickers (Table 2). Four studies^{15–18} found waste pickers to be exposed to several pathogens including Hepatitis A virus, *Toxoplasma gondii*, *Bacillus spp.*, *Clostridium spp.*, *Enterobacter spp.*, and *Escherichia coli*. Two studies^{19,20} found waste pickers to be exposed to high levels of ambient air pollutants including PM, NO₂, and heavy metals. Three studies^{17,18,20} reported high occurrence of respiratory symptoms, skin allergies, asthma, and injuries among waste pickers. Impaired lung function among waste pickers was noted by two studies.^{18,19} Waste pickers also inhale methane, hydrogen sulfide, and other noxious gases generated from decomposing waste materials. At the same time, waste pickers often do not wear personal protective equipment and frequently use their bare hands and feet for scavenging. This habit exacerbates their exposure experiences. In one study,²⁰ more than half (56%) of the waste pickers reported never wearing gloves during their work.

E-waste recycling is also increasingly becoming an important source of livelihood for the urban poor in developing countries, notably West Africa. This is as a result of the continual importation of discarded electronic and electrical appliances in Europe and North America into these countries. E-waste recyclers are exposed to high levels of dust and fumes containing heavy metals and organic pollutants generated through the application of rudimentary techniques such as manual dismantling of appliances and open burning of circuit boards and cables to recover precious metals and other valuables. Studies in Ghana²¹ and India²² found significantly high levels of antimony, cadmium, copper, silver, lead, iron, and bismuth in urine and hair samples of e-waste recyclers. Another study conducted in Ghana²³ reported significantly high levels of urinary 1-hydroxypyrene (1-OHP) among e-waste recyclers. This study further observed high occurrence of allergies and respiratory illnesses, skin infections, injuries, and several other illnesses among e-waste recyclers.

Way forward

The urban poor of developing countries are often migrants and hence curtailing migration of rural dwellers to urban areas is the surest way of addressing urban poverty and its associated public health concerns. This requires that employment opportunities are created in rural areas through industrial and agricultural development. Significant financial commitment is needed for such transformation of rural areas and can be achieved through the creation of an enabling environment by both central and local governments to attract local investors. This can include provision of tax incentives and facilitating access to land and property. Foreign investors could also be attracted, an option often considered by governments in economically developing countries as part of their developmental agenda. This consideration, however, runs the risk of disempowering local communities and further perpetuating poverty, inequality, and migration. One reason is the disregard for provision of healthy working conditions and payment of fair wages

Table 1 Ambient air pollution exposure experiences of street vendors and associated adverse health outcomes.

Author (Ref)	Location	Study design	No. of subjects	Exposures	Main results
Han ²⁴	Trujillo, Peru	Environmental monitoring	8	PM _{2.5} , CO, VOCs	Highest CO exposure (11.4 ppm) recorded among newspaper vendors
Tovalin-Ahuma ²⁵	Mexico City and Puebla, Mexico	Environmental monitoring	4	VOCs	Median toluene, MTBE, <i>n</i> -pentane, and <i>m</i> and <i>p</i> -xylene exposure levels of 112, 41, 48, and 34 µg/m ³ , respectively.
Tovalin ²⁶	Mexico City and Puebla, Mexico	Environmental and bio-monitoring	4	VOCs, PM _{2.5} , O ₃	Median VOCs (about 30), PM _{2.5} and O ₃ exposure among outdoor workers including street vendors was higher (at least 2.5-fold) than among office workers In Mexico city, street vendors had higher percentage of highly DNA-damaged cells compared to office workers (77% vs. 21%).
Ruchirawat ²⁷	Bangkok, Thailand	Environmental and bio-monitoring	72	PAHs, Benzene	Roadside PAH levels ranged from 7.10 to 83.04 ng/m ³ and were about 4–13 times higher than levels in temples (500 m from the roads) and schools. Roadside benzene levels ranged from 16.35 to 49.25 ppb with levels in temples ranging from 10.16 to 16.25 ppb. Mean PAH and benzene exposure levels were significantly higher (<i>p</i> < 0.001) in street vendors compared to controls (monks/nuns, primary school children). Urinary 1-OHP levels were significantly higher in street vendors than in controls (<i>p</i> < 0.01) Office workers had significantly (<i>p</i> < 0.022) lower mean blood Pb levels (2.1 ± 0.7 µg/dL) than all traffic-exposed workers including street vendors (3.2 ± 1.8 µg/dL) Mean exposure levels among street vendors were high (83.7 ± 45.0 µg/m ³) compared to office workers (45.2 ± 13.3 µg/m ³)
Naehe ²⁸	Trujillo, Peru	Biomonitoring	3	Lead	Mean benzene exposure levels among street vendors (77 µg/m ³) were higher than among office workers (44 µg/m ³). A similar trend was observed for ethylbenzene, <i>m</i> - <i>p</i> -xylene and <i>o</i> -xylene.
Meneses ²⁹	Mexico City, Mexico	Environmental monitoring	8	Benzene	Blood benzene levels (beginning and post-shift) for street vendors were significantly higher than levels of office workers
Romieu ³⁰	Mexico City, Mexico	Environmental and bio-monitoring	8	Benzene and other VOCs	Roadside levels ranged from 15.49 to 65.70 ppb with mean of 33.71 ppb and were significantly higher (<i>p</i> < 0.05) than mean ambient levels in temple areas (12.39 ppb).
Navasumrit ³¹	Bangkok, Thailand	Environmental and bio-monitoring	43	Benzene	Exposure levels in street vendors (cloth, 22.61 ppb; grilled-meat, 28.19 ppb) were significantly higher (<i>p</i> < 0.05) than in monks/nuns (12.95 ppb) Urinary t,t-MA levels were significantly higher in street vendors than in monks/nuns (<i>p</i> < 0.05). Exposure levels among street vendors were 130 µg/L and were higher than controls 24-h mean PM _{2.5} level was high (70.94 µg/m ³). Concentrations of the other pollutants were very low
Arewgoda ³² Kongtip ³³	Colombo, Sri Lanka Bangkok, Thailand	Biomonitoring Panel study, Environmental monitoring	26 77	Lead PM _{2.5} , CO, VOCs, NO ₂ , O ₃ , SO ₂	8-h mean CO concentration from fixed sites was 26.2 ppm (range: 13–44 ppm) 3-min mean CO levels: street center (20.1–45.3 ppm), pavement (East/North, 19.5–30.7 ppm; West/South, 15.2–31.8 ppm) Personal CO exposure among street sellers was estimated at 12.0–23.5 ppm with a corresponding 1-h maximum COHb level of 2.4 to 4.9%. Exposure levels were 32 µg/m ³
Fernandez-Bremauntz ³⁴	Mexico City, Mexico	Environmental monitoring	173	CO	Mean ambient benzene and PAH concentrations were 76.0 µg/m ³ and 103 µg/m ³ , respectively. Urinary 1-OHP and phenol were significantly higher (<i>p</i> < 0.001) in all the exposed groups including street vendors (>200 µg/g and 155.5 µg/g, respectively) compared to controls (<5 µg/g and >14 µg/g, respectively) Mean DNA adduct levels were also significantly higher (<i>p</i> < 0.001) in all the exposed groups (>23) compared to controls (<3)
Lan ³⁵	Ho Chi Minh, Vietnam	Environmental monitoring	1	Benzene	52% of the respondents indicated that the working environment was not comfortable for reasons ranging from lack of shelter and dirt, noise, and having to clean the area themselves.
Ayi-Fanou ³⁶	Cotonou, Benin	Environmental and bio-monitoring	16	PAH, Benzene	54% of the respondents reported some form of illness or injury related to their work. 22% of the women were infertile with experience of miscarriages reported by 14% of the women. 177 g (95% CI: 324, 31) reduction in birth weight and 35% (RR = 1.35; 95% CI: 0.87, 2.12) increased risk of LBW among street vendors
Pick ¹³	Johannesburg, South Africa	Cross-sectional	422	Environmental conditions	
Amegah ¹⁴	Accra, Ghana	Cross-sectional	105	Traffic-related air pollution	

Source: Amegah¹¹.

Table 2 Environmental exposure experiences of waste pickers and associated adverse health outcomes.

Author (Ref)	Location	Study design	No. of subjects	Exposures	Main results
Soares ¹⁵	Goiânia, Central Brazil	Seroprevalence survey	431	Hepatitis A virus	Almost all (99.5%) of the participants tested positive for total anti-Hepatitis A virus antibodies
Alvarado-Esquivel ¹⁶	Durango city, Mexico	Seroprevalence survey	90	Toxoplasma gondii	21.1% of the waste pickers tested positive for anti-T. gondii IgG antibodies.
Chandramohan ¹⁷	Tiruchirappalli, Southern India	Cross-sectional, Environmental monitoring	65	Pathogens	Several bacteria and fungi species were identified in waste samples. 40% of the participants suffered from skin allergies, another 40% from a mixture of illnesses, 15% from asthma, and 5% from whooping cough.
Ray ¹⁸	Delhi, India	Cross-sectional	98	Pathogens, TSP	TSP levels at landfill sites where the rag pickers scavenged were 559–2082 µg/m ³ Rag pickers reported higher frequency of upper (75.5% vs. 46.7%) and lower (81.6% vs. 43.3%) respiratory symptoms and had significantly lower spirometric values ($p < 0.001$) compared to controls Rag picking was associated with increased risk of lower respiratory symptoms (Adjusted Odds ratio [AOR] = 3.10; 95% CI: 1.09–9.64) and lung function impairment (AOR=2.49; 95% CI: 0.97–6.37). Toxic granulation of neutrophils was found in all the rag pickers as against 57% of controls. Leukocytosis with elevated number ($p < 0.05$) of eosinophils and monocytes was recorded in 26% of rag pickers as against 8% of controls. Levels of fine particles were considerably higher at the dump site than in reference areas (Average PM _{2.5} : 70–1600 vs. 40–115 µg/m ³). NO ₂ concentration was substantial in all dump areas (100–230 µg/m ³). PM _{2.5} exposure was estimated at 11,000–35,000 and 5000 µg/m ³ per week for waste pickers and controls, respectively. Wheeze and upper respiratory infection were more prevalent in waste pickers than in controls. Highly exposed waste pickers were at increased risk of wheeze compared to controls (OR=3.28; 95% CI: 1.55, 6.95) Mean IgE levels were slightly higher in waste pickers than controls (0.18 vs. 0.15 IU/l). PM ₄ exposure among informal waste recyclers was significantly higher compared to controls (113 vs. 18 µg/m ³ ; $p = 0.0006$) Neighborhood PM ₄ level was 10 µg/m ³ . Levels of Cr, Co, Ni, Cu, Zn, As, Pd, Cd, Hg, and Pb were typically 100-fold below OSHA permissible exposure limits. Formal waste recyclers reported fewer illnesses compared to informal waste recyclers. Cold, flu, and rheumatism were the most common illnesses reported.
Hernández Romero ¹⁹	Managua, Nicaragua	Cross-sectional, Environmental monitoring	103	Particles (TSP, PM ₁₀ , PM _{2.5}), NO ₂	
Cunningham ²⁰	Asunción, Paraguay	Cross-sectional, Environmental monitoring	102	PM ₄ , Heavy metals	

and salaries by foreign investors. Monopolistic tendencies of foreign investors are another reason. Governments must therefore ensure that foreign investors abide by the country's business and labor laws, and also guard against the temptation to favor them over local investors.

In rural areas of many developing countries, farming is often the only means of livelihood of the indigenes. However, farming is increasingly becoming an unattractive venture for many rural dwellers owing to issues with transport and poor roads in rural areas, a situation that frustrates attempts to haul farm produce to market centers. Large quantities of farm produce spoil as a result, at a large cost to farmers. The non-availability of a ready market also compels farmers to sell their produce at unreasonably low prices to cut post-harvest losses and very often they are unable to offset production cost. Building agro-processing industries in rural areas will help develop immediate and fair markets for farmers and possibly serve as a motivation for farming.

The numerous non-governmental and community-based organizations operating in rural areas also have a major role to play through sensitization of rural dwellers about the socioeconomic and health implications of migration to urban areas. These organizations should run vocational training programs to equip rural dwellers with ideas and skills for undertaking productive ventures locally. Governments and their development partners should make funds available to these organizations to undertake such activities in rural areas. Governments should also consider empowering these organizations to serve as fair trade cooperatives in rural areas to help facilitate farmers access to market and also advocate better trading conditions and fair prices on their behalf.

The urban poor are mostly uneducated or have low educational attainment. Education is widely viewed as a powerful tool for poverty alleviation as it provides individuals with the requisite knowledge and skills to improve their livelihoods. Governments of developing countries should therefore expand access to and improve quality of education at the basic level. This should help address widespread educational inequalities in these countries and reduce poverty levels. Through education, rural dwellers are likely to acquire basic entrepreneurial skills to set up micro-enterprises to improve their livelihoods. Those still content on migrating to urban centers can also have some form of employable skills to seek decent employment.

Rural banks and microfinance schemes are plentiful in developing countries with the mandate to reduce poverty through granting of small loans to credible individuals to set up business ventures or expand existing operations. However, the overly rigid demands of these financial institutions for landed properties predominantly as collateral have resulted in these institutions making very little impact in alleviating poverty and curbing rural-urban migration. Going forward, these financial institutions should investigate alternative means of securing their small loan

schemes to reach out to individuals most desiring their services. For instance, a farmer or prospective farmer seeking for a loan could use the farm produce as collateral with the farm being closely monitored by the loan institution.

In conclusion, with the adoption of the SDG, governments are committed to addressing poverty and the associated occupational health hazards experienced by the poor through their choices to help achieve the health-related SDG target (3.9) of substantially reducing the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination by 2030.

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