FACULTY OF ARCHITECTURE RESEARCH UNIT
UNIVERSITY OF MORATUWA, SRI LANKA

FARU 2022 – 15TH INTERNATIONAL RESEARCH CONFERENCE
www.faru.uom.lk

Independence and Interdependence of
Sustainable Spaces

OCCUPATIONAL HEALTH AND SAFETY OF MUNICIPAL SOLID WASTE HANDLERS IN SRI LANKA

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Abstract: Due to improper Municipal Solid Waste Management (MSWM), waste has become one of the pollution sources and caused diverse environmental impacts as well as negative impacts on human health and safety. Despite adverse health impacts on many living organisms, MSW handlers are also subjected to Occupational Health and Safety (OHS) issues in Sri Lanka. Although, they play a significant role in MSWM, the OHS of MSW handlers has been neglected in Sri Lanka. So far, no studies have been carried out on the same. Thus, it has become a timely requirement for exploring the OHS issues faced by MSW handlers. This paper therefore aimed to explore the occupational injuries and illnesses that MSW handlers are associated with, and the basic causes which leads to such OHS issues. Accordingly, a qualitative research approach with two case studies was utilised to achieve the aim of the research. Fourteen semi-structured interviews were conducted with both authority level and worker level employees. Collected data were analysed using content analysis with the support of NVivo 12 plus software. The findings reflected that MSW handlers mostly suffer from back pain, slipping and falling, knee/calf pain, and headaches/migraine due to the nature of the job. Manual handling, negligence of use of Personal Protective Equipment (PPE), poor working environment, inadequate training and instructions, careless behaviour, health condition and age level of MSW handlers are identified as fundamental causes that greatly impact of OHS issues. Both OHS issues and respective causes are bound with organisational, cultural, economic, financial, and individual aspects that are unique to the Sri Lankan context. Finally, the findings generated through this study can be employed in many ways by respective industry practitioners to take informative decision to enhance the OHS of MSW handlers.

Keywords: *Municipal solid waste (MSW), Municipal solid waste (MSW) handlers, Occupational health and safety (OHS)*

1. Introduction

MSW is a term that refers to waste created by natural persons in their dwellings, firms, and construction projects, which is collected and handled by municipalities (Karak, Bhagat, & Bhattacharyya, 2012). In 2014, the world population increased from 2.9 to 3 billion, but MSW generation increased from 0.68 to 1.3 billion tons (Mian, Zeng, Bin Nasry, & Al-Hamadani, 2016). Thus, managing solid waste is the most important service almost every government offers to its citizens (Garnett, Cooper, Longhurst, Jude, & Tyrrel, 2017). Subsequently, mass generation of MSW brings many problems to the society such as weakened public health, ecosystem, quality of life, and many other socio-economic issues (Karak, Bhagat, & Bhattacharyya, 2012; Ramachandra, Bharath, Kulkarni, & Han, 2018). Generally, MSW handlers are attached with wide range of work-related hazards during the collection, sorting, disposal, and recycling of MSW (Rajapaksha, et al., 2017). Hence, they are at high risk for different kinds of OHS issues due to daily exposure to work-related hazards (Gutberlet & Uddin, 2018).

In Sri Lanka, approximately 4,000 occupational injuries and diseases have been reported annually (International Labour Organisation, 2016). Even though the absence of accurate figures in related injuries and illnesses of MSW handlers, they are evidently not excluded (Rajapaksha, et al., 2017).

Mudalige and Dharmathilake (2000) conducted a research in Sri Lanka in the early twentieth century which highlighted the injuries and diseases that Colombo MSW handlers are exposed up to certain extent. That research was merely confined to comprehend the health and safety issues that waste handlers confront as a result of their job nature and explain the preventative measures that are available to mitigate such issues. Exclusive of aforementioned study by Mudalige and Dharmathilake (2000), there were no research conducted in Sri Lanka as of now for exploring the health and safety issues faced by MSW handlers. Within recent decades, researchers have been made effort to study in different areas of waste management, but none in the field of OHS of MSW handlers. For example, most of the

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DOI: https://doi.org/10.31705/FARU.2022.27

research have been focused on emphasising the concept and practices of MSWM and its environmental impacts (Vidanaarachchi, Yuen, & Pilapitiya, 2006; Bandara & Hettiarachchi, 2010; Menikpura, Gheewala, & Bonnet, 2012; Basnayake & Visvanathan, 2013; Hikkaduwa, Gunawardana, Halwatura, & Youn, 2015; Dharmasiri, 2019; Lalitha & Fernando, 2019), the concept of waste-to-energy (Kumarasiri & Dissanayake, 2019; Kumarasiri & Dissanayake, 2021), and E-waste management (Mallawarachchi & Karunasena, 2012; Thavalingam & Karunasena, 2016; Gunarathne, Alwis, & Alahakoon, 2020).

It became noteworthy that over the last few centuries, the OHS of MSW handlers has indeed been abandoned in Sri Lanka. Further, according to Wickramathilake (2011) due to a lack of proper recording mechanisms and research on this area, Sri Lanka lacks a reliable data source on occupational injuries and illnesses, especially in relation to waste handlers. Therefore, it has become a timely requirement to conduct an empirical study exploring the OHS of MSW handlers in Sri Lanka. Thus, having identified the knowledge gap, this paper aimed to explore the OHS issues and its causes of MSW handlers in Sri Lanka.

2. Literature review

There are several parties who are being affected by health and safety problems due to failure of MSWM which include individuals living in a place where lacking adequate waste treatment systems, children, waste handlers, and those living near waste dumps (Alamp & Ahmade, 2013). It was also mentioned that among the aforementioned parties, MSW handlers are quite important to be concerned because they are constantly exposed to MSW.

Due to the working condition and working environment, MSW handlers are exposed to multiple work-related hazards (Bleck & Wettberg, 2012), and as a result, they suffer high rates of OHS issues (Hoefel, Carneiro, Santos, Amate, & Santos, 2013). These issues can happen in every stage of the MSWM process (Bortoleto, Kurisu, & Hanaki, 2012; Lohri, Camenzind, & Zurbrügg, 2014). Furthermore, waste collection is identified as most dangerous in the United States, even more deadly than a police officer or fire fighter (Krajewski, Tarkowski, Cryrowski, Szarapinska-Kwaszewska, & Dudkiewicz, 2002; Olorunnishola, 2010). A study conducted in Netherland on injury associated with solid waste management found that 41% of the waste handlers had one or more injuries (Kuijer, Sluiter, & Frings-Dresen, 2010).

Accordingly, in a common point of view, MSW handlers are supposed to have respiratory disorders, gastrointestinal diseases, skin diseases, eye infections, headache, musculoskeletal disorders, hearing loss, lack of visibility, muscle pain, fever, fatigue, irritation of eyes, and skins, mechanical trauma, pulmonary problems, chronic bronchitis, poor emotional well-being, stress, and depression, falls from a height, slips, traffic accidents and cut and puncture (Poulsen, et al., 1995; Schibye, Søgaard, Martinsen, & Klausen, 2001; Krajewski, Tarkowski, Cryrowski, Szarapinska-Kwaszewska, & Dudkiewicz, 2002; Englehardt, Fleming, & Bean, 2003; Cointreau, 2006; Kuijer, Sluiter, & Frings-Dresen, 2010; Gutberlet, Baeder, Pontuschka, Felipone, & Santos, 2013; Rachiotis, Tsovili, Papagiannis, Markaki, & Hadjichristodoulou, 2016; Salve, Chokhandre, & Bansod, 2017). More interestingly, OHS issues of MSW handlers can happen due to several reasons. Accordingly, Table 1 summarises the different OHS issues and the respective causes of having those issues. This was based on the previous studies, which have been conducted by many researchers in the same area.

Table 1: Different OHS issues and the respective causes

OSH issue	Cause
Musculoskeletal diseases	Damaging postures due to intense physical activities such as carrying, pushing, pulling, or lifting heavy objects during long working hours
Respiratory diseases and allergies	Exposure to bioaerosols
Falling	Hanging from the back of a truck during transportation Falling when the waste collection truck is driving at high speeds
Joints problems	Repetition of similar movements of hands and arms when grabbing and disposing of waste containers
Slipping	Restricted workspace, slippery surface, dim lighting
Skin irritations	Wearing no protective equipment
Hearing disorders	Work near roadside exposing noises due to machineries and vehicles
Headache	Exposure to sun
Animal bites	Work in street and unhygienic condition (disease-carrying insects such as flies and cockroaches)
Job related stress and fatigue	Lack of balance between job demands and capabilities, unpredictable situations during working hours
Burn	Burns from electric sparks during electrical repair
Electrocution	Exposure to wires, faulty wiring connections
Wounds due to cutting	Contact with sharp items

Adopted: (Bleck & Wettberg, 2012; Jerie, 2016; Jeong, Lee, & Lee, 2016; Kuijer, Sluiter, & Frings-Dresen, 2010; Moore, Armstrong, & Fischer, 2021; Poulsen, et al., 1995)

As shown in Table 1, waste handlers mostly suffer from musculoskeletal diseases due to damaging postures (Jeong, Lee, & Lee, 2016; Poulsen, et al., 1995). Remarkably, in this working group, non-fatal injuries are mainly musculoskeletal disorders (Dorevitch & Marder, 2001; Nguyen, Tran, Hoang, Nguyen, & Nguyen, 2020). Musculoskeletal disorders such as low back pain and elbow/wrist pain are commonly experienced (Jeong, Lee, & Lee, 2016; Jerie, 2016), whereas it was proved lower back was the most affected site, followed by pain in the neck and shoulders (Nguyen, Tran, Hoang, Nguyen, & Nguyen, 2020).

Further, cold, cough, bronchitis, bronchial asthma, tuberculosis, other respiratory problems, eye irritations, and intestinal disorders were also subjected (Porta, Milani, Lazzarino, Perucci, & Forastiere, 2009) but, establishing a direct link between these diseases and occupation is difficult (Bleck & Wettberg, 2012).

In this waste collection process, it was observed that overwork is a major problem, as waste handlers engage with long working hours at high speeds, favouring the probability of a work safety accident (Diniz, et al., 2019). Thus, it was demonstrated that MSW collection is the occupation with the highest risk for fatal occupational injuries and illness, much higher than for the general workforce (Dorevitch & Marder, 2001; Bunn, Slavova, & Tang, 2011).

The standards and norms for handling MSW in developed countries have reduced its occupational health impacts substantially (Eskezia, Aderaw, Ahmed, & Tadese, 2016). However, in developing countries, MSW handlers are at a much higher risk of OHS issues (Athanasiou, Makrynos, & Dounias, 2010; Frumkin, 2010; Gizaw, Adimasu, & Molla, 2012; Frey, Battaglia, & Passetti, 2014). They are generally more vulnerable to all risks than their counterparts in developed countries (Bleck & Wettberg, 2012). Thus, as a developing country a similar situation can be seen in Sri Lanka (Rajapaksha, et al., 2017). Nearly, 4,000 occupational accidents have been reported annually in Sri Lanka, and as a result, 600,000 working days are estimated to be lost (International Labour Organisation, 2016). Sri Lankan Ministry of Health (2011) reported that approximately 15% of the total admissions to the Colombo National Hospital were due to occupational injuries. Although specific figures were not available, it is well recognised that MSW handlers are not excluded (Rajapaksha, et al., 2017).

However, when discussing the situation of Sri Lanka, it is manifest that due to insufficient literature sources, the OHS of the MSW handlers has not been adequately studied yet. Hence, it can be embraced as a major research gap in this study. Therefore, this study intends to fill the substantial knowledge gap in Sri Lankan literature by identifying the OHS issues that are mainly subjected to MSW handlers and basic causes for those issues of MSW handlers in Sri Lanka. The next section discussed the research methodology adopted in bridging this knowledge gap.

3. Research methodology

This research aims to examine the OHS issues of MSW handlers in order to enhance their OHS. Accordingly, the research question was developed as follows,

RQ; "How to enhance the OHS of MSW handlers by examining the OHS issues they associated with, and basic causes leads to create those issues in Sri Lanka?"

Qualitative research approach was selected since it allows capturing in-depth opinions and understanding of the respondents by exploring their experiences, attitudes, and behaviour (Dawson, 2007). According to Yin (2015), the choice of the research strategy is based on three primary criteria: the type of research problem, the amount to which the researcher has control over behavioural occurrences, and whether the researcher focuses on contemporary events or not. Thus, since this subjected research question is derived as 'How to enhance the OHS of MSW handlers by examining the OHS issues they associated with, and basic causes leads to create those issues in Sri Lanka?', due to the need for an in-depth and holistic assessment of the research area and the absence of sufficient previous research on the research topic in Sri Lanka, the case study research technique was chosen as the most appropriate research strategy for the study. Further multiple case studies were selected as the most workable technique to collect data because when there are several cases, they can be easily compared to achieve the best results. The selection of the number of cases are based upon the data saturation (O'Reilly & Parker, 2013). Accordingly, the number of cases involved in the research was determined as two. Grbich (2014) stressed that the unit of analysis is the key entity being analysed in the research. Thus, the unit of analysis of the research expounded as OHS of MSW handlers. Furthermore, the case boundary was defined as MSWM in Sri Lanka. Since this research has been limited to Municipal Councils, cases were selected only in place of that category (refer Table 2).

Table 2: Profile of the cases

Case A	Case B
The total municipal administrative area is 37.5 km2	The total municipal administrative area is 28 km 2
Waste is collected by segregating into degradable (kitchen and garden waste) and non-degradable (recyclable waste). Kitchen and garden waste are mainly generated, taking up approximately 90% of waste generation	Waste is collected by segregating into organic and inorganic waste.

Day shift working hours for MSW handlers are from 7.30 a.m. to 3.30 p.m.	There are two shifts per day normally In the special circumstance, Municipal Council escalate the number of waste collection shifts during the seasons of April and December due to rise up the population in Case B. Significantly, as the metropolitan area is known as the one of main commercial centre of the country, waste generation in case B is high due to the large population that was able to move around during those seasons. Therefore, Municipal Council manages to escalate the waste collection shifts.
The entire municipal area has been divided into nine (09) zones	Fishing industry is most active

Semi-structured interviews were applied in this study because they direct the conversation in the appropriate path and allow the researcher to re-questioning and have further clarifications when the interview is conducted than structured interviews. Therefore, fourteen interviewees were selected among the two different levels of employees, including the authority level who are in charge of OHS and worker level from each case (refer Table 3). Respondents of authority level were determined by considering their occupational relationship with monitoring the health and safety of MSW handlers. Similarly, respondents of worker level were selected based on their nature of work. Scope of 'nature of work' was limited to collecting waste from the doorstep/pick point/roadside and anywhere they are assigned. Consequently, waste collectors including tractor drivers and street sweepers were in-lined with the scope.

Table 3: Details of the respondents

Case	Employment category	Code	Designation	Gender	Age (years)	Work experience in the case (years)
A	Authority level	AA1	Medical officer	Female	36	4
		AA2	Nurse	Female	44	5
		AA3	Waste administrator	Male	45	22
	Worker level	AC1	Street sweeper	Female	46	6
		AC2	Waste collector	Male	37	5.5
		AC3	Waste collector	Male	51	13
		AC4	Waste collecting tractor driver	Male	47	7.5
B	Authority level	BA1	Engineer in charge – Solid waste section	Male	34	3
		BA2	PHI	Male	40	14
		BA3	PHI	Male	37	9
	Worker level	BC1	Waste collector	Male	52	8
		BC2	Waste collector	Male	29	6
		BC3	Waste collector	Male	57	11
		BC4	Street sweeper	Female	47	4

After collecting, the data were analysed by content analysis with the support of NVivo 12 plus software since it aids in organising qualitative data gathered to meet the research aim (Opoku, Ahmed, & Akotia, 2016).

4. Research findings and analysis

Detailed description of cross-case analysis of Case A and B is presented under the two subsections: one describes the "OHS issues of MSW handlers" (Section 4.1) and one describes the "basic causes leading to occur OHS issues of MSW handlers" (Section 4.2) as follows.

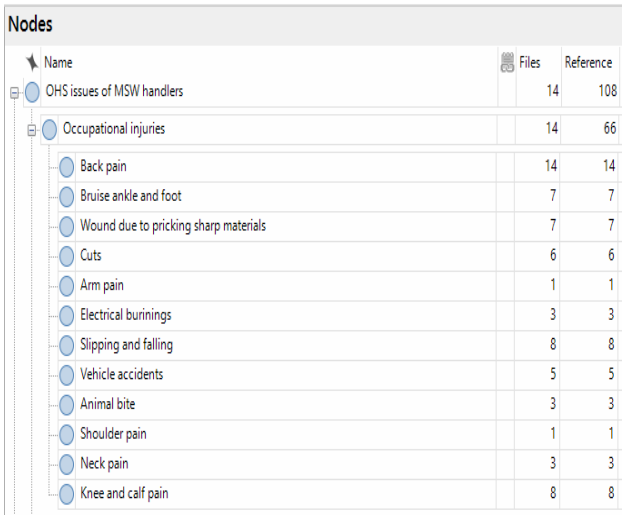
4.1. OHS ISSUES OF MSW HANDLERS

Responses from all respondents in Cases A and B revealed that MSW handlers were frequently exposed to various occupational issues due to constant exposure to several waste hazards. Accordingly, the OHS issues of MSW handlers are presented by categorising into two categories as 'Occupational injuries' and 'Occupational illnesses' as shown in Figure 1 and Figure 2 respectively.

As shown in Figure 1, twelve occupational injuries are identified. It has been reflected that MSW handlers mostly suffer from back pain due to their repeated heavy physical activities. Waste collectors must pick up the garbage bags at certain pick-points or shovelled by their hands. Hence, their manual handling of the heavy load directly impacts back pain.

Besides the back pain, AA1 who is medical officer in-charged of case A stated that *"Muscles cramp in the calf are largely treated"*. Representing both waste collectors and street sweepers, AC2, BC1, and BC4 clearly explained that due to prolonged physical activities and prolonged standing, they are experienced knee and calf pain frequently.

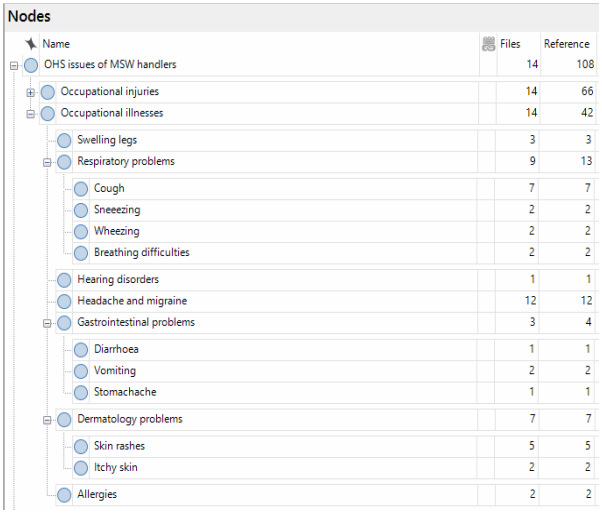
Further, it was revealed that even though the calf muscle cramps are usually temporary, they can cause significant pain and discomfort.



Nodes

Name	Files	Reference
OHS issues of MSW handlers	14	108
Occupational injuries	14	66
Back pain	14	14
Bruise ankle and foot	7	7
Wound due to pricking sharp materials	7	7
Cuts	6	6
Arm pain	1	1
Electrical burinings	3	3
Slipping and falling	8	8
Vehicle accidents	5	5
Animal bite	3	3
Shoulder pain	1	1
Neck pain	3	3
Knee and calf pain	8	8

Figure 1: Coding structure for occupational injuries of MSW handlers



Nodes

Name	Files	Reference
OHS issues of MSW handlers	14	108
Occupational injuries	14	66
Occupational illnesses	14	42
Swelling legs	3	3
Respiratory problems	9	13
Cough	7	7
Sneeezing	2	2
Wheezing	2	2
Breathing difficulties	2	2
Hearing disorders	1	1
Headache and migraine	12	12
Gastrointestinal problems	3	4
Diarrhoea	1	1
Vomiting	2	2
Stomachache	1	1
Dermatology problems	7	7
Skin rashes	5	5
Itchy skin	2	2
Allergies	2	2

Figure 2: Coding structure for occupational illnesses of MSW handlers

It was observed that the most preventable form of injury in MSW handlers was slipping and falling, which usually occur when they are hanging from the back of a truck during transportation. Similarly, they had to work in uneven surface by accepting obstacles which also leads to slipping and falling from height. Usually that reoccur in several times even in the single working day. It creates numerous injuries such as joint failures, muscles pain, bruise ankle and foot.

Wounds are also being experienced by MSW handlers. It occurs basically due to working without using safety gloves and boots. It became evident as AC3 stated, *"Being pricked by a sharp object is very common when not using safety gloves."* It was suggested that accidents are more likely to occur when MSW handlers are not using PPEs. Cuts and vehicle accidents can be identified too as injuries which impact the body parts. All respondents of worker level from both cases agreed that due to heavy traffic and hectic environment, they are more likely to have road accidents during their morning shifts. Furthermore, BA2 emphasised that the negligence of the waste handlers could be asserted as the significant cause of road accidents due to carelessness while working close to the road. Although the animal bites and electrical burning are comparatively rare as per the findings, impact and the severity is significantly high once being affected. The treatment also more costly and difficult to afford by the handlers.

Neck pain, shoulder pain and arm pain are also experienced. The severity of pain in the body parts depends on the amount of works involve, duration of exposure and physical strength as stated by AA2.

When considering Figure 2, thirteen occupational illnesses are identified. More respondents collectively answered that MSW handlers suffer from headaches as they are often required to work in outside by exposing unpredictable environmental variations in prolong period. Respiratory problems can be identified as next foremost occupational illness that MSW handlers are experienced with. Working in outside direct to exposure to numerous particles. Even substantial evidence is available through the case study that exposure to harmful particles exceeds the recommendations. In addition, employment duration for a long time was linked to a higher prevalence of respiratory problems.

It became evident through the case study findings that MSW handlers are at a risk of dermatology problem such as skin irritation and itching which could be explained by direct contact with wastes while wearing no protective equipment. Swelling legs, gastrointestinal problems, allergies, and hearing disorders can be named as rest occupational illnesses which have minimum impact of MSW handlers as per the findings.

Consequently, the comprehensive details of the occupational injuries and occupational illnesses are presented in Table 4 and Table 5 respectively.

Table 4: Summary of responses on occupation injuries and details of MSW handlers

Occupational injury	Details about the issue
Back pain	Due to their repeated heavy physical activities, such as the shovelling, bending, lifting and moving of heavy waste bags and bins. Street sweepers are also standing constantly, stepping, and bending repetitively.

Knee and calf pain	By performing prolonged physical activities and prolonged standing
Wounds due to pricking sharp materials	By pricking sharp materials such as needles, broken glasses, razor blades. It occurred basically due to working without using safety gloves and boots
Vehicle accidents	By collecting and shovelling waste in very close to the road and due to carelessness while working close to the road
Animal bite	Dog bites when they collect the waste in household and un-orphanage dogs Insects and flies attack is being experienced while feeding on waste especially in landfilling sites
Cuts	Work with bare hands and foots and using defective equipment
Bruise ankle and foot	Ill-fitting safety boots, twisting of ankle joints while stepping
Arm pain	Carrying and loading waste bags and bins to the tractor
Electrical burning	Exposed to faulty wiring connections
Slipping and falling	Due to carelessness and obstacles in working ground
Shoulder pain	Handlers entitle to shovel waste by hand, and plastic bags or buckets must be picked up by hand. Hence shoulders are continuously twisted
Neck pain	Street sweepers are supposed to keep sweeping, and while they are doing that, they had to bend their necks

Table 5: Summary of responses on occupation illnesses and details of MSW handlers

Occupational illness	Details of the issue
Headache and migraine	work outside and in immediate contact with the sun, vehicle exhaust fumes, dust, and unbearable noise for prolonged period
Respiratory problems (cough, sneezing, wheezing, breathing difficulties)	exposed to dust, odour, fumes, insecticides, and other potential harmful waste hazards without respirators or masks while collecting waste and dumping sites
Gastrointestinal problems (diarrhoea, vomiting, stomach-ache)	Due to unhygienic behaviour. handlers are tempted to have meal without washing their hands adequately. Their hands get dirty as they handle the waste from exposure to dust and vehicle fumes. When they have meals without washing their hands properly, it causes such illnesses
Swelling legs	Standing in prolonged period, keep stepping
Hearing disorders	Exposure to excessive noise continuously
Dermatology problem (skin rashes, itchy skin)	Exposure to dust and insect bites
Allergies	Food allergies due to unhygienic behaviours

Although fatal accidents are relatively rare in this industry, the researcher argues that even in a single working day, there are more non-fatal accidents. Findings revealed that vehicle accidents are the major types of fatal accidents, and body aches/pains and slipping and falling can be seen as non-fatal accidents on regular working days. Even though the situation is that way, according to BA3 and BA4, MSW handlers report to work daily if they do not have enough pain to get out of bed. Confirming their observation in Case A, AC4 unveiled that *"I only work to earn a daily wage. I do go to work unless I have a severe illness."* It was evident that unless the OHS issue is not severe, MSW handlers attend to work since their priority is earning their daily wages.

Especially, if paid attention to the OHS issues with the Covid-19 pandemic, the foremost reason handlers do not come to work these days has been identified as cough and fever.

4.2. BASIC CAUSES LEADING TO OCCUR OHS ISSUES OF MSW HANDLERS

Primarily, respondents' perceptions convinced that there are numerous causes which leads to create OHS issues of MSW handlers. This section discusses basic leading causes which forced to have OHS issues discussed in Section 4.1.

As a developing country, Sri Lanka still handles waste management manually. It was identified as the root cause of having all the OHS issues related to waste handling and poor waste management practices. According to the opinion of all respondents in both cases, it was confirmed that "***MSW handlers have to consume more physical energy since this process is manually handled***." Hence, it was crystal clear that the waste collection job requires lifting/carrying waste bags, pulling/pushing waste containers, bins and wheelers result in repetitive bending, awkward postures, and therefore, there is a high risk of developing pain in the body parts as back pain, arms pain, knee and calf pain and so on.

It was suggested that "***accidents are more likely to occur when MSW handlers are not using PPEs."*** That idea was confirmed by BC1 and AA3. Significantly, it was revealed that there are reasons for the negligence of PPEs. As divulged by BA1, BA3, AA3 and BC2, management commitment was significantly less towards providing PPEs with

accepted quality to the task. In contrast, BC1 emphasised that MSW handlers' attitude impacts the negligence of PPEs. Similarly, sometimes, wearing PPEs are ignored by the MSW handlers to save time and lack of supervision as per BC4.

Since MSW handlers are committed to working outside, they are unintentionally exposed to the sun in the daytime, excessive noise, dust and bad smells. It became obvious through the case study findings that ***"MSW handlers are more vulnerable to many OHS issues because of working in a poor working environment."*** It was a reason for headaches/migraine and being distracted as stated by AC1 and AC3. Also, MSW handlers expose to hearing loss to some extent due to excessive noise for a prolonged period. Moreover, animal bites can also draw as an issue that MSW handlers are being suffered by collecting waste.

Training and instructions can be highlighted as a factor with substantial ability to manipulate handler attitudes by improving their skills and knowledge. Furthermore, proper training and instruction programmes also positively contribute to job satisfaction. However, the empirical analysis reflected that "***MSW handlers are not currently provided with well-structured training programmes and instructions regularly***." Most of the time, they were only being reminded to wear PPEs. Hence, getting information regarding OHS would be limited. Here, the information means waste hazards, potential accidents/diseases, the most common issues that could experience, what are the severest accidents, precautionary methods, and the PPEs appropriate for different circumstances, etc. Thus, it was impacted to have OHS issues since MSW handlers are less educated.

Individual devotion and hygienic behaviour are a must to sustain OHS among MSW handlers. Unfortunately, such involvement was not observed in both cases. It became apparent that ***"MSW handlers behave carelessly and follow unhygienic practices."*** Apparently, it may be due to the poor education level of MSW handlers towards OHS. According to BA3, some handlers exchanged PPE with one another, which is not acceptable at all since the fungus and viruses might be transferred. It became apparent from the study that, most of the time MSW handlers tend to get their meals without washing hands which leads spread of infection. This has become a series issue nowadays with the COVID-19 pandemic. Thus, MSW handlers are being suffered from gastrointestinal problems and other vulnerable to viral infections. In addition, according to BA1, most of male MSW handlers are addicted to alcohol. It was the reason for deteriorating their physical health and sometimes not concise when working by resulting in accidents, electrocution and slipping and falling due to carelessness.

As per the case study findings ***"the level of severity of OHS issues also depend on health condition and age level of MSW handler."*** The health status of all MSW handlers and their age level are not the same, but all of their job roles are the same, and all handlers are exposed to the same waste hazards. Thus, individuals should have taken care of their personal health to minimise the severity of OHS issues.

5. Discussion

As revealed from both literature findings and data analysis, MSW handlers are highly subjected to different OHS issues. Rather than commonly identifying, data analysis separately presented OHS issues of MSW handlers under two categorisations as 'occupational injuries (refer Figure 1)' and 'occupational illnesses (refer Figure 2)'. Literature findings described that, musculoskeletal diseases are the most common issues among MSW handlers due to awkward postures (Poulsen, et al., 1995; Jeong, Lee, & Lee, 2016). By narrowing down, Nguyen, Tran, Hoang, Nguyen, and Nguyen (2020) revealed that back pain is more influential among other OHS issues. Precisely, the same finding was discovered within the case study too, where in both cases, all respondents at the authority level and worker level stressed that back pain could be acknowledged as the foremost issue suffered by MSW handlers. Further, headaches and migraine were also emphasised within data analysis as common issues other than back pain. It was not broadly addressed in preceding studies. The researcher argued that the Sri Lanka context's environmental condition and social activities can be derived as a reason. Similarly, calf pain was also highlighted by data analysis, whereas it was also not revealed within literature synthesis as a common OHS issue. Precisely, Dorevitch and Marder (2001) as well as Bunn, Slavova, and Tang (2011), collectively demonstrated that MSW collection is a higher risk of fatal accidents. In contrast, case study findings emphasised that fatal accidents are relatively rare in this sector, whereas more non-fatal accidents are reported even in a single working day. Among those, data analysis resulted in body aches/pains, and slipping and falling are the most common types of non-fatal accidents suffered by MSW handlers while literature stressed that non-fatal injuries are mainly musculoskeletal disorders (Dorevitch & Marder, 2001; Nguyen, Tran, Hoang, Nguyen, & Nguyen, 2020). However, in total, it was proved that MSW handlers are highly suffering from various OHS issues in Sri Lanka. Therefore, the researcher sought to find out the basic causes which leads to create OHS issues in MSW handlers. Accordingly, manual handling of solid waste, negligence of use of PPE, working in a poor working environment, inadequate training and instructions, careless behaviour of MSW handlers, and health condition and age level of MSW handlers are identified as fundamental causes which greatly impact to have OHS issues of MSW handlers. It was noted that management commitment is significantly less to facilitate the safe working background and their concern on waste handlers is also not at the level of appreciation. Especially, literature findings on OHS issues and causes were in general and not specifically discussed with reference to the Sri Lankan context. When considering organisational, cultural, individual, financial and economic aspects both OHS issues and causes are unique to Sri Lanka.

6. Conclusion

OHS and MSWM are one of the two most important elements that are entitled to economic changes. With the rapid generation of MSW, it is difficult to keep it at the required level. Because of the failure of MSWM, there are environmental, and public health issues occurred. Consequently, MSW collection is a dynamic form of a job for waste handlers infrequently unplanned and rapidly expanding cities of developing countries. The situation of Sri Lanka is almost the same as to the global, and it is worst to some extent since the country follows a conventional waste management system. It has been proved that the concentrations are deemed to be excessively high to have a negative impact on solid waste handlers' health and safety in Sri Lanka municipalities. In that sense, MSW handlers are extremely vulnerable to occupational injuries and illness due to continues exposure to various waste hazards. It was proven that their OHS issues are varied depending on certain variables directly or indirectly as health condition, age level, personal attitude, negligence of using PPEs. Thus, this paper claims on importance of the investigating OHS issues and causes behind identified OHS issues which leads to in-depth investigation for enhancing OHS of MSW handlers in Sri Lanka.

7. References

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