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Assessment of Factors Associated with Occupational Injuries among Municipal Solid Waste Workers' in Kigali City, Rwanda, 2016

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Abstract: ***Municipal solid waste workers are exposed to a number of pathogens which originates from waste and its composition. Though in developing countries the occupational injuries and health hazards associated with Municipal solid waste have been minimized, the risks are still high in developing countries like Rwanda where there is in adequate understanding of the risk magnitude. This cross sectional study was conducted to assess the factors associated with occupational injuries among the municipal solid waste workers in Kigali City, Rwanda. A total of 239 workers were taken as study sample and data was collected through questionnaire and by use of observational checklists. The quantitative data from the structured questionnaire and observational checklists were coded and a master sheet prepared. The cleaned data was exported into SPSS software program for further analysis. Analysis was conducted using stata, bivariate and multivariate logistic regression analysis were computed to determine statistical association between the outcome variable and independent variables using Odds Ration; significant of statistical association were tested using 95% confidence interval (CI) and p value (< 0.05). The total number of workers that had sustained occupational injuries were 123 (51.5% 95% C.I = 44.94 – 57.96). The most of injuries occurred on the upper arm with occurrence of 43 (18% 95% C.I = 13.34 - 23.46) followed by the neck and shoulder with occurrence rate of 36 (15.1% 95% C.I = 10.78 - 20.24) and 24 (10% 95% C.I = 06.54 - 14.57) respectively. Concerning the type of injuries that occurred, cuts were the most high with 62 (25.9% 95% C.I = 20.51 - 31.99) followed by puncture 44 (18.4% 95% C.I = 13.71 - 23.92) with fracture having 6 (2.5% 95% C.I = 00.93 - 05.38) and the slips and fall being the list with 4 (1.7% 95% C.I = 00.45 - 04.23). Some of the factors have been revealed to be more influential than others in facilitating the occurrence of injuries were low level of education with no education with (odd ratio OR=1.000), Primary education (OR = 1.064019, 95% CI: 0.5399431, 2.09677) marital status especially single (OR = 7.136472, 95% CI: 0.7820925, 65.11919), male gender (OR = 1.298817, 95% CI: 0.6536932, 2.580607), having extra work (OR = 1.000), working under pressure (OR = 7.136472, 95% CI: 0.7820925, 65.11919), drinking alcohol at work (OR = 1.309791, 95% CI: 0.6467055, 2.652758). The government institutions and private sector involved in municipal solid waste management should set up measures to prevent the occurrence of occupational injuries through controlling the associated factors reveled by this study.***

Keywords: occupational Injuries occurrence, municipal solid waste management, waste handlers

1. Introduction

Municipal solid waste (MSW) is defined as the waste that originates from activities conducted in households, non-hazardous solid waste from industrial, commercial and institutional establishments including hospitals, market waste, yard waste and street sweepings. While hazardous industrial and medical wastes are, by definition, not components of MSW, they are normally quite difficult to separate from municipal solid waste, particularly when their sources are small and scattered (1).

One of the major and most important roles of local government is management of municipal solid waste (MSWM). This is a complex task that demands the strong corporation between numerous stakeholders within the private and public sectors. Despite its significance to public health and environmental protection, MSWM in most cities of developing countries is highly unsatisfactory (1).

The International Labor Organization (ILO) convention set standards for Occupational safety and Health (OSH) which are meant to promote OSH at work (2). The convention set out the tools that are supposed to be used at the national level in promoting OSH. The instruments include the policy-based approach focused on prevention that will always improve their national OSH system. The instrument also gives emphasis based on the employer responsibilities as well as the workers' rights and duties concerning OSH. This convention has other tool like flexibility. In this case flexibility as tool seek to take into account the national circumstances and provide for some flexibility in the application of Conventions, with a view to gradually improving the protection of workers by taking into account the specific situation in some sectors and of limited categories of workers. (2).

According to the convention on OHS number 155 in its article number 4, member states are given the mandate to formulate, implement and review a coherent national policy on OSH in consultation with representatives of national organizational employers and workers. This article also specifies the aim of the national policy as to prevent any occupational injury that is connected with work or may occur at work place (3)

Globally, Municipal Solid Waste Workers' (MSWWs) are exposed to occupational health risks from waste materials, emissions' from them and the equipment's they use in handling them (4). These occupational health risks include contact with human feacal matter, toxic materials, residues from chemical bottles, residue pesticides and solvents from

metal containers, sharps and other infectious waste from Health care facility (HCF), and batteries containing heavy metals (4).

In 1994, an average estimated fatal occupational accident rates in the whole world was 14.0 per 100,000 workers, and the total estimated number of fatal occupational accidents was 335,000 (5). In 2008, hazardous substances which were connected to work accounted for about 900,000 deaths among the workers. The average Economic costs of work related injuries and illness was estimated at 4% of the country's GDP with Singapore at 3.2% of GDP (6). Occupational accidents and work related diseases account for over 2.3 million fatalities annually across the countries and work related death accounts for 2 million globally (6). In 2010, the fatal occupational accidents accounted for over 350,000 whereas fatal work related diseases accounted for over 1.9 million (6). The prevalence for occupational injuries and infectious diseases was at 15% and 10% respectively (6).

In USA, solid waste collection is the fifth most dangerous job due to the number of fatal accidents involving employees (7). In addition, SWW suffer thousands of reported injuries and illnesses annually and waste collection vehicles get involved in thousands of accidents each year (7).

In developing countries, the discharged waste for collection is always hardly ever stored in closed and protected containers which are coded and sometimes is dumped directly on the ground (4). This requires it to be collected manually by hand which provides direct exposure of Waste handlers (WHs) to municipal solid waste than their counter parts in industrialized countries who usually handle sealed and protected waste containers (4).

In Ethiopia, a cross sectional study conducted on small scale industry workers revealed that the prevalence for occupational injuries among small-scale industry workers was considerably high (8). This therefore necessitated promoting occupational safety and health through appropriate prevention programs and provision of comprehensive occupational health and safety services with the provisions of personal protective equipment's (PPE), and focused interventions for young, less experienced, workers who work for extended hours (8). In Zanzibar, the municipal solid waste management system is weak with waste collection at 45-50% of mixed waste (9). The collected waste ends up in open dumpsite for final disposal without treatment and this creates a potential hazard to the health of the people and the environment. This study also indicated that Zanzibar Municipal waste collection lacked skilled personnel with only 7% of professionals and the rest being unskilled laborers (9). In Ghana, Waste handlers' (WH) who used bare hands reported high chances of getting occupational diseases such as diarrhea compared to those who used rubber gloves (10). At the same time those who were found without masks were found to report more of respiratory diseases compared to their counter parts that used the masks (10). In general, this study showed that WH who did not use the PPE had more chances of acquiring diseases compared to those that used them (10).

Rwanda's Occupational Safety and Health (OSH) concerns mirror international trends that seek to improve safety and health in the work environment as defined by ILO. Rwanda has, therefore, aligned its OSH response to ILO Convention 187 on the Promotional Framework for Occupational Safety and Health and Convention 155 on Occupational Safety and Health and the working environment(2) ("occupational safety convetion c 155," n.d.). The Rwanda Profile on OSH conducted by the Ministry of Public Service and Labor in 2012 indicated that National OSH system presents gaps (11). It has also revealed that the number of fatalities in the year 2012 varied from six to seven times higher than their number in the year 2007 (11). The survey indicated the number of injuries in the year 2012 being almost four times greater than their number in the year 2007 and an amount of 1,400,190,808 Rwandan Francs was spent on Occupational hazards for six years (2003-2009/2010) (11). The country profile reported that the occupational injuries in mining and quarrying (34%); construction (18%); agriculture, hunting, fishing (13.8) and transport, warehousing and communication (13%) (11). OSH Country Profile also revealed that among OSH preventive measures, the existence of sanitary convenience was high with 94.3% and existence of OSH Policy was low with 3.8% in the organizations (11). However, the survey did not indicate the occupational injury accident and injuries and work related diseases among the MSWWs. Despite the challenges faced by OSH, the government of Rwanda has significant achievements in regard to OSH which includes development and implementation of legislations in addition to developing OSH Country Profile in 2012 to come up with the general picture of OSH in the Country.

Population growth and economic development has led to increased rate of MSW generation especially in developing countries (4). Safe Management of MSW is a vital role for the urban environmental services provided by cities (12). Solid waste management integrates a wide range of activities including garbage collection, transportation, sorting, recycling, processing and final disposal and in each of these stages, there are health occupational risks associated with it (4)

Municipal Solid waste may contain hazardous or infectious material depending on its source of origin. The MSW coming from HCF or industries, if not well managed or controlled, may be contaminated with infectious and hazardous material. Once the MSWWs are exposed to the infectious or hazardous material contained in MSW, they may end up falling sick or getting other health problems associated with waste.

Globally, the World Health Organization estimated injuries due to sharps from medical waste to be approximately 66000 and 16000 cases of infections with Hepatitis B and C respectively in the year 2000 and 200 to 5000 cases of infection with HIV were observed among the health care workers (13). The ILO estimates indicate high accident fatality figures are seen in the Other Asia and Islands Region and in Sub-Saharan Africa. It estimates the death as a result of accidents to constitute 19% of the total death and it accounts to be the third source of death among the workers (14).

A study conducted in the hospitals of Tabuk city in Saudi Arabia on the practices of medical waste management, revealed that among the seven practices of MWM, segregation and minimization were practiced on daily basis, storage, collection, transportation, and disposal were often practiced, and treatment was not practiced at all (15)

2. Objective of the Study

The study aimed on the assessment of factors associated with occupational injuries among municipal solid waste workers in Kigali City, Rwanda

3. Methods and materials

Waste handlers were defined as those workers that were either employed by waste collecting companies who may be directly or indirectly involved in waste handling throughout the chain of municipal solid waste management or those employed by landfill management company who are directly involved in waste management. Municipal solid waste was defined as the waste generated from households, commercial centers and institutions.

3.1. Study design

Across sectional study was conducted in Kigali City 2016 to assess the factors associated with the occupational injuries among the municipal solid waste workers. The study employed the use of questionnaires and observational checklists.

3.2. Study Population and data collection

The study involved all the municipal solid waste workers (241) who had direct contact with municipal solid waste in the City of Kigali. Data collection was done by use of pre-tested standards questioners which was developed based on the previous done and published studies that were related to this with some definite modifications. The observational checklists were also used in data collection where the workers were observed while on work. The questioner used had four parts, the social demographic, Occupational safety measures, factors associated with occupation injuries, occurrence of Accidents and injuries with the most affected body parts and the knowledge of the workers on solid waste management. Data collected among the sample units was obtained on their experience, use of PPE, prevalence of injuries and accidents, knowledge towards safety measures taken to prevent health hazards. Back ground information concerning their social demographic factors, occupational and behavior factors was also obtained. Observational checklist were used to collect data on the safety measures used to prevent occupational injuries and diseases. The observational checklists were used in covert manner where the respondents were not aware of what the investigator was observing so that they feel free to do what they usually do without any interference.

3.3. Determination of perseverance rate for occupational injuries

The prevalence rate of injuries was determined by interviewing the municipal solid waste management workers on the occurrence and type of occupational injuries that occurred 12 months before the data was collected and current prevalence was determined by interviewing the workers on the occurrence of injuries in the last twelve (12) months prior to data collection.

4. Results

4.1. Observational

Observational checklists were used to assess the procedures used by waste handles while ata work. The observational check list was also used to assess the behavior conduct of the workers as well as the type of personal protective equipments' used at work.

The type of personal protective gears that were worn like overall, masks, gloves and gumboots were not appropriate to be used in waste handlers on addition to being not sufficient to all WHs thus exposing some of their body parts to dangers associated with MSWM. The observed WHs were those that were found loading waste on trucks from community and public places like hotels and those that were operating at the landfill.

4.2. Questioner administration

In total 239 WHs out of 241 that were identified were interviewed using a closed ended questioner. The information was collected to classify and describe the type of injury that occurred and the rate of injury occurrence plus the associated factors.

Socio-demographic and economic characteristics of the respondents

A total of two hundred and thirty nine (96.4%) respondents participated in this study. Majority of the study participants were male with a population of 171 (71.55% 95% C.I= 65.38 - 77.18) and female with a population of 68 (28.45% 95% C.I= 22.82 - 34.62). In addition the majority of respondents were married 150 (62.76% 95% C.I= 56.30 - 68.91). 71 of the respondents (29.7% 95% C.I= 23.99 - 35.94) were not educated whereas 94 (39.33% 95% C.I= 33.09 - 45.83) had primary education with only 9 (3.77% 95% C.I= 01.74 - 07.03) having tertiary education. 150 (62.3% 95% C.I = 56.30 - 68.90) of the respondents had other side job.

Table 1: Social demographic characteristics of the respondents

Study respondents background characteristics			
Item Variable	Freq.	%	95% C.I
Marital Status			
Single	74	31.0	(25.16 - 3724)
Married	150	62.8	(56.30 - 68.91)
Separated	15	6.3	(035.55 - 10.14)
Gender of the Respondent			
Female	68	28.5	(22.82 - 34.62)

Male	171	71.5	(65.38 - 77.18)
Age group of the Study Participants			
20 to 25 years	78	32.6	(27.73 - 3897)
25 to 30 years	91	38.1	(31.89 - 44.56)
30 to 40 years	45	18.8	(14.08 - 24.37)
40 years and above	25	10.5	(06.88 15.05)
Participant Educational status			
None	71	29.7	(23.99 - 35.94)
Primary	94	39.3	(33.09 - 45.83)
Post primary	65	27.2	(21.66 - 33.35)
Tertiary	9	3.8	(01.74 - 07.03)
Participants having other jobs			
No other job	89	37.2	(31.09 43.70)
With other job	150	62.8	(56.30 - 68.90)

Table 2: Respondents behavior character and work experience

Item Variable	Freq.	%	95% C.I
Duration of work experience			
0 to 1 year	69	28.9	(23.21 - 35.06)
1 to 5years	117	49.0	(42.45 - 55.48)
5 to 20years	53	22.2	(17.07 - 27.98)
Number of hours worked per day			
0 to 8 hours	69	28.9	(23.21 - 35.06)
8 to 12 hours	170	71.1	(64.94 - 76.79)
Job Satisfaction			
Not satisfied	164	68.6	(62.32 - 74.45)
satisfied	75	31.4	(25.55 - 37.68)
Habit of sleeping on duty			
No	218	91.2	(86.88 - 94.48)
Yes	21	8.8	(05.52 - 13.12)
Respondents like to take alcohol			
No	197	82.4	(76.99 - 87.03)
Yes	42	17.6	(12.93 23.00)
Status of the contract			
Temporal	194	81.2	(75.63 - 85.92)
Permanent	45	18.8	(14.08 - 2437)
Respondents' Occupation			
Waste collector	219	91.6	(87.37 - 9481)
Driver	12	5.0	(02.62 - 08.61)
Supervisor	8	3.3	(01.45 - 06.49)

Concerning the rate of injury occurrence, 123 (51.5% 95% C.I = 44.94 – 57.96) had injuries and the most injured body parts were the upper arm with proportion of 43 (18% 95% C.I = 13.34 - 23.46) followed by the neck and shoulder with occurrence rate of 36 (15.1% 95% C.I = 10.78 - 20.24). The type of injuries that occurred mostly were cuts with 62 (25.9% 95% C.I = 20.51 - 31.99), puncture 44 (18.4% 95% C.I = 13.71 - 23.92), fracture having 6 (2.5% 95% C.I = 00.93 - 05.38) and the slips and fall being the list with 4 (1.7% 95% C.I = 00.45 - 04.23)

Table 4: The rate of injury occurrence among the respondents

Item Variables	Yes Freq.	%	95% C. I.	No Freq.	%	95% C. I.
Number of Injury occurrences	123	51.5	(44.94 – 57.96)	116	48.5	(42.43 – 55.06)

Table 5: The most occurring injuries among the respondents

Item Variable	Freq.	%	95% C. I.
Total number of occurrence among participants	123	51.5	(44.94 - 57.96)
Cut Injury	62	25.9	(20.51 - 31.99)
Puncture Injury	44	18.4	(13.71 - 23.92)
Fracture Injury	6	2.5	(00.93 - 05.38)
Slips and fall	4	1.7	(00.45 - 04.23)

Table 6: The most injured body parts of the respondents

Item Variable	Freq.	%	95% C. I.
Total number of occurrence among participants	123	51.5	(44.94 - 57.96)
Occurrence on the Head	11	4.6	(02.32 - 08.09)
Occurrence on the Neck and Shoulder	36	15.1	(10.78 - 20.24)
Occurrence on the upper arm	43	18.0	(13.34 - 23.46)
Occurrence on the leg	24	10.0	(06.54 - 14.57)
Occurrence on the Body	2	.8	(00.10 - 02.99)

Under the bivalent analysis, the following factors were significantly associated with occurrence of injuries: Gender ($p < 0.045$), marital status (single) ($p < 0.019$), Education level ($p < 0.000$), having other jobs ($p < 0.001$), type of occupation ($p < 0.02$), and Job satisfaction ($p < 0.034$), working under pressure ($p < 0.009$), and drinking alcohol ($p < 0.065$).

In the multivariate analysis, risk factors associated with solid waste that remained statistically significant were low level of education with no education having (odd ratio OR=1.000), Primary education (OR = 1.064019, 95% CI: 0.5399431, 2.09677), marital status and more especially single has empirically satisfies the relationship with occupation injuries having (OR = 7.136472, 95% CI: 0.7820925, 65.11919), gender where male gender statistically is significant with (OR = 1.298817, 95% CI: 0.6536932, 2.580607), working under pressure (OR = 7.136472, 95% CI: 0.7820925, 65.11919) and drinking alcohol at work with (OR = 1.309791, 95% CI: 0.6467055, 2.652758) as indicated in the table 7 below.

Table 7: Multivariate logistic regression model solid waste effect on workers

Injury occurrence	Odds Ratio	Std. Err.	P>z	[95% Conf. Interval]	
Gender					
Female	1				
Male	1.298817	0.4549725	0.455	0.6536932	2.580607
Marital Status					
Single	1				
Married	0.8876179	0.302307	0.726	0.4553253	1.730335
Divorced	0.221027	0.1831493	0.069*	0.0435628	1.121438
Education Level					
None	1				
primary	1.064019	0.3682577	0.858	0.5399431	2.09677
Post primary	0.2268117	0.0923496	0.000***	0.1021143	0.503784
Tertiary	0.2221176	0.1938007	0.085*	0.0401696	1.228198
Others Jobs					
Yes	1				
No	0.3192878	0.1026555	0.000***	0.1700235	0.5995918
Working under pressure					
Disagree	1				
Agree	7.136472	8.050528	0.081*	0.7820925	65.11919
Drinking Alcohol					

Disagree	1				
Agree	1.309791	0.4716217	0.454	0.6467055	2.652758

Source: Primary data

On the presence and use of safety measures, 138 (57.74% 95% C.I = 51.21 – 64.08) accepted the presence of PPE at work, 152 (63.6% 95% C.I = 57.15 – 69.70) accepted the use of PPE whereas 197 (82.43% 95% C.I= 76.70 – 87.03) agreed to be using hands while loading the waste. Furthermore, 84 (35.15% 95% C.I = 29.10 - 41.56) had to buy PPE for themselves, 59(24.69% 95% C.I = 19.35 - 30. 66) had PPE that were spoiled and not yet replaced, 49 (20.5% 95% C.I = 15.51 - 26.18) did not see the reason as to why they should put them on and 47 (19.67% 95% C.I = 14.82 - 25.28) were uncomfortable with them and that why they did not put them on.

On assessing the role of PPE on prevention of injuries and health hazards, 233 (97.49%) of the respondents agreed to the positive role of PPE on preventing the injuries as well as the significance of sharp objects to the occurrence of injuries. On the aesthetical satisfaction due to change of cloth after work, 180 (75.31%) agreed that changing cloth after work is aesthetically satisfying.

5. Discussions

In line with other studies that were conducted (16) and (17) and (18) and (19), this cross sectional study has revealed that there is occurrence of occupational injuries among the waste handlers. The Prevalence rate of injuries occurrence among the WHs udder this study was 123 (51.5% 95% C.I = 44.94 – 57.96). The study indicated lower rate compared to other studies that were conducted (17) and (19). The Study revealed the most common injuries that occurred were cuts with 62 (25.9% 95% C.I = 20.51 - 31.99), puncture with 44 (18.4% 95% C.I = 13.71 - 23.92) fracture with 6 (2.5% 95% C.I = 00.93 - 05.38) and the slips and fall with 4 (1.7% 95% C.I = 00.45 - 04.23). It is important to point out that these records are completely reasonable, given the protocol that is used to handle solid waste which is designed in such a way that workers must physically lift up heavy garbage bags either with plastic gloves or not. The physical injuries occurred mostly on body parts that are entirely exposed to human maneuvers that are required in that exercise. The findings showed that most of injuries occurred on the upper arm with number of injuries totaling to 43 (18% 95% C.I = 13.34 - 23.46) followed by the neck and shoulder with occurrence rate of 36 (15.1% 95% C.I = 10.78 - 20.24), leg with 24 (10% 95% C.I = 06.54 - 14.57), head with 11 (4.6% 95% C.I = 44.94 - 57.96), and body with 2(0.8% 95% C.I = 00.10 - 02.99). Whereas a similar study conducted in Ethiopia revealed that most injured body parts were hands with 22.7%, legs with 21.8%, neck with 19.8%, back with 17.2%. (17) Further more, a similar study conducted in Australia indicated that most body parts that were injured were hands with 9%, legs with 20%, neck with 21%, back with 25**%.** (21)**.** The discrepancy between hand, neck, shoulder, fingers and legs is attributed to the nature of the waste containers used which were not puncture proof and also to the mode of working mechanism where workers had to carry the garbage on their head and shoulder as they load the waste collecting trucks.

The results in this study concur with results of the study conducted in Ghana where 56.4% of the respondents confirmed body pains as a result of lifting and carrying solid waste (10). The study revealed factors that are associated with occupational injury occurrence which concur with other studies that were conducted in Ethiopia (17)

Similar to study conducted in on the carpet thread factory workers (22), this study revealed pressure/stress at work and gender among others as factors that are associated with occurrence of injuries.

The gender of the workers was significantly associated to the occurrence of injuries under this study which is consistent to the study conducted in (10) which revealed that male had more body pains compared to their female counter parts in the study but this is not in consistence with the study conducted in Ethiopia among the textile factory workers (23) This is attributed to the heavy work male do of lifting the waste bins. The most the male respondents were involved in the physical maneuvers of waste collection, lifting and loading on the trucks. The nature of the work male respondents were doing on addition to their behavior character of drinking alcohol exposed them to higher risks of occupational injuries at work.

People who were taking Alcohol were found to be more susceptible to injuries compared to those who were not drinking. The odd ratio 1.309791 for those who drink alcohol was found empirically significant to be associated with occurrence of injuries among the workers in this study and this is in line with the similar study that was conducted in Ethiopia among MSWWs (17) and tendahoro agricultural development in Ethiopia (24)

Another interesting factor is level of education where the study revealed that people who are more educated are less likely to be injured compared to their workmates who are either none educated or have low level of Education. This is attributed to the fact that the more people become educated, the more chances of understanding the dangers associated with waste management and thus able to apply the measures used to prevent them. This is in line with several studies that were conducted among the MSWW and other workers in different fields like textile factories. (17) and (25). It is of important for the government authorities in charge of waste management to ensure people who work in waste management are educated and where they are not, the government authorities should give them the on job trainings to help them understand the dangers of waste management.

Furthermore, the study revealed that people who had more than one job were likely to suffer from injuries compared to those that were settled at one Job. People with one job had OR=0.3192878, 95% CI= 0.1700235, 0.5995918). This may be attributed to workers being exposed to different waste items, restless at work, much work burden and use of unsuitable PPE. This could later lead to lack of concertation at work and un satisfaction with what they are doing. However, this is in consistence with studies conducted in Tendaho Agricultural Development S.C, (24)**.** In this case, the government should put in place remunerations that

motivates people to remain at one job in order to reduce the occurrence of injuries**.**

Furthermore, the factor of working under pressure was also statistically significantly to the cause of occupational injuries. This could be attributed to the fact that where there is too much work and pressure, there is lack of concertation and thus workers would intend to ignore some of the procedures to save time in order to be able to finish the work on time. In long run, this will not only make workers fore go the set procedures for safety measures but also develop the habit of being unsatisfied with what they are doing thus being exposed to occupational injuries and health hazards.

Another factor that was revealed with this study to be empirically associated with injury occurrence was marital status. The study revealed that people who are single are more susceptible to injuries compared to those who are married and those who are divorced. This can also be associated with the age of workers since most of the people that were un married were under 25 years of age. According to this, one can argue that the cause of injuries among unmarried people could be as a result of their energetic nature which encourages them to do physical activities at work yet they are less responsible to their life compared to the married people who are old and are more responsible for their life and family. It is therefore of great importance to ensure that un married people especially young are tightly supervised at work and advised to adhere with the precautions concerning the safety measures.

Similar to studies conducted in Malaysia (26) and (27), this study revealed that 197 (82.43% 95% C.I= 76.70 – 87.03) use hands in loading and lifting of waste. This automatically makes them to be exposed to waste dangers thus increasing chances of occupational injuries occurrence. On addition to this, when the workers were asked as to why they do not use PPE at work, 84 (35.15% 95% C.I = 29.10 - 41.56) had to buy PPE for themselves, 59(24.69% 95% C.I = 19.35 - 30. 66) had PPE that were spoiled and not yet replaced, 49 (20.5% 95% C.I = 15.51 - 26.18) did not see the reason as to why they should put them on and 47 (19.67% 95% C.I = 14.82 - 25.28) were uncomfortable with them. These reasons justifies a reason as to why there is high proportion of injury occurrence among the MSWWs and is supported by the results of similar studies (17). It is of great importance therefore, for the local government and the private sector to put in place measures of providing the PPE of quality to workers on time and train them on how to use them and their role.

The study further assessed the knowledge of the respondents on the measures used in prevention of occupational injuries. According to the responses from the workers, the highest proportion indicated that they are aware of the preventive measures used. 233 (97.49%) of the respondents agreed to the positive role of PPE on preventing the injuries as well as the significance of sharp objects to the occurrence of injuries whereas 180 (75.31%). agreed that changing cloth after work is aesthetically satisfying. This means that workers are aware of measures to be taken in order to prevent the occurrence of injuries. this study is consistent with the study conducted in Lideta Sub City of Addis abbab on knowledge and attitude of Municipla solid waste collectors revealed that 64% of study participants had good knowledge on preventing occupational health risks whereas 76.4% had good attitude(28) and is also in consistence with the study conducted in Ghana (29). However, these findings are contradicting with the findings revealed by the study conducted in west of Ethiopia and est Ghana which revealed high percetange of respondents with low knowledge on waste management and protective measures. (30) and (31)**.**

6. Strength and limitations of the study

a) Strength

Data was collected among the MSWWs in the City of Kigali to increase the power of the study. The tools used in data collection were proven and pre-tested before use. The tools used were also internationally accepted and recommended.

b) Limitations

The study was six months including data collection thus did not provide information in different periods. There could be a possibility of recall bias and social desirability bias resulting from under or over reporting and misreporting of the events.

c) What it adds

The prevalence rate and associated factors related to injury among the municipal solid waste workers in Rwanda is not known thus needs to be addressed plus the risk factors associated with them. This study will therefore play its role in the assessment of the occupational injuries prevalence rate as well as the factors associated with them. The study findings can be used in developing, promoting and adopting the strategies that can be used in preventing and minimizing the occupational injuries associated with Municipal solid waste management. Further still it can be used as guiding tool for other researchers. The study has provided information to the MSWWs to about the severity and prevalence of occupational injuries and how to minimize their impacts as well as information to ensure they are safe in their working environment and remain healthy

7. Conclusion

Occupational injuries is one of the disciplines that plays a big role in the development of the sector and country at large. In areas where there is always much of occupational injuries and hazards, there is always less production as people spends much of the time in hospitals and also spending what they have earned on medical bills. This cross sectional study have assessed the factors associated with occupational injuries among the City of Kigali Municipal solid waste workers.

Compared to other studies that were conducted in developing and developed countries, the injury prevalence rate of 51.5% was recorded with most of injuries recorded on “upper arm neck and shoulder, leg, head and body” while the common type of injuries revealed were “cuts, puncture fracture, slips and fall.”

The factors associated with injury occurrence were, Gender, marital status, level of education, working under pressure, having other job and alcohol consumption at work. The safety measures provided at work were not sufficient enough as PPE were not given and even those given were not enough on addition to being un appropriate for the intended purpose.

The study concludes that waste handlers experience a burden of occupational hazards including injuries. Lack of PPE which results into the use of hands performing multiple tasks in solid waste management increases chances of higher proportion of occupational injuries among them. There is a need for the government institutions and private sector involved in municipal solid waste management to provide the complete and appropriate personal protective equipments' to waste handles and also provide them with the basic trainings on municipal solid waste management. For future, the government institutions and private sector should put in place measures to address the above factors that have been identified as the cause of occupation injuries. There is need to conduct further research to determine other health hazards that could be occurring among the municipal solid waste workers.

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