

*Full Length Research Paper*

# Exposure, protection and self-reported health problems among solid waste handlers in a Coastal Peri-urban community in Ghana

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**Mixed method design was used to investigate exposure to waste, use of personal protective gear (PPG), and self-reported health problems among 280 solid waste handlers in a peri-urban township of southern Ghana. From the survey, the most commonly reported health problems were bodily pains (56.4%), headache (38.6%) and fever (35.7%). In-depth interviews highlighted eye problems, stomach pains and non-specific symptoms such as stress and tiredness. Waste handlers whose bare hands were exposed to waste had a higher likelihood to report fever [odds ratio (OR) = 1.89 (95% C.I 1.37 – 2.56),  $p < 0.0001$ ] and diarrhoea [OR = 6.25 (95% C.I 4.17 – 10.00),  $p < 0.0001$ ] compared with those who used rubber gloves. Similarly, waste handlers with uncovered mouth/nose had higher likelihood to report cough than those who used mouth/nose cover [OR = 7.69 (95% C.I 4.00 – 14.29),  $p < 0.0001$ ]. Waste handlers who did not use PPGs consistently cited reasons including physical discomforts, impracticalities of wearing them in hot/humid conditions, inability of employers to supply or to finance PPGs. Waste handlers need affordable and suitable protective gear to reduce risk to health as well as the provision of water and soap to promote personal hygiene at work. Employers must educate and train waste handlers on disease preventive purposes of using PPGs.**

**Key words:** Solid waste handlers, mixed method, exposure, protection, health problem, Peri-urban.

## INTRODUCTION

Population densities in urban areas are increasing worldwide and so are the solid wastes generated. In many less developed countries, e.g. Ghana, waste handlers are occupied with the removal of large volumes of different types of contaminated waste, often by hand as they have limited access to appropriate waste removal technology (McGregor et al 2011; Amoateng et al., 2013). These waste handlers are therefore exposed to several

health hazards which occur throughout the waste management chain, from collection to final disposal. Solid waste handling is therefore generally considered to be an occupation which presents substantial health risks (Kitsantas et al., 2000).

The magnitude of work related health problems may be influenced by an individual's level of protection and exposure (Mutha et al., 1999). Common ways to reduce exposure to health problems in waste handling include the use of personal protective gear (PPG) (Tjoe Nij et al., 2003). The use of proper PPG may prevent direct physical contact of waste handlers with solid waste, which

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often is faecally contaminated, and also prevent cuts and injuries during waste handling activities.

Previous studies have described health effects among solid waste handlers and found health problems including bodily pains (Norman et al 2013), eye, skin, and gastrointestinal problems that were associated with solid waste handling (Dorevitch and Marder, 2001; Rushton, 2003).

However, type and magnitude of health problems are likely to be influenced by culture and behaviour within local contexts under which waste handlers work (Whitelaw et al., 2001; Tate et al., 2003; Gutberlet, 2008). Even though there is available information on health problems faced by waste handlers in North America (Rendleman and Feldstein, 1997) and Brazil (Gutberlet *et al.*, 2013), there is limited published research on health problems among waste handlers in Ghana with none focusing on those in peri-urban communities. Existing studies on solid waste management in Ghana have focused mainly on nuisance aspects of solid waste pile-up due to poor management (Fobil et al., 2008; Ampofo, 2013) and not direct health hazards that solid waste handlers are exposed to, including associated health outcomes.

Nonetheless, the information about health problems is important to gain insight into the types of public health measures that would curb the impact of these health problems among solid waste handlers in peri-urban communities, in less developed countries.

This study therefore aimed to describe different waste handling activities and self-reported health problems among solid waste handlers, including physical exposures and protection in a peri-urban community in southern Ghana.

## **MATERIALS AND METHODS**

Waste handlers were defined as those who either worked for waste management companies and institutions or as volunteers directly handling waste materials along the waste management chain. The waste managed included solid waste; solid waste mixed with fresh and decomposed human excreta or effluents from domestic waste pipes and sludge from tanks emptied into open drains.

### **Study Area and Design**

This cross-sectional study was conducted in a coastal and peri-urban community located in the Dangme West District, in the southern part of Ghana. A mixed method design (Ulin et al 2005; McBurney and White 2009) including observations, in-depth interviews and a questionnaire were used to collect data on exposure to waste, personal protection and self reported health problems.

### **Observations**

The types of protective gear worn, (e.g. over-all gowns, nose/mouth cover, gloves, Wellington boots etc.) and parts of body of waste handlers exposed to waste whilst working were observed. Waste sites observed included open drains by the road-sides, around ponds, dumping sites, beaches, around waste containers, public toilet facilities and other open spaces within the peri-urban communities where waste was disposed, collected and handled. The observations were systematically recorded using observational guides and into field notes.

### **Questionnaire Administration**

All the 280 waste handlers identified based on their activities, were interviewed using a close-ended questionnaire comprising twenty (20) questions. The questionnaire was adopted from Mbeng et al (2009) and Ifegbesan (2010) and modified within the context of the current waste handling practices at the study site. Information was collected to classify and describe types of activities undertaken and to determine the type and level of exposure to waste as well as self reported health problems among waste handlers. The waste handlers were identified and questioned on the site where they carried out waste work.

### **In-depth interviews**

In total 22 waste handlers, representing a diversity of all the different types of waste workers, were interviewed with the purpose of understanding their work conditions, perceptions of common health problems, and the use of Personal Protective Gear (PPG). A face-to-face in-depth interview approach was adopted to allow an open communication which could expand on some of the observations made at the waste sites (Sturges & Hanrahan 2004). The in-depth interviews were conducted in a neutral venue away from the work place of waste handlers to create a relaxed interview atmosphere. Interviews were recorded using a digital audio device with each in-depth interview lasting between 45 minutes to one hour using a semi-structured interview guide.

### **Ethics Statement**

Ethical clearance was obtained from the Institutional Review Board of the Dodowa Health Research Centre, Ghana Health Service with review number (DHRC-IRB – STUDY NO.01/10/11).

### **Data Management and Analysis**

Survey interviews and in-depth interviews were all conducted by research assistants fluent in the local Dangme

language In-depth interviews were transcribed in the Dangme language by the research assistants on the day of the interviews and translated into full-text English. Thematic content analysis was conducted with an inductive approach (Elo and Kyngas 2008) and all transcripts were manually coded as well as summarized into emerging higher level themes. The main themes identified were; exposure of uncovered parts of body and the resulting risks to health, difficulties with using personal protection during waste handling, and commonly reported health problems.

After fieldwork, each questionnaire was checked for completeness before entering data into SPSS 17.0 for Windows 7 (SPSS, Inc., Chicago, IL.) to minimize errors and to validate the data. Double entry of data from questionnaire responses was done to ensure accuracy. Cross tabulations were used to compare the differences in responses among the different waste handlers. A logistic regression model was used to analyze the association between exposure (use of bare hands, uncovered mouth/nose); protection (use of gloves, mouth/nose cover, overall gown, Wellington boots) and reported health outcomes (including fever, diarrhea, cough, skin problems). The information obtained from the different data collection methods were triangulated to obtain an in-depth understanding of reported health problems.

## RESULTS

### Socio-Demographic Characteristics of Waste Handlers

The majority (76.1%; 213/280) of waste handlers were females and waste handlers had an overall mean age of 42.7 years, with a few (2.9%; 8/280) being children while the rest were old people above 60 years (8.9%; 25/280). Age range was 8-87 years. Waste handlers within the very young and old age groups worked at public toilet facilities as sweepers or collectors of human faecal matter but also as disposers of solid waste generated both within and outside the toilet facilities. Most (69%; 193/280) waste handlers had only basic level education. A majority (82.9%; 232/280) earned between 80 and 100 Ghana Cedis (GH¢) per month from waste handling (i.e. approximately USD 36-45), which was the main source of income for most waste handlers. This income was far lower than the average monthly per capita income in Ghana (GH¢ 225; about USD 117) (GSS, 2013).

### Waste Handling Practices

A high proportion (69.3%; 194/280) of waste handlers engaged in multiple tasks including sweeping, collection and disposal. Other waste handling activities were

sweeping only (18.2%; 51/280), collection only (4.3%; 12/280), disposing only (6.4%; 18/280) and transport only (1.8%; 5/280). Table 1 describes the specific waste handling activities.

### Exposed Body-Parts/Surfaces during Waste Handling

Observations conducted among waste handlers during work showed that most workers had bare parts of their bodies exposed to waste during most of their daily work time. This was in agreement with the results from the questionnaire survey that showed that in all groups of waste handlers, most (87.1%; 244/280) used bare hands to handle waste including all transporters (5/5), 91.8% (178/194) of workers performing multiple tasks, 88.2% (45/51) of sweepers, 83.3% (15/18) of disposers and 16.7% (2/12) of collectors. The survey further showed that 41.8% (117/280) of all waste handlers performed their work with uncovered mouth/nose. Observations again showed that pregnant and breastfeeding mothers also engaged in waste handling with uncovered mouth/nose, hands or feet. Few breastfeeding waste handlers (5.6%; 12/280) who brought their children to work, with no form of physical protection, also performed waste work whilst carrying the children at their back. Though these vulnerable groups of female waste handlers with their children were few, the possibility of reporting anaemia from hook worm infections and inhalation of organic dust among the children could be high.

### Association between Use of Uncovered Parts of Body and Self-Reported Health Outcomes

A logistic regression showed that waste handlers who used bare hands to perform multiple waste handling tasks in a day had significantly higher likelihood to report fever [odds ratio (OR) = 1.89 (95% C.I 1.37 – 2.56),  $p < 0.0001$ ] and diarrhoea [OR = 6.25 (95% C.I 4.17 – 10.00),  $p < 0.0001$ ] than those whose hands were covered with rubber gloves. Similarly, waste handlers who performed multiple waste handling tasks whose mouth and nose were uncovered during a day's activities had significantly higher likelihood to report cough than those whose mouth/nose were covered with nose/mouth cover [OR = 7.69 (95% C.I 4.00 – 14.29),  $p < 0.0001$ ].

During in depth interviews, waste handlers elaborated on the use of bare hands in waste handling and the reasons for not washing hands during and after carrying out their day's activities. A 55 year old male waste handler stated that; *"Sometimes I forget to wash my hands in a haste to eat when I am sweeping the gutter. May be I am very hungry and just want to eat something. Instead of taking my time to wash my hands with water, I say oh let me just finish this food quickly, this is nothing. But I have*

**Table 1.** Classification and description of waste handling activities identified.

Waste handling activity	Description
Sweeping	Using brooms to manually clean and gather wastes from streets, lorry park, beaches, gutters, sanitary facilities (public toilet facilities and dumping sites), waste receptacles, tricycles, around dumping sites and open spaces within the peri-urban communities such as the market place.
Collection	Using either bare or gloved hands, shovels, brooms, or rakes to pick or remove solid waste from beaches, public amenities, sanitary facilities (public toilet facilities and dumping sites), gutters, fresh water ponds, abandoned grave yards within the peri-urban communities. The waste materials were collected into solid waste receptacles or wheelbarrows and transported to landfill sites, buried or dumped into nearby bushes.
Transportation	Waste handlers who transported waste were tricycle drivers who used motor-powered tricycles with attached open tray/caravan for rear loading of solid waste from the peri-urban communities).
Disposal	Throwing or dumping collected solid waste into waste receptacles, landfill sites or 'unofficial' dumping sites along the beach, around fresh water ponds or in the bush. Waste disposal also involved burning or digging the soil to bury waste materials. Waste materials were usually disposed of in bulk without prior sorting or treatment.

*forgotten that whiles I was working in the gutter, some of the waste water splashed on me.... Even if I wash my hands, I use only water because there is no soap".* Observations also highlighted that access to water and soap for effective routine hand washing during work was limited; most waste handlers were part of a mobile work force and did not have access to a site with running water and freely available soap for hand washing before eating or after defecation.

### Use of and Knowledge about Personal Protective Gear

The questionnaire interview yielded information about the different types of Personal Protective Gear (PPG) which were used by waste handlers during work. Four types of PPGs were mentioned; namely overall gowns to cover the surface of the body (72.6%; 204/280), Wellington boots to cover the sole and feet (62.5%; 175/280), gloves to cover the fingers and palms up to the wrist (59.3%; 166/280) and mask to cover the mouth and nose (32.1%; 90/280). The use of gloves (91.6%; 11/12), overall apron (100%; 12/12) and Wellington boots (75.0%; 9/12) was significantly higher among collectors compared to sweepers, disposers, transporters and those who performed multiple waste handling tasks ( $X^2 = 77.996$ ;  $p < 0.0001$ ). Observations further showed that almost every waste handler who did not wear Wellington boots wore open "slippers" and sandals as footwear, or were barefooted.

In-depth interviews with the 22 waste handlers showed that two-thirds had only basic knowledge about the disease protective purpose of wearing PPGs. One 32-year old female sweeper said; *"Sometimes it is good that they train us how to use the safety gears because unless*

*we try to acquaint ourselves with its use, we can get the health problems in the near future".* A waste collector also explained: *"If we do not use the hand gloves... we can contract some of the health problems, like diarrhoea" (35 year old male).* Another waste handler iterated that: *"This is why we have to be given something to cover our nose to minimize the amount of dust that we inhale" (40 year old female waste handler who performed multiple tasks).*

### Barriers to using Personal Protective Gears

Contradicting the survey results, observations revealed that most waste handlers did not use PPGs consistently throughout a day's work. Waste handlers such as community waste volunteers, scavengers and night soil collectors did not have functional PPGs available.

In-depth interviews further sought to understand the main barriers to using PPGs. One reason mentioned was the inability to purchase PPG from personal funds. This was a problem for the group of waste workers who were not employed in official waste management companies including scavengers, night-soil-collectors, volunteer community waste handlers and private public toilet managers. These groups of waste handlers constituted approximately one fourth of all waste workers who were the poorest since they only received daily wages based on the waste they scavenged and sold, how many households they visited to empty latrines or how many customers used public toilet facilities. The volunteer waste handlers did not receive any salaries or allowances since they only performed waste handling activities occasionally as part of communal initiatives.

One night soil collector explained his inability to purchase PPG to use when he manually collected night soil into simple buckets, that were then transported and

disposed of by hand: *"If I am transporting the human faeces, I don't have anything to cover my nose....sometimes, what I use to protect myself gets spoilt and I don't have money to replace it"*. Though the use of bare hands in night soil collection would represent a very high exposure to faecal pathogens and the associated risk for oral transmission of disease among waste handlers involved, the risk of disease was paradoxically mainly associated with the bad smell of faeces.

Another reason for not using PPG was simply not having it. Once employed by a waste company, waste workers were supposed to receive PPG to perform their work. However, it was mentioned by all waste handlers, employed by waste companies, during in-depth interviews that PPGs were not supplied to all waste handlers. For waste handlers who were provided with PPGs, these were not replaced by the employer after protective gear became worn out. Waste handlers thus had to manage with torn PPGs that did not protect them well. A 32-years old female collector described the problems: *"When I use the nose cover today and fix it again for a period of time, sweat gets into it and then it brings out some bad smell and makes it uncomfortable to use"*. Thus discomfort in general was a major barrier to wearing PPG. A waste collector expressed his feelings of panting for breath when wearing nose masks: *"The nose cover causes us to pant for breath. There are some pores in the nose cover...Sometimes we begin to pant for breath, so we take it off at a point and continue to work"*(55-years old male waste collector).

Problems with using gloves and boots were also commonly mentioned in interviews. The problems stated were mainly related to experiences of skin becoming hot, humid or wet inside gloves and boots and developing into skin problems. A logic regression model to show association between the use of Wellington boots [OR = 2.0 (95% C.I 1.43 – 2.86),  $p < 0.0001$ ] and overall gown [OR = 2.94 (95% C.I 1.89 – 4.55),  $p < 0.0001$ ] among waste handlers showed significantly higher likelihood for those who performed multiple tasks to report physical discomfort than those who did not use them.

During an in-depth interview, one 55-years old male waste collector described the effects of using Wellington boots: *"For the boots sometimes, I contract foot rot when I use it for a long time"*. Wellington boots were also perceived as too heavy and unpractical to wear by everyone interviewed: *"For the wellington boots, once the feet keep so long in the boot, my foot becomes hot. It's very difficult wearing them, because the boot is heavy and walking in the sun, it's not easy"....* (A 37-years old male waste disposer). A 34-years old female sweeper had similar experiences with using gloves: *"The gloves...it's just that my fingers do not get enough air; they get wet. When I take my fingers from the gloves it feels as though it's from the cold store"*.

### **Types, Frequency and Perceived Cause of Self Reported Health Problems among Waste Handlers**

Different proportions of waste handlers reported various health problems which they linked to their occupation as

revealed in the different interviews. Even though some waste handlers reported health conditions that could be due to viral, bacterial or parasitic infections (such as fevers, diarrhoea, cough and skin disorders), the most common health problem reported in the interviews was bodily pains (56.4%; 158/280). Other health problems reported during questionnaire survey were headache (38.6%; 108/280), fever (35.7%; 100/280), feeling of discomfort (28.2%; 78/280), diarrhoea (11.4%; 32/280), dizziness (6.8%; 19/280), cough (8.9%; 25/280), skin disorders (5.4%; 15/280) and asthma (1.8%; 5/280). In addition, in-depth interviews with the waste handlers revealed that eye problems, stomach pains and non-specific symptoms such as stress and tiredness were common health problems.

### **Pains**

A high proportion (63.4%; 123/194) of waste handlers who reported bodily pain were those workers who performed multiple waste handling activities. A waste handler explained: *"After collecting the waste, I push the waste in the wheel barrow several times in the morning, to the dump site to dispose. I feel waist pains (setso yemi) and pains in my whole body"* (35-years old male waste handler performing multiple waste handling tasks). A 32-years old female waste handler who performed multiple waste tasks in a day also narrated her experience with bodily pains: *"In this waste work, I sweep, collect and dispose of the waste.... This disturbs me a lot. I suffer a lot of pain in my body and my waist. Previously I did not experience these body pains but since I started this work then the pain also started"*.

Field observations revealed that handling wastes was characterized by hard manual work. Apart from two motor-powered waste tricycles used to transport waste, waste handling equipments were all manually operated including physical dragging, pushing and pulling of waste containers, wheelbarrows etc. This hard physical work is likely to have resulted in reported bodily pains among waste handlers.

### **Other Perceived Causes of Self Reported Health Problems**

A high proportion (67.5%; 189/280) of waste handlers reported direct exposure of uncovered parts of body to waste as the main cause of their health problems, whilst 61.4% (172/280) reported that inhaling bad smell of waste was a major cause of their health problems. Other factors reported to be associated with health problems included; eating with dirty hands (45.7%; 128/280) and wearing dirty clothes for work (8.6%; 24/280). These things in combination with working outdoors under harsh conditions were also commonly explained as causing disease: *"I sweep and collect money by the waste container, mosquitoes bite*

*me and I get malaria (atlidii) and sometimes after standing in the sun then half of my head is aching very bad. I also experience like I want to vomit and my anus itches me (fito mi plɛmi)" (40-years old female waste handler who swept and collected money near waste container). One 35-years old female waste handler who collected human faeces from the beach each morning explained how this caused her health problems and discomfort: "The health problems come from the work we do...We handle human faeces and the bad scent gets into our nose. We get increase in abdominal pain as a result. This morning for example, there were lots of human faeces at the beach...and as we sweep, the bad scent then gets into us and gives me sickness."*

## DISCUSSION

Similar to research conducted in other parts of Africa, Getahun et al. (2012), Asia (Zhang et al., 2010) and Europe (Magrinho et al., 2006), our study showed that there were a range of different people engaged in waste handling activities in peri-urban communities to control and reduce the volumes of accumulating solid waste. The high proportion of females engaged in waste handling in these townships in southern Ghana is in agreement with the traditional perception of female dominance in waste handling in Ghana (Kadfak, 2011).

Though this study did not specifically investigate hookworm infections among female waste handlers, research conducted in Ghana has shown that females were more likely to report anaemia from occupation-related hookworm infections compared with males (Glover-Amengor et al., 2005; Humphries et al., 2011). The exposure of pregnant and breastfeeding waste handlers to waste may increase the likelihood of acquiring occupation-related hookworm anaemia among female waste handlers compared with males (Glover-Amengor et al., 2005; Humphries et al., 2011). Similarly, children of waste handlers who are brought to work may have reported higher prevalence of cough due to inhalation of organic dusts and associated pathogens, (Wouters et al., 2002; Park et al., 2011) compared with adult waste handlers. It is advisable for female waste handlers to take adequate protective precautions against hookworm anaemia, and to keep their children away from exposures to contaminated work environments in order to avoid cough and other airborne infections.

Waste handlers who are young (8 years) or old (87 years) may have been more susceptible to infections due to weak immune status. This may account for the observed significant positive association between age and self-reported fever in this study. It is known that Ghana, like many African countries, is endemic for many infectious diseases, which cause non-specific symptoms like fever. It is important for local government authorities in charge of waste management in rapidly urbanizing

communities to ensure that very young and old persons are excluded from waste handling activities at the community level, including public toilet facilities.

Widespread open defecation in peri-urban communities in southern Ghana, as reported by Asante and Oduro (2006), is a major health hazard for waste handlers who perform multiple waste handling tasks with their bare hands increasing the likelihood of contracting sanitation-related orally transmitted infectious diseases. The high rate of waste handlers reporting fever and diarrhoea with a significant positive association between such diseases and their exposure of bare (2001) showed that despite the rapid population growth and the associated increase in waste generation, it is still common for waste handlers to manually push, pull, lift or cart waste materials. Waste handlers in these areas were therefore prone to develop bodily pains, such as neck, wrist, lower and upper back pains from engaging in strenuous physical activities, as also reported by Quansah (2005), Kanchanomai et al., 2011; Abou-EIWaf et al., 2012; Thirarattanasunthon et al., 2012 and Norman et al., 2013). Even though bodily pain is known to be an inherent health problem for solid waste handlers (Poulsen et al., 1995), there is a need for use of improved waste handling equipment and correct ergonomic postures in carting heavy loads of waste. Employers of waste handlers in peri-urban townships need to offer training in correct ergonomic work postures to waste handlers.

Asthma and cough were linked with inhalation of different types of dust through exposed mouth and nose during handling of particular organic wastes. In this study, the exposure of mouth/nose of waste handlers who performed multiple tasks in a day was significantly associated with reported cough problems. This finding is corroborated by many other studies from both developed and developing countries which have reported occupational asthma, cough and other respiratory diseases as linked with inhalation of organic dusts, bio-aerosols and microorganisms during handling of organic wastes (Wouters et al., 2002; Binion and Gutberlet 2012; Ross and Pons, 2013), especially among young and old waste handlers. Follow-up studies are needed to characterize the actual airborne agents and their concentrations that waste handlers are exposed to, e.g. types of dust and the actual hazards including mycotoxins and volatile organic compounds from stored organic wastes. Such studies may include use of personal filter devices to collect airborne particles as well as analysis of metabolites in blood or urine (biomarkers of exposure). The use of worn out mouth/nose cover among waste handlers in this study may indicate a real hazard for respiratory/airborne diseases.

Even though the use of PPGs, including overall gown and Wellington boots, are very important to reduce direct exposure and physical damage, e.g. skin cuts, during waste handling (Dorevitch and Marder, 2001; Tjoe Nij et

al., 2003) which was also acknowledged by waste workers in this study as important for protecting their health, the waste handlers experience different types of bodily discomfort when using them. Our study have shown that the most vulnerable self-employed waste handlers are not able to purchase own PPG and that waste companies are not actively ensuring adequate supply of PPG, that supplied PPG is intact and working, and that PPG is properly used. There is a need to draw the attention of local governments and commercial waste handling companies employing waste handlers to their responsibility to provide and educate their workers/employees on the correct and appropriate use of PPGs to effectively protect their health.

### Limitations of Study

Bias in recall could result in over or underestimation of reported health problems among waste handlers. Further, waste handlers, in an attempt to portray good health and to avoid being sacked from work, may have underreported or not reported health problems. Thirdly, response on pain could be exaggerated to portray evidence of hard work. It should also be stressed that the health problems as reported by waste handlers may not necessary be associated with their occupation as it could be caused by other factors, e.g. bodily pain is also commonly reported by farmers during long hours of work in agricultural fields. As we were not able to include a control group in the study design, follow-up epidemiological risk factor studies are needed to assess the magnitude of such health problems.

### CONCLUSION

The study concludes that waste handlers experience a burden of disease which may be consequences of their occupation. Using bare hands to perform multiple waste handling tasks increased the likelihood of reporting fever and diarrhoea among waste handlers. We are convinced that waste handlers in per-urban areas would need affordable protective gear, but also water and soap for the promotion of personal hygiene at the work place. Waste companies and government institutions employing future waste handlers should address these issues. There is a need for further research to determine actual health problems among waste handlers (e.g. contamination of hands by human faeces and helminthes infections) in order to guide the design and implementation of health promotion measures to protect the health and safety of waste handlers in such peri-urban settings. The authors suggest measures to include psychosocial health risk outcomes among waste handlers in future studies.

### CONFLICT OF INTEREST

The author(s) declare no conflicts of interest to the content of this article.

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