# An Occupational Health Program for Waste Collection Workers

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**ABSTRACT**

***Context:*** The waste collection is necessary worldwide for inhabitants' health and living conditions. Waste collection workers are at risk of disease from exposure to various work hazards and fatal and nonfatal occupational accidents.

***Aim:*** Evaluate the effect of an occupational health program on waste collection workers' knowledge and practices.

***Methods:*** A quasi-experimental (pre and post-test) design was used. All five zones of the Suez Governorate were recruited for the data collected through the General Authority for Cleanliness and Beauty (GACB). A purposive sample of 95 formal waste collection workers conveniently participated in this study. Two tools were used for the assessment of knowledge and practices. An interview questionnaire was used to collect data regarding the waste collection workers' demographic data, work characteristics, medical history, and habits. It also assesses the knowledge of the waste collection workers regarding occupational health safety. A reported practice checklist was used to assess the waste collection workers' practices regarding safe waste collection practices.

***Results:*** The present study reveals that all the study sample was males, with a mean age of 38.76±5.13, 51.6% can read and write, had a mean year in occupation of 10.59±4.84, and had no training. 92.6% were previously injured during their work. The comparison of waste collection workers' total knowledge reveals statistically significant differences between pre-and post-program at $p<0.05$, while total practices of the waste collection workers are unsafe in pre- and had improved post-program with statistically significant differences between pre-and post-program implementation regarding all safety practices.

***Conclusion*:** Based on the present study findings, waste collection workers had better knowledge and safe practices after program implementation than their pre-program levels. The ongoing occupational health program is highly needed by the waste collection workers related to hazards of waste collection and preventive measures. Scheduled medical surveillance and availability of supervision by GACB to provide protection devices and equipment are strongly recommended.

***Keywords:*** Waste collection workers, occupational health program

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## 1. Introduction

The world generates 2.01 billion tonnes of municipal solid waste annually, and at least 33% of that is not managed in an environmentally safe manner. Worldwide, the average calculated waste generated per person per day was 0.74 kilograms, but ranges varied widely, from 0.11 to 4.54 kilograms. High-income countries generate about 34 percent, or 683 million tonnes, of the world's waste. However, they only produce 16 percent of the world's population *(Kaza et al., 2021).*

Around the world, waste generation rates are rising. In 2020, the world was estimated to generate 2.24 billion tonnes of solid waste, amounting to a footprint of 0.79 kilograms per person per day. With rapid population growth and urbanization, annual waste generation is expected to increase by 73% from 2020 to 3.88 billion tonnes in 2050 *(The World Bank, 2022).*

In low-income countries, over 90% of waste is often disposed of in unregulated dumps or openly burned. These practices create serious health, safety, and environmental consequences. Poorly managed waste is a breeding ground for disease vectors, contributes to global climate change through methane generation, and even promotes urban violence *(Kaza et al., 2018).*

Waste collection is a necessary activity all around the world for inhabitants' health and living conditions. Unfortunately, waste collection workers are at risk for diseases resulting from exposure to various work hazards and fatal and nonfatal occupational accidents. Waste collection can be practiced as either an occupation or an essential means of survival *(Boteler, 2018).* The WHO estimates that over 23 million infections of hepatitis B, C, and HIV occur yearly due to unsafe injection practices. The waste collection workers are victims of many diseases due to mixing medical waste with municipal waste *(WHO, 2017).*

They are also victims of environmental contamination due to substances mixed in waste, such as pesticides, organophosphates, and carbonate, which damage the nervous system and can cause cancer. Some may cause reproductive and endocrinal damage, and a few are carcinogens. Synthetic organics such as benzene and other

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petrochemicals can cause cancers. As for industrial waste like mercury and electronic waste, exposure in the short term may lead to altered liver function and skin lesions, whereas long terms exposure leads to impairment of the immune system, nervous, endocrine, and reproductive system *(Department of Environmental Quality, 2017).* Furthermore, waste collection workers are potentially exposed to various health risks. Collection of domestic waste is also a job that requires repeated heavy physical activity such as lifting, carrying, pulling, and pushing *(Aminuddin & Abdul Rahman, 2015).*

Many preventative measures have been proposed and implemented to reduce the risk of accidents and occupational disease. Such measures involve increasing safety and reducing the risk of musculoskeletal, respiratory, and gastrointestinal disorders *(Boteler, 2018).* Meanwhile, preventive measures and safety policies among waste collectors are crucial areas related to the economic status of a country and the lifestyle of its population and community *(Seow, 2014).*

Occupational health refers to identifying and controlling the risks arising from physical, chemical, and other workplace hazards to establish and maintain a safe and healthy working environment to gain safe and efficient waste collection systems *(Alli, 2008).* Training and health education programs should be provided to all waste collection workers from the start of work through adequate instruction and training to enable them to use personal protective equipment effectively and to gain knowledge and skills for the safe handling of waste and safe transfer to waste collection trucks and welfare facilities. These areas address common safety issues in everyday waste collection work and include improvement points that can be implemented at a low-cost through cooperation for waste collection workers (WCWs). Trainers should develop practical improvement guides, illustrations, and photos *(Bleck & Wettberg, 2012).*

No work is risk-free, and all healthcare professionals should know about workforce populations, occupational hazards, and methods to control hazards and improve health *(WHO, 2017).* So that occupational health programs address the broad range of workplace hazards, from accident prevention to the more insidious hazards, including toxic fumes, dust, noise, heat, and stress. Preventing work-related diseases and accidents must be the goal of occupational health programs to create worldwide awareness rather than attempting to solve problems after they have already developed and place the health and safety of all workers on the international agenda to stimulate and support practical action at all levels *(International Labour Organization, 2017).*

Occupational health nurses are a part of a larger occupational health service team providing occupational health advice on a consultancy basis and support for health problems protection at work by understanding the effects of work on health and health at work, screening for the early signs of health problems, assessing and managing workplace risks, training, and education *(Royal College of Nursing, 2011).*

## 2. Significance of the study

In Egypt, uncollected municipal solid waste (MSW) and substandard disposal practices are estimated to result in adverse health impacts across Egypt, equivalent to 1.5% of the Gross Domestic Product (GDP). It contributes to diminished air and water quality, adverse impacts on tourism, trade, and the attractiveness of Egypt as a place to do business *(Egypt-Cairo Municipal Solid Waste Project (2016).*

Egyptian waste collection workers deal manually with mixed hazardous wastes with substantially increased occupational health impacts. Waste management practice in Egypt has been largely focused on the issues of collection and disposal, with little or no attention paid to the health status of waste collection workers. They are exposed to many additional hazards that can adversely affect their health and well-being, such as long hours, changing shifts, physically demanding tasks, violence, and exposure to infectious diseases. Harmful chemicals are hazards that put these workers at risk for illness and injury. However, WCWs, often face many risks associated with their collection work, such as handling heavy and dangerous waste, traffic accidents, and hot working environments *(Ewis et al., 2014).*

*Shams El-Din et al. (2017),* in a study about health problems among municipal waste collectors in Sohag City, Egypt, reported injuries by 64% of the studied waste collectors, followed by musculoskeletal disorders 58%, fatigue 40%, respiratory disorders 32.4%, gastrointestinal disorders 24%, eye disorders 18%, and skin disorders at 16.8%. Most municipal waste collectors did not use personal protective equipment (PPE); none were vaccinated, had periodic checkups, and were trained before work.

Community health nurse plays a critical role in preventing waste collection hazards among waste collection workers. So, preventing work-related diseases and accidents must be the goal of occupational health programs. So, this study aimed to assess the effect of occupational health programs on waste collection workers' knowledge and safety practices.

## 3. Aim of the study

The study aims to evaluate the effect of an occupational health program on waste collection workers' knowledge and practices through:

- Assessing knowledge of the waste collection workers regarding occupational health hazards.
- Design and implement occupational health programs for waste collection workers.
- Evaluate the effect of the occupational health program on waste collection workers' knowledge and practices.

### 3.1. Research Hypotheses

- The waste collection workers exposed to the occupational health program will have better knowledge than their preintervention level.
- The waste collection workers exposed to the occupational health program will have improved practice compared with their preintervention level.

## 4. Subjects & Methods

### 4.1. Research Design

A quasi-experimental (pre/post-test) design was used to achieve the aim of the study. Quasi-experimental study designs are often described as nonrandomized, pre-post-intervention studies. The quasi-experimental design attempts to establish a cause-and-effect relationship by using criteria other than randomization *(Harris et al., 2006).*

### 4.2. Study setting

The study was conducted at all five zones of Suez Governorate, namely, Ataqa, Faisal, Arbaeen, Suez, and Ganayen, through the General Authority for Cleanliness and Beauty (GACB), which works under the supervision of the governmental administration. Each zone has the main place for waste collection workers to gather. This place contains room for a signature where they know the workplaces and hand over work tools.

### 4.3. Subjects

A convenient sample of 95 formal waste collection workers representing 25% as a sample size from the total number of (380) formal waste collection workers at all five zones of Suez Governorate, 19 WCWs for every pre-mentioned setting. The low intellectual level and psychotic WCWs were excluded. Finally, the estimated total sample number equals 95 WCWs from Suez Governorate.

### 4.4. Tools of data collection

Two tools were used for data collection.

#### 4.4.1. Structured Interview Questionnaire

It was designed by the researcher to include two parts.
Part I is concerned with the assessment of demographic data of the waste collection workers, such as gender, age, educational level, marital status, and the number of family members.
Part II included the work characteristics such as years of occupation, working system, number of working hours, types of motor activities, training, and work resources.
Part III encompassed the waste collection workers' medical history, such as chronic diseases, long-term medication, type of medication, the side effect of medication, history of injury during work, and timing of the injury.
Part IV covered the WCWs' personal habits, such as smoking, coffee/tea drinking, sports practice, and its frequency.
Part V is concerned with the assessment of the knowledge of the waste collection workers. This part included 64 closed-ended questions distributed under four main sections. The first section included the assessment of knowledge regarding occupational health and safety measures. It included four closed-end questions regarding the safety measures against work hazards, wearing personal protective closing, using preventive tools, and safety procedures for workers and equipment during work.

The second section was concerned with types of occupational hazards, which are physical, mechanical, ergonomic, biological, chemical, and psychosocial. It includes six closed-ended questions. One question for each type of hazard.

The third section assessed knowledge regarding preventive measures against work-related hazards. It included four subsections related to protection from hazards during work (6 MCQs), types of protective clothes (5 MCQs), types of auxiliary tools (6 MCQs), and personal hygiene (5 MCQs).

The fourth section is concerned with the assessment of waste collection workers regarding first aid. It included 13 subsections regarding the meaning of first aid (1 MCQ), the importance of first aid (2 MCQs), ambulance number (1 MCQ), four basic components of first aid bag (1 MCQ), first aid that should be done in case of an accident (4 MCQs), protection practice during first aid (3 MCQs), principles of first aid (3 MCQs), assessment of the conscious level of the injured person (3 MCQs), first aid to do to conscious injured (3 MCQs), first aid to do to unconscious injured (2 MCQs), safe way to open the air passage for unconscious injured (1 MCQ), first aid to wound injury (4 MCQs), and first aid to burn injury (4 MCQs) *(Kawakami & Khai, 2010).*

*Scoring system*

Each closed-ended question was scored as correct (1 score) and incorrect (zero scores). For each area of knowledge (part), the score of the items was summed-up and classified as two levels; satisfactory level of knowledge >50% of the subsection score and unsatisfactory level of knowledge for those who obtain <50 of the total subsection score. The same scoring was used for the total score of knowledge. These scores were converted into percent scores.

#### 4.4.2. Reported Practice Checklists for WCWs

This tool was concerned with waste collection workers' practices regarding waste collection. It was adopted from *Kawakami and Khai (2010)* and modified by the researcher to assess the following parts:
The first part was concerned with the assessment of the waste collection worker's practices regarding preventive measures, facilities, and others. It included three checklists. The first checklist included three main practices concerning personal protective clothes, special clothes for bad weather (rains), and wearing glasses when handling hazardous waste.
The second part was concerned with the practice of safe handling of waste. It consists of 9 items, including safe waste collection places, bins covered for insect and dust protection, waste at waist level of WCWs, the proper size of waste bins, arms for waste collection boxes, heavy boxes are raised between two workers, waste separated from cans, glass in separate boxes, a special box for sharp wastes, and left the waste collection area clean.
The third part was concerned with the practices of the waste collection workers regarding the safe handling of waste cars. It consists of 5 practices included: Standing away from the box and vehicle movement place, emergency stop on the vehicle, control panel that is easy to handle with simple

language, workers sitting inside the cabin during waste transportation, and the vehicle parked in a safe place away from traffic.

*Scoring system*

Responses of the WCWs regarding their practices were classified into two score levels: Done was scored as 1; not done was scored as zero for each item. Each subsection was summed up and classified as safe practice if the subsection total score was ≥65% and unsafe practice if the subtotal score was <65%. The same scoring system was used for the total practice score. These scores were converted into percent scores.

### 4.5. Procedures

Content validity: A panel of five experts (professors) from the community health nursing department, Faculty of Nursing, Ain Shams University, reviewed the tools for clarity, relevance, comprehensiveness, understanding, and applicability. They were the same panel that validated the program content. The tools' reliability was assessed by measuring their internal consistency with Cronbach's Alpha coefficient test. The structured interview questionnaire (knowledge section) had a reliability of 0.794, and the reported practices' checklist had a reliability of 0.771.

An official letter clarifying the purpose of the study was issued from the Dean of the Faculty of Nursing, Ain Shams University, to the directors of the General Authority for Cleanliness and Beauty and related governorates office of all zones in Suez Governorate to conduct the study and seek their cooperation for carrying out the study in the selected areas and collect the necessary data.

Approval was taken from the Dean and Faculty of Nursing, Ain Shams University Scientific Research, and Ethical committee before starting the study and agreement of the waste collection workers to participate in the study after explaining the aim of the study. Anonymity and confidentiality were assured. Ethics, values, culture, and beliefs were respected. WCWs were informed that they could choose to participate or withdraw from the study at any time. After obtaining the data collection permission, verbal informed consent before starting the interview was taken from each WCW. In a structured interview explaining the study's aims and purpose, they are told that the collected data will be used for research purposes. The collected data were coded, and all participants' data were treated confidentially.

The pilot study was conducted on 10% of the total sample of 95 WCWs, which equals the number size of 10 workers who were excluded later from the total sample to test the applicability of the developed tools, clarity of the included questions, and practicability, identify the obstacles and problems that may be encountered with data collection; and estimate the average time needed to complete the study tools. The needed modification was done, including rephrasing some questions and rearrangement the questions.

Fieldwork: After taking the study setting approvals and proper coordination for the suitable dates and times to implement the study, the investigator used to do phone calls before going to each zone for the WCWs supervisor to get their agreement for the appropriate date and time, which is based on the availability of WCWs at rest time or in between shifting to avoid any work interruption. On each work site, the investigator sits in the daily signature room, which considers a place of data collection from the study subjects, either between the shifts or during their rest time, or according to the schedule reported by the supervisor. The researcher followed these methods for data collection until the sample size was completed. The researcher used the study tools to assess knowledge and practice for WCWs before the occupational health program (pretest).

The occupational health program was constructed and conducted in four phases:

Preparatory phase: The occupational health program was designed by the researcher and based on the result obtained from pre-program assessment (pretest); also, a review of recent, current, national, and international related literature in various aspects of the occupational health among waste collection workers.

Planning phase: The researchers designed the occupational health program based on *Kawakami and Khai (2010)*. The implementation was based on designing the session plan, setting the program objectives, and sessions' objectives, determining the educational methods and media used, and designing a guiding booklet specifically designed and developed based on WCWs' needs revealed in the pretest.

The general objective of the program: The program will improve waste collection workers' knowledge and safe practices regarding hazards of waste collection and preventive measures. The program's theoretical content included occupational health rules, the nature of waste, the composition of municipal solid wastes, waste collection hazards, environmental hazards, disposal of hazardous waste, and public health and types of occupational hazards. The practical contents included safe waste handling, work environment, personal protective equipment, work facilities and organization, sanitary toilets, and washing facilities, resting corners and recreation facilities, safety and health training, and first aid training.

Implementation phase: It took nine weeks, four days/ week, four hours/day from (6 am-10 am) and sometimes from (12 MD- 4 pm). It was determined by the WCWs supervisor based on the availability of WCWs at rest time or in between shifts. Also, the number of hours differed from one session to another to accomplish the health education session and practice training. Program sessions were completed in ten hours allocated for each zone for occupational health program sessions. It was carried out in 4 sessions distributed (6 hours for theory and 4 hours for practices) for each zone.

At the beginning of the first session, orientation about the program and its purposes was given. Each session started with a summary of what was given through the previous session and the objective of the new one, considering using simple and clear language to suit the level of all WCWs. By the end of each session, a summary was made, time was allocated for questions and answers, and a plan for the next

session was made. Except for the last session, the sessions were terminated through feedback.

Methods used in teaching the program content included lectures, group discussions, videos and poster presentations, demonstrations, and re-demonstration. Suitable teaching aids, such as a booklet, handouts, and laptop, are prepared especially for the program. The booklet included all content of the program. It was given to the WCWs as an occupational health program handout. The program was implemented over three months, from the beginning of July 2019 until the end of September 2019.

Program evaluation phase: The evaluation phase aims to evaluate the improvement in WCWs' knowledge and practices (post-test). The researcher used the same pretest tools to assess knowledge and reported practice for WCWs. The post-test was conducted immediately after the program for the knowledge assessment. After two months, the researcher used the same reported practice checklist as the post-test to assess WCWs' practice.

### *4.6 Data Analysis*

All data were coded, tabulated, and subjected to statistical analysis. Statistical analysis is performed by SPSS (version 20). Since all the research variables are qualitative categorical variables, they are described by proportions and percentages. For the Inferential statistics, the Chi-square test is used or the Fisher Exact test if the expected frequencies per cell are less than 5. The significance level is considered at $p \leq 0.05$, highly significant was considered at $p \leq 0.01$, and a non-significant result was counted at $p > 0.05$.

## 5. Results

Table 1 shows that 100% 0f the studied sample was males, 50.5% of waste collection workers aged 35-<45 years with a mean age of 38.76±5.13 years. 51.6% of WCWs could read and write, and 28.4% could not read or write. Also, 82.1% of WCWs were married. Regarding the number of family members, 44.2% of the WCWs had 2-<4 members.

Table 2 shows that 44.21% of WCWs had 5-<10 years of occupation. Also, 42.1% of WCWs were working at morning shift. 97.9% of the workers were working 6-8 hours per day. Concerning types of motor activities at work, 100% were pushing, 93.7% of WCWs were carrying, and 91.6% bent. Also, 88.4% were pulling, and 76.8% of WCWs were climbing waste vehicles. At the same time, the WCWs had not gotten any training courses at work. Regarding work resources, 80% of the WCWs had a water source, bathrooms, and basins for washing hands. However, there is no food place, a place for washing work tools, a locker for saving protective clothes, or a recreational place.

Table 3 shows that 35.8% of waste collection workers had high blood pressure and 34.7% of WCWs suffered from chest allergy, and 16.8% had diabetes. 92.6% of WCWs were taking lifelong medications. 59.1% took analgesics, and 42.0% of WCWs took blood pressure medications. 92.6% of WCWs had been injured during work. 47.7% of them were exposed to injury during work for less than one year.

Figure 1 illustrates the percentage distribution of the WCWs' body parts injured during waste collection. Hands were the most body part that was frequently injured (56.8%), followed by fingers and feet (45.5%) for each, followed by backs (15.9%).

Figure 2 illustrates the percentage distribution of WCWs type of injuries. It illustrates that wounds and hematomas injured 64.8% of workers, punctures 39.8%, falls 27.3%, scribble 23.9%, fracture and lumber discs 22.7%, and muscle sprain 13.6%.

Table 4 shows that 78.9% of the WCWs were smokers, and 85.3% of them were smoking during work hours. 91.6% of WCWs were drinking coffee/tea. Also, 23.2% of the WCWs are practicing sports, 59.1% of them walk, 36.4% play football, and 45.4% of the WCWs practice sporting every day and twice per week.

Table 5 compares WCWs' knowledge pre and post-implementation of the occupational health program. It reveals a statistically significant difference between pre and post-program implementation in all knowledge elements regarding occupational health and safety measures, types of occupational hazards, preventive measures, first aid, and the total.

Table 6 compares WCWs' safe practices pre and post-implementation of occupational health program. The table reveals that 30.5% of the WCWs safely practice the safety measures pre-program, compared to 55.8% post-program, with statistically significant differences between pre and post-program implementation in all practices of the preventive measures, safety handling of waste, safety handling of the waste car, and the total.

Table 7 demonstrates the correlation between satisfactory knowledge and safe practice. It showed a none statistically significant correlation between knowledge and practice pre-program when the p-value was >0.05 and a statistically significant correlation between the satisfactory knowledge score and the safe practices post-implementation of the occupational health program.

## 6. Discussion

Waste collection workers pick up garbage for deposit at transfer stations. Waste collection workers face many health hazards. They are exposed to foul odors, dust, ants, and flies and get dirty easily even when they wear protective clothing if any. Several studies reported that waste collectors are at high risk for developing diseases resulting from exposure to various work hazards. It is a hazardous job that exposes its workers to infections, especially with the little protective measures they apply. The occupational health program among waste collection workers works as guidelines for safety measures and to control waste collection hazards *(Al-Khatib et al., 2019).* This study aimed to evaluate the effect of an occupational health program on waste collection workers' knowledge and practices.

**Table (1): Frequency and parentage distribution of the waste collection workers' demographic characteristics (n=95).**

| Socio-demographic characteristics | No. | % |
|---|---|---|
| **Gender** | | |
| Male | 95 | 100 |
| **Age (years)** | | |
| 25-<35 | 9 | 9.5 |
| 35-<45 | 48 | 50.5 |
| 45-<55 | 35 | 36.8 |
| 55-65 | 3 | 3.2 |
| Mean±SD | 38.76±5.13 | |
| **Educational level** | | |
| Cannot read and write | 27 | 28.4 |
| Read and write | 49 | 51.6 |
| Basic education | 13 | 13.7 |
| Technical & Intermediate | 6 | 6.3 |
| **Marital status** | | |
| Single | 13 | 13.7 |
| Divorced | 4 | 4.2 |
| Married | 78 | 82.1 |
| **The number of family members** | | |
| 2-<4 | 42 | 44.2 |
| 5-<6 | 41 | 43.2 |
| 6 or more | 12 | 12.6 |

**Table (1): Frequency and parentage distribution of the waste collection workers' work characteristics (n=95).**

| Work characteristics | No. | % |
|---|---|---|
| **Years of occupation** | | |
| 1-<5 | 12 | 12.63 |
| 5-<10 | 42 | 44.21 |
| 10-<15 | 37 | 38.95 |
| 15 or more | 4 | 4.21 |
| Mean±SD | 10.59±4.84 | |
| **Working system** | | |
| Shifting | 17 | 17.9 |
| Morning shift | 40 | 42.1 |
| Evening shift | 16 | 16.8 |
| Night shift | 22 | 23.2 |
| **The number of Working Hours (per day)** | | |
| 6-8 hours | 93 | 97.9 |
| >8 hours | 2 | 2.1 |
| **Types of motor activities at work** | | |
| Carrying | 89 | 93.7 |
| Bending | 87 | 91.6 |
| Walking for a long time | 50 | 52.6 |
| Stand for a long time | 30 | 31.6 |
| Climbing waste vehicle | 73 | 76.8 |
| Pulling | 84 | 88.4 |
| Pushing | 95 | 100 |
| **Training** | | |
| Work training course | 0 | 0 |
| Types of training course | 0 | 0 |
| **Work resources** | | |
| Water source | 76 | 80.0 |
| Bathroom | 76 | 80.0 |
| Basins for washing hands | 76 | 80.0 |
| Place for rest | 6 | 6.3 |
| Food place | 0 | 0 |
| The place to wash work tools | 0 | 0 |
| The place for saving tools | 91 | 95.8 |
| locker for saving protective clothes | 0 | 0 |
| Recreational Place | 0 | 0 |

*N.B: Responses are not mutually exclusive*

**Table (2): Frequency and parentage distribution of the waste collection workers' medical history (n=95).**

| Medical history | No. | % |
|---|---|---|
| **Suffer from any disease** | | |
| High blood pressure | 34 | 35.8 |
| Low blood pressure | 6 | 6.3 |
| Diabetes | 16 | 16.8 |
| Chest allergy | 33 | 34.7 |
| Others | 73 | 76.8 |
| Do not suffer | 4 | 4.2 |
| **Take lifelong medications** | 88 | 92.6 |
| **Medication types (n=88)** | | |
| Blood pressure medications | 37 | 42.0 |
| Diabetic medications | 14 | 15.9 |
| Heart medications | 2 | 2.3 |
| Renal medications | 11 | 12.5 |
| Analgesic | 52 | 59.1 |
| Others | 57 | 64.8 |
| **Side effects with these medications (n=88)** | | |
| Headache | 10 | 11.3 |
| Dizziness | 4 | 4.5 |
| Blurred | 6 | 6.8 |
| Shortness of breath | 2 | 2.3 |
| Drowsiness | 5 | 5.7 |
| I do not know | 70 | 79.5 |
| **Injured during work (n=95)** | 88 | 92.6 |
| **Injured from (n=88)** | | |
| <One year | 42 | 47.7 |
| >One year | 53 | 60.3 |

*N.B: Responses are not mutually exclusive*

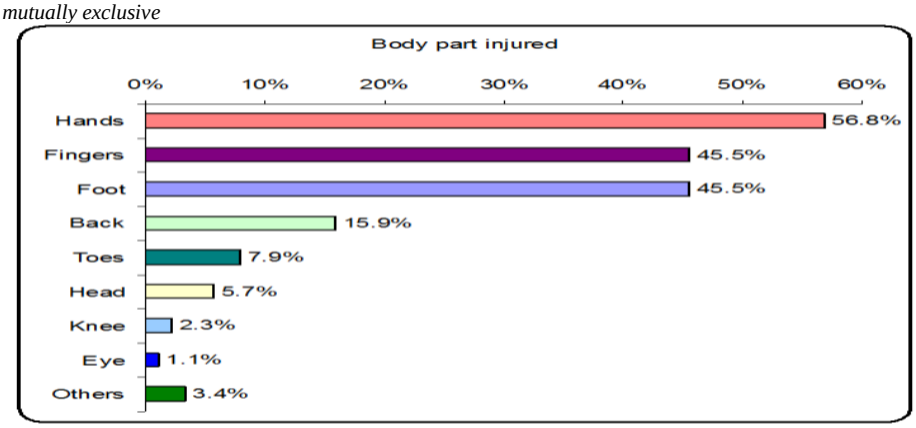


**Figure (1): Percentage distribution of the waste collection workers' injured body parts (n=95).**

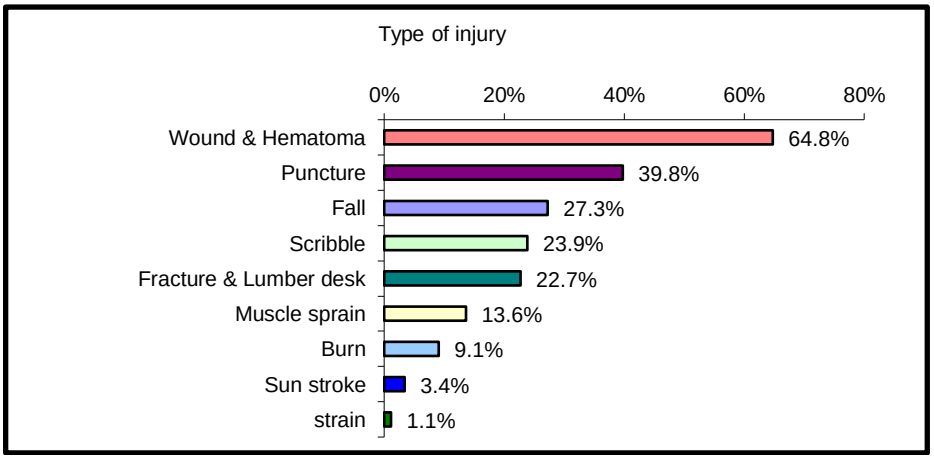


**Figure (2): Distribution of the waste collection workers' type of their injury (n=88).**

**Table (3): Frequency and parentage distribution of the waste collection workers' personal habits (n=95).**

| Personal habits | No. | % |
|---|---|---|
| **Smoking** | 75 | 78.9 |
| Smoking during work | 64 | 85.3 |
| **Drinking Coffee/tea** | 87 | 91.6 |
| **Practicing sports*** | 22 | 23.2 |
| Types of sports (n=22) | | |
| Walking | 13 | 59.1 |
| Foot Ball | 8 | 36.4 |
| Bodybuilding | 2 | 9.1 |
| Running | 2 | 9.1 |
| Frequency of practicing sporting per week (n=22) | | |
| Daily | 10 | 45.4 |
| Twice per week | 10 | 45.4 |
| Three times per week | 2 | 9.2 |

*N.B: Responses are not mutually exclusive*

**Table (5): Comparison of the waste collection workers' total satisfactory knowledge pre- and post-program (n =95).**

| Knowledge elements | Satisfactory level of knowledge | | | | $X^2$ | P |
|---|---|---|---|---|---|---|
| | Pre-program | | Post-program | | | |
| | No. | % | No. | % | | |
| Occupational health and safety measures | 22 | 23.2 | 55 | 57.8 | 14.53 | 0.014 |
| Types of occupational hazards | 52 | 54.7 | 93 | 97.8 | 14.35 | 0.016 |
| Preventive measures against work-related hazards | 41 | 43.2 | 74 | 77.8 | 11.67 | 0.033 |
| First aid | 25 | 26.3 | 42 | 44.2 | 16.28 | 0.025 |
| **Total** | 35 | 36.8 | 66 | 69.5 | 12.45 | 0.011 |

**Table (6): Comparison of the waste collection workers regarding their total safety level of practices pre and post-program (n=95).**

| Total practices about | The safe level of practices | | | | $X^2$ | P |
|---|---|---|---|---|---|---|
| | Pre-program | | Post-program | | | |
| | No. | % | No. | % | | |
| Practices of the preventive measures | 27 | 28.4 | 48 | 50.5 | 13.61 | 0.005 |
| Safe handling of waste | 30 | 31.6 | 36 | 37.8 | 7.14 | 0.041 |
| Safe handling with waste car | 29 | 30.5 | 74 | 77.8 | 19.08 | <0.001 |
| **Total** | 29 | 30.5 | 53 | 55.8 | 10.52 | 0.012 |

**Table (7): Correlation between waste collection workers' satisfactory knowledge and safe practices pre-program and post-program (n=95).**

| Intervention phase | Knowledge pre | | Knowledge post | |
|---|---|---|---|---|
| | r* | P-value | | |
| Practice pre | 0.078 | 0.738 | | |
| Practice post | | | 0.392 | 0.019 |

**Correlation is significant at the 0.05 level (2-tailed), and Correlation is significant at the 0.01 level (2-tailed).*

The studied WCWs' demographics show that all studied subjects were males, more than half of them were 35-<45 years, most of them were married, near half of them had family members between two to four members. These results could be attributed to waste collection work being hard work that needs young men's muscular efforts rather than women.

The findings agree with *Abd El-Wahab et al. (2014*) in their study entitled "Adverse health problems among municipality workers in Alexandria (Egypt)", who stated that most waste collection work was performed by male workers. Also, 82.4% were aged above 30 years.

Half of the studied subjects can read and write, and more than a quarter cannot read and write. These findings could attribute to various socioeconomic factors, e.g., illiteracy or inadequate education. General Authority for Cleanliness and Beauty currently provides literacy courses to elevate their educational level, but these courses must be applied adequately. This finding agreed with *Ravindra et al. (2016),* who studied occupational exposure to solid waste by municipal workers in Chandigarh, India, and reported that the waste worker profession is mainly dominated by males, except in rag pickers, and with a lower literacy rate.

According to work characteristics, the years of occupation show that almost half of them had between five and ten years in their occupation. This finding could be that WCWs in the past worked on a day-by-day basis as informal workers. Now, due to the increasing need for WCWs, with the increase in the volume of waste and the population in

developing countries that are more affected by uncontrolled waste, recruitment is considered the best option. The finding is similar to *Byung (2016)*, who reported that 41.7% of workers have five to ten years of experience.

The current study reveals that nearly half of them work in the morning shift, and all are engaged in motor activities, including pushing. Most of the sample had engaged in other motor activities such as carrying, bending, pulling, and climbing waste vehicles during daily work. Also, most work between six to eight hours per day. Although these risky activities, they did not receive any training courses regarding safe waste management, as no training was provided (by the General Authority for Cleaning and Beauty) for those workers. Additionally, they were deprived of some optimal work criteria of a place to rest, a place to wash work tools, lockers for saving protective clothes, and a recreational place. Only four-fifths had access to water sources, bathrooms, or basins for washing hands, which is evident in this study.

These results did not come in harmony with *Reddy and Yasobant (2015)*, who mentioned that 30% of studied samples did not take training about safe waste handling. Also, *Rogoff and Biderman (2015)* also reported that waste collection is among the most dangerous professions, and solid waste collectors had fifth-ranked deaths from occupational hazards. They reported 35.8 deaths per 100,000 workers. They have the highest number of nonfatal injuries and illnesses, most caused by overexertion, being struck, striking against, or being compressed in equipment.

Regarding medical history, more than one-third of the sample suffers from high blood pressure, nearly half are on a lifelong antihypertensive and have chest allergies. Nearly two-fifths had diabetes mellitus. More than half use a lifelong analgesic. These findings might be attributed to the nature of their work, as they are continually exposed to bad odors, fumes, smoke, and organic dust inhaled from the waste. Also, they need analgesics for muscular pain from exhaustion and extensive physical effort. Meanwhile, they need medical care for their chronic disease.

This result matches the finding of *Jayakrishnan et al. (2013).* who reported an increased risk of respiratory disease chest allergy among WCWs by 35%, which might be related to exposure to organic dust containing high concentrations of bacteria and fungi, biologically active agents, gases, bioaerosols in Bombay.

This finding was also supported by *Abd El-Wahab et al. (2014)*, who mentioned a higher prevalence rate of respiratory complaints, particularly cough, by 29.1% (dry or productive), found specifically with WCWs who ride on footplates on the backs of the trucks exposed to exhaust fumes, dust, carbon mono-oxide and welding fumes containing heavy metals.

Another study by *Slave and Bansod (2016)* supported these findings and reported that 55% of waste collection workers had a cough, sneezing symptoms, and chronic bronchitis in Germany. Waste collection has a potential risk for the development of chronic respiratory diseases higher prevalence of respiratory complaints, particularly cough (dry or productive).

Regarding the injury history of waste collection workers, this study shows that most of them were injured during work, and nearly half had recently been injured in less than one year. Their hands were the most frequently injured, followed by their fingers, feet, and backs. This finding might be attributed to unsafe practices during waste collection.

Regarding the type of injury, more than half of WCWs suffer from wound injuries and hematomas, followed by punctures among nearly two-fifths of them, then falls, scribble, fractures, and lumber discs among around one-quarter of the study sample, in addition to muscle pain. In the researcher's opinion, this could be attributed to the manipulation of waste mixed with glass, sharp material, and needles. They collect it by bare hand with inadequate protective measures that expose them to a high risk of wounds and punctures. The fracture and back disc might be referred to the motor activities in which the WCWs engaged, such as pushing, carrying, bending, pulling, and climbing the waste vehicle with no training on the safe practices of these motor activities.

This finding is similar to an Ethiopian study by *Tefera and Negussie (2015)*, who stated that 95% of WCWs were exposed to injuries. Picking openly disposed wastes, including hazardous substances, leads to direct exposure without adequate personal protection. Also, *Tegbaru et al. (2014)* in Addis Ababa, Ethiopia, reported that hands were commonly injured body parts among eighty percent of the studied WCWs, followed by fingers among three-quarters of the sample. These findings could be attributed manual handling of municipal solid wastes with various hazards, unsuitable protective measures, and absence of safety training and no special box for sharp wastes as a part of safety handling to prevent injuries during waste collection.

In contradiction to these findings, *Bleck and Wettberg (2012)* asserted that injuries among waste collection hazards were dermatological problems, especially on hands by 55%, regarding manual handling as a source of accidents and long-term injuries.

Moreover, waste collection workers' habits reveal some bad habits. More than three-quarters of WCWs were smokers, most smoking during work, and most consume coffee and tea. Besides some healthy habits such as practicing sports among only less than one-quarter of them such as walking and football. Smoking might have an adverse effect on their lung health, parallel with coffee/tea consumption might participate in rising their blood pressure. These findings might shed light on the need for such workers to schedule regular medical checkups and continuous health education.

Similarly, in Egypt, *Ewis et al. (2014)* mentioned a relatively high percentage of current smokers in WCWs than non-smokers by using a comparison group of 30.4% compared to only 18.1% of the comparison group (university employees). They found a higher prevalence of respiratory complaints and referred this complaint to their exposure to organic dust during waste loading work. This finding is congruent with the Egyptian study result, which reported that 80% of waste collection workers were smokers. Smoking

was associated with chronic bronchitis among WCWs *(Madian & Abd El-Wahed, 2018)*.

The current study reveals a statistically significant difference between pre and post-program implementation in all knowledge elements regarding occupational health and safety measures, types of occupational hazards, preventive measures against work-related hazards, first aid, and the total. These findings might be referred to the occupational health programs they were never exposed to before, as evidenced in this study, with no worker training before the current program. Also, the program provided knowledge that touched their personal safety, which was very interesting to them. The program also provided information about occupational health and safety measures, the nature of wastes, the type of occupational hazards they might be exposed to, preventive measures, the proper disposal of hazardous wastes, and first aid.

*Kumar et al. (2015)* studied "Effectiveness of intensive healthcare waste management training model among health professionals at teaching hospitals of Pakistan: A quasi-experimental study" and found in the post-intervention survey a statistical significance difference (<0.05) between the intervention and control group's knowledge.

*Kumar et al. (2016)* studied the "Impact of waste management training intervention on knowledge, attitude, and practices of teaching hospital workers in Pakistan. Pakistan". They found 18 months after the intervention that the mean scores on knowledge differed statistically significantly since the baseline and intervention groups had statistically significantly better knowledge at p<0.001 compared to controls.

The finding is similar to *Health and Safety Executive (2017)*, which stated that occupational health program helps waste collection workers who face many risks associated with their collection work, such as handling heavy and dangerous waste, traffic accidents by training materials such as video and poster presentations which may be effectively used for practice. These findings support the first research hypothesis.

Regarding the comparison of WCWs' safe practice pre and post-implementation of occupational health program, the current study reveals that less than one-third of the WCWs safely practice the safety measures pre-program, compared to more than half post-program, with statistically significant differences between pre and post-program implementation in all practices of the preventive measures, safe handling of waste, safe handling of the waste car, and the total. These findings might be referred to the effect of the current educational program that provided practices about safe waste handling, the proper work environment and organization, appropriate sanitation, and how to provide first aid in case of emergency.

*Kumar (2015)* reposted a similar finding as in the post-intervention survey; a statistically significant difference was found between the intervention and control group's knowledge, attitude, and practices. At the same time, within the control group, no statistically significant difference was reported (>0.05) after three months. *Kumar (2016)* reported a statistically significant improvement in the practices of waste collection workers after an occupational health program (p <0.001). The intervention group's health care and sanitary workers scored statistically significantly higher (p < 0.001).

*Redling (2020)* reported the findings of the "Days Away, Restricted or Transfer" (DART) program, which was an institution of athlete program for waste collection workers to decrease their injuries. The program uses a combination of on-site resources and online programs to help improve the wellness of waste management employees at three landfills, a recycling facility, and a chemical waste facility in the greater Portland area. The company reduced its total recordable incident rate by 37.6 percent to 3.71. Also, it showed a 35.5 percent decrease in worker's compensation allocations and decreased severe injuries in 2018. Further decreases occurred in 2019, and the company's total recordable incident rate dropped another 26.7 percent to 2.72. These findings support the second research hypothesis.

The study demonstrates a statistically significant correlation between the satisfactory knowledge score and the safe practices post-implementation of the occupational health program. This finding might be explained by the fact that when the WCWs' knowledge improved, the safe practices consequently improved. Similarly, *Khan et al. (2019)* stated a statistically significant relation between WCWs' knowledge and practice that ascertained that training or health education programs should be provided to all WCWs from the start of their work on solid waste collection.

## 7. Conclusion

Based on the present study's findings, it can be concluded that most of the WCWs had a low literacy level, performed a hard job that included many motor activities, were exposed to many hazards, and were provided no training. They show a statistically significant difference in their knowledge and safe practices at the post-test compared with their pretest level after implementing the occupational health program that supports the research hypotheses.

## 8. Recommendations

Based on the current study's findings, the following recommendations are suggested.

- continuous educational training programs related to waste collection hazards and preventive measures, protection devices, and hygienic measures should be held periodically and implemented for all WCWs, whether formal or informal.
- Provide a booklet that should be customized to their literacy level summarizing the information about safe waste management practices, different hazards associated with waste, and general instruction on proper waste disposal.
- Ensure an appropriate level of occupational safety during the waste disposal process and availability of supervision by GACB to provide protection devices and equipment.

## 9. References

***Seow TW (2014)***. Municipal Solid Waste Management in Malaysia: An insight towards sustainability. *SSRN Electronic Journal*. In the proceeding of the 4th International

Conference on Human Habitat and Environment. *Universiti Kebangsaan Malaysia, 18*, 192-206.

***Abd El-Wahab, E. W., Eassa, S. M., Lotfi, S. E., El Masry, S. A., Shatat, H. Z., & Kotkat, A. M. (2014).*** Adverse health problems among municipality workers in Alexandria (Egypt). *International Journal of Preventive Medicine, 5*(5), 545–556.

***Al-Khatib, I. A., Al-Sari', M. I., & Kontogianni, S. (2020).*** Assessment of occupational health and safety among scavengers in Gaza Strip, Palestine**.** *Journal Of Environmental and Public Health,* 2020, 3780431. https://doi.org/10.1155/2020/3780431

***Alli, B. O. (2008).*** *Fundamental principles of occupational health and safety.* 2nd ed., International Labour Office. GENEVA.

***Slave, P. S., & Bansod, D. (2016)***. Occupational morbidity among municipal solid waste loaders in Mumbai. *Social Science Spectrum, 2*(3), 195–202.

***Bleck, D., & Wettberg, W. (2012).*** Waste collection in developing countries—tackling occupational safety and health hazards at their source. *Waste Management, 32*(11), 2009–2017. https://doi.org/10.1016/j.wasman.2012.03.025.

***Byung, Y. J., Sangbok, L., & Jae, D. L. (2016).*** Workplace accidents and work-related illnesses of household waste collectors. *Saf. Health Work, 7*(2), 138–142. https://doi.org/10.1016/j.shaw.2015.11.008.

***Department of Environmental Quality (2017).*** Material management, solid waste disposal report, explanation of types of waste, Portland. An Official Website of the State of Oregon

***Tegegne, D., Desta, K., Tegbaru, B., & Tilahun, T (2014).*** Seroprevalence and transmission of Hepatitis B virus among delivering women and their new born in selected health facilities, Addis Ababa, Ethiopia: A cross-sectional study. *BMC Res Notes 7,* 239 (2014). https://doi.org/10.1186/1756-0500-7-239.

***Reddy, E. M., & Yasobant, S. (2015).*** Musculoskeletal disorders among municipal solid waste workers in India: A cross-sectional risk assessment. *J Family Med Prim Care, 4*(4), 519–524. https://doi.org/10.4103/2249-4863.174270.

***Ewis, A. A., Mohamed, E. S., Rahma, M. A., & Hifnawy, T. M. (2014).*** Occupational health-related morbidities among street sweepers and waste collectors at Beni-Suef, Egypt, *Egyptian Journal of Occupational Medicine, 37*(1), 79–94. https://doi.org/10.21608/EJOM.2013.773.

***Harris, A. D., McGregor, J. C., Perencevich, E. N., Furuno, J. P., Zhu, J., Peterson, D. E., & Finkelstein, J. (2006).*** The use and interpretation of quasi-experimental studies in medical informatics. *Journal of the American Medical Informatics Association: JAMIA, 13*(1), 16–23. https://doi.org/10.1197/jamia.M1749.

***Health and Safety Executive (2017).*** Health and hazardous substances in waste and recycling [Internet]. 2017 [cited 2017 January 2]. Available from: http://www.hse.gov.uk/pubns/waste27.htm.

***International Labour Organization (2017).*** *Canadian Centre for Occupational Health & Safety*. ILO International Occupational Safety and Health Information Center. Pp. 11-24.

***Kaza, S., Yao, L., Bhada-Tata, J., & Woerden, F. (2018).*** *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. The World Bank Group.

***Jayakrishnan, T., Jeeja, M. C., & Bhaskar, R. (2013).*** Occupational health problems of municipal solid waste management workers in India. *Int J Env Health Eng., pp. 2,* 42. https://doi.org/10.4103/2277-9183.122430.

***Kawakami, T., & Khai, T. T. (2010).*** *WARM: Work adjustment for recycling and managing waste*. Action manual for waste collectors and communities to promote their joint actions in improving safety, health, and efficiency in waste collection and management. International Labour Organization.

***Aminuddin, M. S. H., & Abdul Rahman, H. (2015).*** Health risk survey for domestic waste management agency workers: Case study on Kota Bharu Municipal Council (MPKB), Kelantan, Malaysia, *International Journal of Environmental Science and Development, 6*(8), 629-634. https://doi.org/10.7763/IJESD.2015.V6.671.

***Khan, B. A., Cheng, L., Khan, A. A., & Ahmed, H. (2019).*** Healthcare waste management in Asian developing countries: A mini-review. *Waste Management & Research: The Journal of The International Solid Wastes and Public Cleansing Association (ISWA), 37*(9), 863–875. https://doi.org/10.1177/0734242X19857470.

***Kumar, R., Somrongthong, R., & Ahmed, J. (2016).*** Impact of waste management training intervention on knowledge, attitude, and practices of teaching hospital workers in Pakistan. *Pakistan journal of medical sciences, 32*(3), 705–710. https://doi.org/10.12669/pjms.323.9903

***Kumar, R., Somrongthong, R., & Shaikh, B. T. (2015).*** Effectiveness of intensive healthcare waste management training model among health professionals at teaching hospitals of Pakistan: A quasi-experimental study. *BMC Health Services Research, 15, 81.* https://doi.org/10.1186/s12913-015-0758-7

***Madian, A. A., & Abd El-Wahed, A. Y. (2018).*** Adverse health effects among solid waste collectors in Alexandria Governorate, Egypt, *International Journal of Occupational Health and Public Health Nursing, 5*(2), 23–48.

***Egypt-Cairo Municipal Solid Waste Project (2016).*** Project information document (Concept stage), Government of Egypt, Project (P152961), Report No.: *PIDC18002. Washington, D. C.:World Bank Group*

***Ravindra, K., Kaur, K., & Mor, S. (2016).*** Occupational exposure to the municipal solid waste workers in Chandigarh, India. *Waste Management & Research: The Journal of the International Solid Wastes and Public Cleansing Association, ISWA, 34*(11), 1192–1195. https://doi.org/10.1177/0734242X16665913.

***Redling, A. (2020).*** Adapting to on-the-job injuries. https://www.wastetodaymagazine.com/article/adapting-to--on-the-job--injuries/

***Rogoff, M. J., & Biderman, D. (2015).*** Workers' safety in solid waste collection. MSW management. https://www.scsengineers.com/wp-content/uploads/2015/10/Worker_Safety_in_Solid_Waste_Collection_MSW_Nov-2015.pdf.

***Royal College of Nursing (2011).*** Career options in occupational health nursing Member Support Services Factsheet series, March 2011, No.11mss@rcn.org.uk

***Shams El-Din, A. A., Mohammed, A. S. E., & Abd El-Gaber, M. A. (2017).*** Study of Health Problems among Municipal Waste Collectors in Sohag City, Egypt. *New York Science Journal, 10*(4), 75-79.

***Boteler, C. (2018).*** SWANA: Solid waste fatalities in first 10 days of 2018. Available at: https://www.wastedive.com/news/swana-7-solid-waste-fatalities-in-first-10-days-of-2018/514609/

***Tefera, D. Y., & Negussie, D. B. (2015).*** Micro and small enterprises in solid waste management: Experience of selected cities and towns in Ethiopia: A review. *Pollution, 1*(4), 461-472.

***The World Bank (2022).*** Solid Waste Management: Brief. https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management

***WHO (2017).*** Occupational health, WHO programs and activities Workplace health promotion, *WHO Journals, P No1-3,http://www.euro.who.int/.*