OCCUPATIONAL HEALTH PROBLEMS AMONG DOOR TO DOOR SOLID WASTE HANDLERS IN SURAT CITY, GUJARAT

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Dissertation submitted in partial fulfilment of the requirements for the award of the Degree of Master of Public Health

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Dr. Sanjay Sujitranjan Das

CERTIFICATE

I hereby certify that the work embodied in this dissertation entitled *'Occupational Health Problems among Door to Door Solid Waste Handlers in Surat City, Gujarat'* is a bona fide record of original research work undertaken by **Dr. Sanjay Sujitranjan Das,** in partial fulfilment of the requirements for the award of the Degree of Master of Public Health under my guidance and supervision.

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DECLARATION

I hereby declare that the work embodied in this dissertation entitled '*Occupational Health Problems among Door to Door Solid Waste Handlers in Surat City, Gujarat*' is the result of original research and has not been submitted for any degree in any other university or institution.

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ABBREVIATIONS

CLW	– Cut lacerated wound
COPD	– Chronic obstructive pulmonary disease
GIT disorders	– Gastrointestinal disorders
MSW	- Municipal solid waste
MSWM	– Municipal solid waste management
MT	– Metric ton
PPE	– Personal protective equipments
SMC	– Surat Municipal Corporation
SWM	– Solid waste management

ABSTRACT

Background

Waste collection is considered one of the most dangerous job in the world since it exposes the workers involved to physical, chemical and biological hazards and predisposes them to certain occupation related morbidities. Occupational morbidities related to solid waste management has not been adequately addressed in developing countries.

Objectives

To study the prevalence of occupational related morbidities and factors related to them among door to door waste collectors in Surat, Gujarat, India

Methodology

A cross-sectional survey among 300 door to door waste collectors of Surat Municipal Corporation selected randomly. Data was collected using semi structured interview schedule and morbidities assessed using operational definitions of the Occupational Safety and Health Authority guidelines

Results

Among the door to door waste handlers in Surat, Gujarat 77.7 percent reported injuries, 71 percent reported skeletomuscular, 62.3 percent respiratory, 39.3 percent gastrointestinal, 36.3 percent eye and 30 percent skin disorders. Multiple logistic regression indicates major risk factors were workers new to the job, untrained workers, manual handlers, risky and unhygienic sorting of waste, non-use of protective equipments, part time job, not following protocol for waste handling and workers collecting household waste less than three tons per day. The poor hygienic behaviours and poor socio economic conditions, habit of consuming alcohol aggravate the risk of morbidities. Female waste handlers had more risk of skeletomuscular and gastrointestinal disorders.

Conclusions

Considerable numbers of door to door waste collectors in Surat Municipal Corporation suffer from injuries, skeletomuscular, respiratory, gastrointestinal and eye and skin disorders that seem to be related to their occupational characteristics. Personal protection, training and strict implementation of protocols of waste handling practices will help in protecting the waste handlers from exposure and related adverse health effects.

CHAPTER – 1

INTRODUCTION AND REVIEW OF LITERATURE

1.1 Introduction

Solid wastes may be defined as discarded solids arising from human or animal life and activities.[1] As per the environmental agency of the United Kingdom classification, wastes are two types[2,3] namely controlled type waste and non-controlled type of waste.

- Controlled solid waste generated from house hold, commercial, industrial organization, and construction and demolition sites.
- Non-controlled solid waste generated from agriculture, mines, quarries and degrading operation

In India, Municipal Solid Waste (MSW) includes commercial and residential wastes generated in a municipal or notified area in either solid or semi-solid form excluding industrial wastes but including treated bio-medical wastes.[4]

1.1.1 Municipal solid waste management

Municipal solid waste management (MSWM) encompasses planning, engineering, organization, administration, financial and legal aspects associated with generation, storage, collection, transfer and transport processing and disposal of MSW which include household garbage and rubbish, street sweepings, sanitation residues, etc.[5,101] MSW also considered as chemical or biological refuse of domestic or consumer origin, considered potentially pathogenic to human and/or the environment.[6] Solid waste workers as compared to general population has been found to have six times more relative risk of developing infectious diseases, around three times more relative risk for allergic respiratory disease and about one and a half times more risk for non-allergic respiratory disease, two and a half times more relative risk for chronic bronchitis, nearly two times

increased risk for hepatitis, ten times more relative risk for acute diarrhoea in studies done across Europe three times more relative risk for parasites in India.[7] Health risks from solid waste management occur mainly due to the contents of waste which include toxic, allergic and infectious substances, component of waste which include gases, dust, leachate and hard objects like sharp and nature of the waste while decomposing which includes gases, dusts, leachate and particles all of which cause adverse health effects. Solid waste management exposes the workers to adverse exposures during the handling of waste which involves working with odorous waste, working in traffic ridden areas, manual handling, lifting, accident during transportation, vibrations of vehicles, during processing of waste that includes exposure to odour, noise, vibration, accidents, explosion, and residual toxic substances, and during disposal of solid wastes that includes residual toxic substances, noise, vibration, accidents and even explosions.[8,9,17]

1.1.2 Solid waste management in developed countries [8,9]

Municipal solid waste workers of developed countries had considerable work related hazards till about three decades back. However they could be reduced to a large extent with the adaptation of standard norm and practices, protocols for waste handling, strict implementation of occupational and safety laws and mechanisation of waste handling which reduce the direct contact of workers with hazards. The waste sorting at material recovery facilities were designed to have facilities for dust suppression, conveyance enclosure and controlled ventilation at work environment and appropriate personal protective equipments for the workers. Strict regulations were made to make waste collecting containers covered, be of specified size and weight and in addition reduction of the contact of waste handlers with hazardous waste was also facilitated by strict source segregation and different types of wastes separately managed in secure transport, processing and disposal facilities.

1.1.3 Domestic solid waste management in south Asian countries

In the countries in south Asia, large population sizes, increase in industrialization led to unplanned urbanization and changing patterns of consumption behaviour of people in the past two decades. This has resulted in an increase in the generation of solid waste in this region. Increase in solid waste generation has created challenges for the environment and health of the people of the region.[10] The waste generated in the developing countries is however still lower than the developed countries in terms of quantity.

The difference between the developed and the developing countries is with regard to the stress on the environmental and health concerns raised by the solid waste management. There is little stress on regulatory frameworks or safety standards for workers in the developing countries in contrast to strict implementation of environmental protection laws and occupational safety standards in the developed countries.

The system of municipal solid waste collection in the developing countries continues to be mostly manual and involves a labour-intensive system. At source, the waste discharged for collection is seldom strictly segregated in plastic or metal containers and covered with lid. The waste is left on open grounds that require shovelling by hand, or left in an open cartons or baskets that require to be picked up manually. In either case, the waste awaiting collecting is open to insects, rodent vectors and scavenging animals. These unsegregrated wastes may contain hazardous waste materials (defined as toxic, inflammatory, reactive, explosive or infectious and containing batteries, electronic sludge, paint and its solvent, pesticides and infectious medical waste) that predisposes waste collectors to be in direct contact with them and make them prone to significantly more adverse occupational health risks than their counterparts in developed countries.[8,9]

1.1.4 Solid waste management in India (SWM) [11]

The epidemic of plague in Gujarat, India in 1994 was a key milestone in the development of solid waste management sector in the country. There has been a renewed

focus on improving the delivering of solid waste management services in the country.[12] Local self governments like the municipal corporation and the gram panchayats have been accorded the responsibility for SWM of the respective areas.[10]

The municipal waste generation has grown from 3200 metric tonns per day to 5355 metric tonns per day, which indicates a growth of around 67 percent. The reasons for this trend are many including changes in lifestyle, food habits and standard of living. Per capita waste generation range between 0.2 kg and 0.6 kg per day in the Indian cities amounting to about 1.15 lakh metric tonne of waste per day and 42 million metric tonnes annually.[13,10]

MSWM though an essential service, is given low priority[6] and the faced by the system include rapidly increasing area to be served, quantity of waste, inadequate resources, societal apathy, inappropriate technology and therefore lower efficiency and disproportionately high cost of human resources. Cost on human resources accounts for 90 percent of the total expenditure waste collection. Waste collectors in India are predominantly from the lowest socio-economic situation and constitute one of the most deprived sections of the urban population. Therefore under nutrition, anaemia, tuberculosis, and other bacterial and parasitic diseases are very common amongst waste collectors. These factors render them more susceptible to occupational health hazards.[8,9,14]

Waste handlers in developing countries including India have greater risks of occupational morbidity since they are exposed to hazardous materials daily, unaware of the hazards of solid wastes, absence of any protective measures while at work, less access to health care. Since most of them are from poor socio-economic situation and the work predominantly manual the workers resort to separating the waste into sellable and eatable material for personal use.[8,9,14]

1.1.5 Solid waste management in Surat city, Gujarat[15]

The fastest growing city of India is governed by The Bombay Provisional Municipal Corporation Act (BPMC), 1949. The BPMC act specifies at least 25 activities as the obligatory duty of a corporation among them health and sanitation. The salient features of solid waste management in Surat are as follow; Area of Surat Municipal Corporation is 327 Sq. Km which is divided into seven zones for administrative purposes which consisting of 72 sanitary wards. The organizational setup of SMC for Solid Waste Management comprises of Commissioner, Dy. Commissioner, Medical Officers, Dy. Health Officers, Chief SI (Sanitary Inspector), SI's, SSI's, Mokaddams, etc. At present quantity of MSW generated is 1100 MT of which collected and transported quantity includes 1050 MT. Stake holders in Surat city for solid waste management are Surat Municipal Corporation officials and staff, elected political body of SMC, contracted companies, People of Surat, Industrial and Business communities, NGOs and Environmentalist. Types of waste in Surat city:[16] 1) Domestic waste - Residential houses- 45 percent, 2) Trade wastes – Traders, Hawkers, Shops, Hotels, Offices, and Community halls – 25 percent, 3) Clinical waste – Hospital and Nursing Homes – 5 percent, 4) Other wastes including industrial waste – Drain silt, Building activity waste, Street sweeping, waste from Industries, etc. – 25 percent. The organic waste is the main constitute of waste in MSW and it is about 30 to 32 percent of total waste which is composted very fast. Composition of MSW of Surat contents are; compostable (30.53 percent), plastic (3.57 percent), metal (0.86 percent), glass (1.13 percent), recyclable paper (26.01 percent), brick stone (14.97), earth (38.89 percent), miscellaneous (4.76 percent).

1.1.6 Surat municipal corporation door to door solid waste collection project

Door to Door system is a point collection systems in which workers are collecting the solid and semisolid household waste from house to house of city area. Collection point is at which a truck stopping to collect waste. This involves the movement of truck; there are many collection points for truck to stop. Door to door waste collection system,

in Surat, the household waste is collected from assign societies or apartments or areas of SMC jurisdiction by waste collectors in waste collecting vehicles and transporting it concern transportation zone. The workers are also collecting the waste from commercial areas. First, door to door system started on 1/4/2004 in Central zone, East zone, and Athwa zone. In November 2005, this system was started in remaining zones. After expansion of Surat city all the areas are covered with this system. For this door to door system three private companies have given the contract. Total 894 workers are working in this system at present.

Table 1.1 Summary of door to door waste collection system in SMC is given below.

Name of zones	No. of vehicles	No. of routes	Man power	Duration of work	Covered population
1) Central zone	44	44	121	7 am-2 pm	4,13, 641
2) East zone	53	53	209		9,17,609
3) Athwa zone	26	26	88		3,13,233
4) West zone	33	33	119		3,33,084
5) Limbayat zone	28	28	119		4,86,184
6) Udhna zone	28	28	118		4,95,392
7) North zone	40	40	120		5,13,896
TOTAL	252	252	894		34,73,039

1.2 Review of literature

1.2.1 Occupational hazards of municipal solid waste

Waste collection can be practice as either an occupation or essential mean of survival which exposed them to various high work hazards, as are the risks of various morbidities and factors like socio-economic status which is low and their working environment make them more vulnerable to hazardous exposure. Risk of morbidities increases with the intensity and duration of exposure to hazards, as well with the age of workers.[18] Workers performing waste collection, transportation and unloading operations are exposed to certain hazards which are primary related to high workloads, and that the manner in which work is organized may increased the baseline risk. Multidisciplinary aspects of Occupational hazards and injuries:[8,9,17,19]

1) Immediate causes: are personal protective equipments (safety equipments) provided but not used, hazardous handling (failure to watch for sharp or slippery objects and pinch points, lifting, loos grip, etc.), improper tool or no tools for handling waste given by employers, hazardous movement of workers (running stepping on, climbing over, throwing, etc.).
2) Un safe conditions (ineffective safety device, no safety device, hazardous house hold waste, equipment and tools are defective) and Safety management performance (inadequate instruction, rules not enforced, safety not planned as part of job, infrequent employee safety contacts, hazardous not corrected, safety device not provided).
3) Mental condition of workers (lack of safety awareness, lack of co-ordination, improper attitude, slow mental reaction, lack of emotional stability, nervousness, tempramentalism and no attention in work). Physical condition of workers (Extreme fatigue, deafness, poor eye sight, lack of physical qualification of job, hearing condition, crippling and other handicap).
4) External environments: design of vehicles, trade (engage in handling waste that is rear-loading versus side loading truck), waste producing sectors (residual or market waste) and their location, seasons (climate condition), residential supports, Types of authorities.
5) Working environment: There is significant difference between the job's formal definitions (by law, formal organization and management of waste collection), and the work actually performed in the condition of constrains faced by both workers and management.

The US National Research Council's recommended framework for health risk assessment involves; Identifying hazards, the exposure routes, and the dose-response relationship for various pathogens; characterizing the risk; and managing risk.[20]

1.2.2 Working environment as hazardous exposure

Biological hazards: Aeroslization of microbial pathogens, endotoxins, odors and dust particles is an inevitable consequence of generation and handling of waste material.[21] Primary human pathogens (including viruses, mycoplasmas, bacteria, fungi, and cysts or egg of intestinal parasites, found primarily in disposable diapers and household medical waste), Secondary pathogens and their toxins (spores and endotoxin) generated by bacteria and fungi growth within household (composting) waste, Volatile and semi-volatile organic chemicals of both synthetic and natural origin (including noxious odors), Allergens from household and yard waste, Corrosive, caustic, explosive and sharp materials are present household waste.[22] Some of more communally reported occupational health and injuries issues workers of MSW are; respiratory illness (due to inhalation of particulates, bioaerosols and volatile organic during waste collection), infections (from direct contact with contaminated materials, dog and rodent bite, or eating of waste fed animals), punctured wound (may lead to HIV, tetanus and hepatitis), headache and nausea (due to noxious content of waste and odour).[8,9] The physically demanding work carried out at a high speed results in pulmonary ventilation of 25-40 l/min instead of the normal 6 l/min.[39] At high pulmonary ventilation, particles may travel further down into respiratory tract, thus inducing irritative reaction.[39] Various routes of diseases transmissions are as follows:

a) Diseases transmitted by inhalation

Bio-aerosols: It is aerosol or particulate matter of microbial, plant and animal origin that is often used synonymously with organic dust and it may consist of pathogenic and non-pathogenic live or dead bacteria and fungi, viruses, high molecular weight (HMW) allergens, bacterial endotoxins, Mycotoxins, peptidoglycans, β(1→3) -glucans, pollen, plant fibres, etc.[22,23,24] These bio-aerosol produce potential health hazards among the waste handlers.[22,23,24] High concentration of organic dust found in summer season around the truck which cause for health hazard related to occupational exposure to bio-aerosol

reported for different environment and even causal microbial agents are isolated but often cause for disease are difficult to assess because of dose response relationship[29,30,35] which is very complicated to measure and furthermore no standard instruction or protocol to exist for sampling to accurate measurement of contamination cause by germs presence in environment[30,31] even though the acute symptoms are found at higher concentration than is require for the chronic effect from long term exposure.[30] Measurement of bioaerosols in workplace there for urgently required. Waste handlers are exposing to bioaerosols when collecting household waste but the exposure level of bacteria, fungal spores, glucans and endotoxins are moderate compare to working population as farmers, cotton workers, and sewage workers where health effects are reported after bioaerosols exposure.[32] Filamentous fungi (mould) and bacteria grow in biological contaminated waste and when these materials are handled, airborne micro-organisms and spores are emitted in air as inhalable organic dust or bioaerosols.[33] The 'loader', who is in the closest contact with waste, had highest bioaerosols exposure level in the team because sample obtain from the roof of the truck had significantly higher concentrations of total microorganisms, viable fungi and dust than all other sample- by about ten higher that means that the loader was probably exposed to higher peak values when he was working close to the scoop of truck in Geneva.[34] Exposure to air contaminants is correlated with working condition- the loader is most exposed during collection of household waste.[34] The level and composition of the aerosols generated during handling of waste depends on several factors including; The type and composition of waste, The weather condition, Number of household in the city, Type of collection equipments, Trucks, The collection procedure therefore comparisons between systems are therefore difficult.[35] In case of type of truck, the low loading was associated with higher exposure compare to high loading truck.[35] Exposure level to microorganisms during collection of all waste fractions during the summer are fairly high compare to levels associated with health effects, while personal exposure to dust and endotoxins were low.[35] Exposure levels during winter time were lower by a factor of two compared to level in summer.[35] Waste collectors were

significantly lower exposed when they use truck with a loading at two meter, a curtain and exhaust ventilation, compare to truck loaded at a level of one meter in summer.[35]

Volatile organic compounds: In addition to bioaerosols exposure, waste collectors are also exposed to volatile organic chemical (VOCs) which might be expected to cause irritation of mucous membranes of the upper respiratory tract or having nauseating effects.[36] VOCs are found in solid waste decomposition gases and because of their property like low solubility and able to generate high vapour pressure it is found in the headspace of loading area of solid waste collection trucks which includes alcohols, aldehyde, ketones, carbolic acid and esters, and total VOCs concentration varied from 0.9 to 8.1 mg/m^3 in the loading area of headspace.[8,9] High microbial activity also results in high VOC level in waste.[37] High VOC (volatile organic compound) level in waste which cause for GIT disorder.[38] Exposure to VOCs in the handling facility was three times higher than at landfill sites, being at highest 3000$\mu g/m^3$, considered to be the limit for discomfort.[39] The exposure to in waste collection was generally low, but it is possible that while opening a waste container the worker can be exposed to high level of microorganism and VOCs for short period of time.[39]

Odour: Unpleasant odour have been considered warning signs or indicators of potential health risks to human health but not necessarily direct trigger of health effect. Malodours provide warning of microbial growth in waste.[40,41,42,43,44] Malodour elicit complaints of eye, nose and throat irritation, headache, nausea, diarrhoea, hoarseness of voice, sore throat, cough, chest tightness, nasal congestion, palpitations, shortness of breath, stress, drowsiness, and alteration of mood.[40,45,46,48] The symptoms which are produced by odour exposure might be due to co-pollutant such as endotoxins or innate (genetically coded) or learn aversion or odour compound properties which cause irritation or other toxicological effects which served as exposure markers.[40-47] The environmental odour may play either a central or bystander role in the genesis of acute air pollution-related symptoms.[44] Odour is a very complex issue with many factors dictating why certain odours are more or less

offensive to different individuals.[45] Human can respond both mentally and physically to unpleasant odors.[45] Odour associated with a hazardous waste site describe the relation between worry (a mood disturbance) and physical symptoms such as headache and eye and throat irritations as one where physical and psychological effects of the irritating odour acted synergistically to produce overall reaction.[45,47] Significant positive relationships were observed between the prevalence of several symptoms (headache, nausea, and eye and throat irritation) and both frequency of odour perception and degree of worry.[95] Headache showed a prevalence odd ratio of 5.0 comparing respondents who were noticing environmental odours frequently versus those notice no such odours and 10.8 comparing those who described themselves as 'very worried' about environmental conditions.[95]

a) Diseases transmission by direct contact with MSW:[8,9] In developing countries, workers are working with-ought any safety measures and they are handling waste and dirty containers with-ought wearing any gloves and only wearing sandals or slippers as footwear and stepping on the waste, hence coming into direct contact with hazardous infectious agents like viruses (e.g. HIV and Hepatitis), enteric infections and parasitic infections (e.g. *Trichris trichuris*, *Ascaria lumbricoides*). Workers injuries and poor hygienic practice also play major role in direct contact transmission.
b) Diseases transmission through Vectors:[8,9] The organic materials in the waste provide breeding sites for insect and rodents of varied spaces. There is probability of increase incidence of diseases like Dengue, Malaria, Leptospirosis, Enteric fever.

Chemical hazards: result from the hazardous like car and regular batteries, oils, greases, insecticide/ herbicides, solvents, paints, cleaning products, cosmetics drugs and aerosol containers under pressure found in house hold solid waste which they handled it without any safety gears may cause for higher morbidities among waste handlers. In developing countries, waste collectors are exposed to high level of diesel exhaust fumes than counterpart in developed countries and probably cause for respiratory problems and also decrease lung function capacity.[8,9]

Ergonomics and Psychological hazards: Because of lack of equipment facility, waste collectors are lifting, puling, and pushing heavy.[8,9,18,56] Vibration induced musculoskeletal disorder in waste collectors found.[8,9,18,56] long and irregular work day including night, struggle for survival, and uncertainty about the future, poor socio-economic conditions, low wages and job discrimination all can have negative impact on their mental health.[8,9,17]

Other source of hazards:

Work load: In developed countries like UK waste industry implemented norm and standard for waste handlers[51] but it is not possible to implement in India. In India, the condition is quite different and waste collection total labour intensive and mostly manually done,[8,9] so collection speed average is many time lower and work condition and environment is quite opposite or different. The physical and mental load of waste collectors is very much higher than the waste collectors of developed countries. Because waste collectors of developing countries working under unfavourable and unsafe condition therefore they are exposed to hazardous conditions.[8,9]

The diversity and nature of object handled: handling of objects and container of variable weight interrupts the smooth flow of operation and break the rhythms. These hidden objects of household waste contains heavy, large and bulky object, sharp and pointed objects and hazardous materials. These types of objects are cause for serious problems.[8,9,17]

Work organization (Human resources management):[17] the elements which increase the work load and by extension hazards among the waste handlers are; flat-pay scale, rout organization, dispatching and allocation, work-team training, schedules, employment criteria, training, personnel turnover, the nature of collection contracts, bylaws and extensive job categories.

Training to solid waste collecting workers has been given inadequate and too short, and veterans' expertise not exploited. Mentoring by more experienced workers is far from

systemic. Collectors learn on job, in street, with no preparation. It is rare that new employee receive information on work practices that would permit them to perform their job without wearing themselves out or injuring themselves. Workers adopt faster work rhythms on heavy collection days in order to finish their rout within the allotted time. The knowledge of collection route is major determinants of efficiency and safety of the waste collectors. Due to rapid urbanization is cause for expansion of the city boundaries which disrupt the management process of the waste collection and increase work load which ultimately produce pressure on the employers for recruitment of new inexperience personnel with high turnover while experience workers, who view their job as a true trade, develop a wealth of insight into their collection routes and try to manage energy expenditure, adopt safer, more effective and productive work rhythm, and incur few risks. This development is only possible when the workload only within acceptable limits and workers are able to maintain work rhythms which are suitable to them. Due to expansion of enterprises expansion and hence to developed problems, they lost their control of this important phenomenon and discipline. This may explain the high frequency of occupational risks and accidents observed. Some hazards are beyond the control of waste collectors (as oppose to work rhythm) and can only be control by the 'art of route'- so allow collectors to manage their workload.

Variation of resident behaviour:[7,8,9,10,11] prohibited or dangerous waste skilfully hidden in regular waste, non-standardise containers, large and excessive large and heavy waste, disagreement over collection times and nonconformity with bylaw all increase the number of hazards. Waste collection is heavily influenced by the habits and behaviours of residents who generate the waste.

1.2.3 Work related health risks among door to door solid waste handlers

According to 2002, International Labour Organization, 270 million workers experience occupational accidents annually (approximately 360 000 fatally), while

another 160 million workers incur occupational diseases, with million dying each year (ILO-2002). Even within health impact assessment, hazards and risk faced by workers- usually greater than in the case of general population, by virtue of nature of exposure- are typically not specifically reviewed. With regards to, the collection of municipal solid waste represents the greatest and most diverse set of hazard of all waste management aspect. The data on solid waste workers and related health effects are limited.

Injuries: British Medical journal (1991) banned the word of 'accident,' which implies that injuries are unforeseen, perhaps random events, marking their prevention as somewhat futile goal and particularly non-fatal injuries thought of less serious, has not received much attention.[49,50] The main issue is that the lack of attention the evaluation of interventions is a failure of injury prevention as a science; specifically the evaluation of occupational injury interventions has been describe as an area of 'in the greatest need of more attention and effort.' Unpredicted latency period of occupational injuries cause for limitation of the evaluation of injury prevention effort.[50] The science of injury epidemiology is built around the reorganization that injuries are not unfortunate, random events- and that if we approach the problem in scientific manner we can identify the event leading to injuries and design the intervention to abate hazards, can evaluate the effectiveness of these interventions.[50] The average annual accident rate in solid waste collection industry of Brazil is almost 80 accidents for every 2000 hours of collection. This equivalent to 8 workers of every 10 suffering an injury at least once in a year. Four accidents occur for every 1000 10-tonne workloads.[17] The most common accidents appear to be; crushed hand, fingers, arms (18 percent), lacerations (18 percent), scrap and bruises.[17] The UK waste industry reported around 4100 to 4300 accidents per year, although the figure did reduce to around 3800 in 2001/02.[51] The major injury accident rate for the waste industry in 2001/02 is estimated 330 per 100,000 workers which is three times more than the national rate (101 per 100,000).[51] The accidents predominantly occur during refuse collection, with significant occurring during loading/unloading and on-site transfer activities. Over 3-days injuries accidents account for around 85% of total number

of accidents. Handling and sprain injuries resulting from refuse workers handling refuse during collection account for the largest proportion of three days accidents. The peaks accidents higher in 30 to 39 years of age group.[51] In Brazil 1992, 81 garbage collectors reported injuries were; Wound, cutting-contusion injury, cutting injury, excoriation-30 (29 percent), Tenosynovitis, tendinitis-25(24.3%), Trauma, contusion, hematoma, ecchymosis-17 (16.5 percent), Ligament injury, contracture, sprain, crepitation-9 (8.7 percent), Lumbalgia-8 (7.8 percent), Fracture-4 (3.9 percent), Other-4 (3.9 percent), Pain-1 (1.0 percent), No information available-5 (4.8 percent).[52] The most affected body parts were; Lower limbs-67 (65.0 percent), Upperlimbs-18 (17.5 percent), Spine-8 (7.7 percent), Thorax-1 (1 percent). Face-1 (1 percent), Skull-1 (1 percent), Elbow and skull-1 (1 percent), Foot, face and hand-1 (1 percent).[52] A total of 103 injuries occurred among 81 garbage collectors; major cause of accidents was improper garbage wrapping.[52]

Musculoskeletal disorders (MSD): Musculoskeletal disorders of the low back and upper extremities are an important health problem, resulting in approximately one million people losing time from work each year.[53] There is relation between back disorders and physical work; that is manual material handling, load moment, frequent bending and twisting, heavy physical work and whole body vibration while for upper extremities, repetition of work, force and vibration particularly important work related factors.[53] There is association between work related low back disorders and work related psychological factors like rapid work place, monotonous work, low job satisfaction, job decision latitude and job stress while in case upper extremities the work related psychological factors are high job demands and high job stress.[53] A number of characteristics of individual appear to affect vulnerability to work related Musculoskeletal Disorders, including age, body mass index, and number of individual psychological factors.[53] These factors are important as contributing and modifying influence in development of pain and disability and in transition from acute to chronic pain.[53] There is biological plausibility for association between musculoskeletal disorders and workplace physical exposure.[53] Studies on refuse collectors health complain reported increased the

risk for musculoskeletal morbidities in Brazil, Denmark, Taiwan and the USA and the most affected body region was low back and other frequent affected parts are the shoulder, knee, and neck, depending on methods of collection.[54] The important risk factors for MSD were biomechanical workload, lifting, pushing and pulling and whole body vibration.[18,54,56] There were chances of fatigue complaints due to energetic work load for eight hours.[18,54,56] Whole body vibration is seen as important risk factor for back complaints. Waste collectors are exposed to whole body vibration while sitting in refuse truck or standing on riding steps at back of truck.[18,55,56] They might be exposed to higher vibration than a normal truck due to the mechanical system that empties, the wheel container, the mechanical compression of refuse in cargo space; the situation is aggravated by the bed road condition of streets areas of city.[55] A cross-sectional study with self responded questionnaire in Tehran, Iran reported that prevalence of symptoms in low back (45 percent), knees (29 percent), shoulders (24 percent), back (23 percent) and neck (22 percent) in waste collector.[56]

Respiratory disorders: Organic dusts which airborne particulates of vegetable, animal or microbial origin also called bio-aerosol contains fungal spore, β(1-3) glucans and endotoxins and exposure to it cause for respiratory morbidities among household solid waste handlers.[3,7,54,57,59,60,61,68,69] Respiratory and systemic disease a possibility as result of exposure by inhalation or skin absorption of large variety of chemical compounds.[58] Workers in waste not only exposed to a mixture of bio-aerosol including bacteria, endotoxins and mouldy spores and other airborne particles but also to exhaust gas of the trucks in work environment.[62-66] Epidemiological survey of 400 waste pickers in Calcutta, India showed that 71 percent of workers experienced some form of respiratory disease as compare to 34 percent of control group.[7] 95 waste workers studied at an Mumbai showed, 73 percent respiratory ailments among them 25 percent workers had coughs and approximately 26 percent experienced dyspnea.[7] Testing the pulmonary function of waste pickers at a dump site in Bangkok revealed that 40 percent below normal range.[7] Waste collectors working with certain combination of equipments, types of work and work

routines resulting in relatively high level of bio-aerosol exposure have a significant increased prevalence of self reported symptoms related to bronchitis.[68] Waste collectors' exposure to organic dust and microorganisms is dependent on the type of waste handled and the methods used in waste collection.[68,70,71] Long exposure to low concentrations (even below the maximum allowable concentration) of the irritant produce symptoms of respiratory disorders like higher prevalence of chest tightness, flu-like symptoms or sore throat and chronic bronchitis in garbage handlers.[72] Primary effect of exposure to bioaerosols is often an inflammatory response of upper airway with congested nose, sore throat, and dry cough often connection with symptoms of the eyes like redness and tears (mucous membrane irritation) subsiding several hours after the end of exposure.[33] Increased health risk due to exposure to bioaerosols, mainly infection of the upper airways and skin were reported in workers sorting waste.[33] Allergy of moulds can trigger type I allergies- such as bronchial asthma and allergic rhinitis.[33] The (sub)-chronic airway inflammation seemed to be associated with bioaerosols exposure and microorganism and their constitute such as endotoxin may be the etiological agents involve.[72] The exposure to microbial agents is probably associated with the increased prevalence of respiratory symptoms and upper respiratory inflammation.[73] Within group of waste collectors a dose-response relationship between exposure and increased upper respiratory inflammation.[73] The upper respiratory inflammation was shown at end of working week.[73]

Gastrointestinal disorders: The incidence of gastrointestinal problems like diarrhoea and nausea sometimes with vomiting may be greater in waste collectors.[74-78] An exposure-response relation was found among refuse collectors nausea and endotoxins and between diarrhoea and exposure to both endotoxin and viable fungi which is aggravated in summer seasons because of higher concentration of micro-organism *Aspergillus fumigates* and endotoxins around the truck.[54,74,75,76,79] Nausea and diarrhoea were reported among the waste collectors due to organic fraction of household waste, high demand at work and low job support.[74] As expected diarrhoea was more prevalent among waste

collectors when returning to work after a weekend or holiday.[74] A dose response relationship between level of exposure to fungal spore and self reported diarrhoea was indicated means the higher weekly dose, the more reports of diarrhoea.[76] Inhalation of Gram-negative bacteria, which contain endotoxin cause inflammation of the GIT problem.[74] High microbial activity also results in high VOC (volatile organic compound) level in waste which cause for GIT disorder.[76] There is association between GIT symptoms and job as waste collectors and more over symptoms predominantly occur in summer.[74] GIT problem also follow the seasonal pattern.[75] Other relevant pathway for exposure were ingestion (dirty hands when eating eating/smoking) or because of psychological factors (the smell of waste).[76,77] There is association between level of high exposure to fungal spores was associated with diarrhoea among waste collectors.[76] There is association between GI symptoms and work with recycling or sorting of house-hold waste where high concentration of micro-organisms found in paper waste that come from mixed house-hold waste.[79] Sorting of paper associated with diarrhoea where as plastic cause for nausea. Working with compost was cause for diarrhoea.[79] Female are reported more symptoms than male.[79] Total of 37 out of 274 (13 percent) reported diarrhoea where as total 58 out of 276 (21 percent) reported nausea while sorting in household waste in Danish waste collectors.[79]

Dermatological disorders: In developing countries particularly in India where waste handling done by manual waste workers which exposed the waste worker to dermatologic problem.[8,9] Because in the house-hold waste there are presences of sharps, chemicals and microorganisms which are causes for skin disorders.[8,9] There is high chances of trauma from sharp simultaneously infection from micro-organism in waste among solid waste handlers.[8,9] Skin problem resulting from direct contact with waste and from infected wound.[57] Because of manual handling of waste collection and nature of material handled, puts workers carrying it out at risk for various injuries and skin diseases.[80]

Eye problems: The mucous membrane is first exposed to enteric hazards of pollutant coming out from municipal solid waste. In study of USA, 10 to 25 percent of eye injuries reported among waste collectors due to sharp objects. High concentration of chemicals, bioactive dusts and other potential irritating compounds in house-hold waste come into direct contact with face/eyes may responsible for irritation and inflammation. Exposure to aerosol from waste cause for eye and nose irritation.[81] The household waste collectors always complaining of burning eyes, watery discharge and dimness of visions. According to UNEP Report, 1992, eye problem is due to infected dust.[54] 95 workers studied at Mumbai showed 80 percent had eye problems.[7] Large amount of dust from garbage irritate mucous membranes and also Eye injuries have been constant problems as result of foreign body.[1] Eye and skin injuries from splashes and contact with broken glass others edges.[58]

1.2.4 The Municipal Solid Wastes (Management and Handling) Rules, 2000 [4]

The schedule II of the Management of MSW rule strictly inhibit the manual handling of solid waste but there is flexibilities under special conditions and authorities are always privileged with these special conditions and all precaution for safety measures elopes when it reaching to ground reality. This is clause IV that stated that manual handling prohibited but if in unavoidable condition due to constrains, manual handling shall be carried out under proper safety measures **(**Schedule II– rule 6(1) and (3), 7(1) - Management of Municipal Solid Waste).

1.2.5 Personal protective equipment (PPE)

As per Federal Regulation, USA mandates that, to protect the workers' first important preferable step is through engineering and/or administrative control, but when it is not possible, the use of PPE is required.[82] Waste collectors' bioaerosol exposure may correlate with PPE[91] and it required for workers are Safety glass or goggles, Steel-toed shoe, chemical-resistant, a two-glove system consisting of an inner vinyl or latex glove

and outer chemical resistant (Nitrile) gloves , a poly-coated Tyvek coverall, a chemical-resistant splash apron and half-facepiece respirator respirators with organic vapor/acid gas cartridge or mask.[54] In addition to PPE, eye washes and showers are necessities for minimizing the effect of splashes or spills.[54] To prevent or minimize the hazard which is associated with lifting, banding and twisting by installing more automated bulking equipment. Material handling equipment such as Fork-lift, hand-operated trucks and lifts and conveyers.[54] Routine Medical checkups of workers and viability of PPE is essential safety measures for waste handlers.[54] Providing PPE to hazardous waste worker not only solution to preventing diseases but important is to understand the workers' perceptions of their risks and their attitude about the use of PPE.[83] It responsibility of health professional to develop meaningful educational materials and effective training programs and assuring adequate protection of workers requires co-operation of many parties including employers, health professional and especially the workers' themselves.[83] Inappropriate or non- use of PPE by workers may an important contributor to occurrence of occupational diseases. There is knowledge gaps are the major barrier that can interfere with proper use of PPE.[83] Factors that affect the use of PPE are: Knowledge, belief and attitude (which includes vulnerability to diseases, PPE use, work exposure, medical clearance, Training, Fit testing). Physical and psychological effect (includes somatic/health effects, personal comfort, visual effects, fatigue, communication and anxiety); External influence (Included structural environment, quality and availability of PPEs, co-workers influence, supervisor influence and organizational culture).[82,83] Often the workers' perception about the hazards to which they are exposed and the measures that are needed to protect themselves are neglected component of this triad.

1.2.6 Potential confounders: of which influence the household MWS collectors study are Low socio-economic status, active and passive smoking, poor living condition such as inadequate sanitation, poor housing, unsafe water supply and restricted access to health care.[7,8,9]

1.2.7 Job rotation

Job rotation can be defined as lateral transfer of employees[84] or regularly alternating between different jobs within organization on the basis of scheme or spontaneous alternating on basis of the worker' need.[85] Rotation of task is generally advocated by ergonomist, who concentrating on both physical and mental workload. The goal of rotating tasks should not be to lower workload as such, but to divide physically and demanding work equally among the employee. Job rotation can be defined as systemic alternating task, in order to improve mental workload and to stimulate variation of physical workload. During their illness they should provided the facility for job rotation, so they can recover well from their illness. The effect of job rotation cannot easily be estimated because of the complex effects of altering task. Job rotation might be less effective than expected.[85] Rotating task is believed to enhance skills,[84] to improve quality, reduce monotony and to generate flexibility in employment. Job with a dynamic type of work and great difference in muscular activity should be able to benefit especially from the introduction of job rotation[88] Job rotation might be an effective measure to reduce the risk of musculosketodisorders,[86,87] although its effect has not been established.[89] The job rotation had no effect on the intensity with which the task was performed but decrease the perceived load and the energetic load, but perceive fatigue and exertion did not differ.[90]

1.2.8 Seasonal variation, Climatic condition and the nature of objects transported

Household waste are wet and dry and during seasonal variation the weight of waste varied.[17] Collection of waste from various points which required need to rush and faces traffic problems in roads and the street where cars are parked and crowd of people.[17] All these cause mishaps and dangerous recovery manoeuvres.[17] Waste collectors' bioaerosol exposure may correlate with season of year.[91] A seasonal variation of level of endotoxin is found due to variation in gram-negative bacteria presence in environment.[96]

The season had statistical significant influence on the concentration of total micro-organisms, culturable fungi, A. fumigates, and endotoxin with lowest concentration in the winter but the bacterial concentrations showed no clear seasonal variation.[91] The higher concentration of airborne endotoxin in summer than winter is probably due to change in content of waste and higher bacterial growth in warmer months.[92,93,98] While in a study found that no seasonal environmental variation of endotoxins exposure of household waste collectors.[94] These seasonal variations of exposure may cause for variation in disease pattern.[91] The extreme weather conditions to be far more crucial to waste collector's health.[39]

1.2.9 Waste collecting vehicles

Transportation means conveyance of MSW from place to place hygienically through specially designed transport system so as to prevent foul odour, littering, unsightly conditions and accessibility to vectors.[4] Waste collectors' bioaerosol exposure may correlate with Waste Collecting Vehicles.[91] Vehicles loaded from top (approximately 3 m above the ground) caused lower exposure (by factor of 25) to fungi than vehicles loaded at the level or breathing zone of worker.[91] The use of a bio-truck (a high loading of waste) to collect household waste in containers decreased the exposure level compared to the common compactor truck (low loading of the waste).[91] The truck with exhaust ventilation resulted in lower exposure level to microorganisms in relation to basic truck in study.[91] The exposure to fungi and bacteria was fairly low compared to collection of waste using basic compactor truck.[91]

1.2.10 Potential impact of Epidemiology on prevention of occupational disease [99]

The evaluation of epidemiologic methods in studying non-infectious disease has been of particular benefit to the study of occupational disease and has resulted in expanded knowledge about health risk in working environment. The recognizing the

study categories are descriptive, etiologic and intervention to explore applications of epidemiology to prevention of occupational disease. Descriptive study provides information for setting priorities, identifying hazards, and formulating hypothesis for new occupational risk which ultimately provide sufficient idea intervention. But the modern epidemiology gives emphasis on aetiology study and that required R. Doll's epidemiological four criteria for associations. But the value of epidemiology to practice of public health, and particular the practice of occupational health is critical. Now, it is essential that the science of epidemiology and science of public health be rejoined so that maximum advantage is taken of every opportunity to prevent disease and promote health and academician should take part in these prevention efforts.

1.2.11 Validation of interview for estimating morbidity [100]

There are several potential pitfalls in assessing validity, such as selection bias, difference in populations and pattern of diseases in study populations compared to community. Factors affecting the validation of the instrument are cost, characteristics of candidate illness, linguistics and respondent reorganization of illness, recall of the illness and its signs, imperfect external standards, selection bias.

1.3 Rationale of the study

The US Bureau of Labour Statistics reported that garbage collectors have the seventh most dangerous job in the world.[81] Because of inadequate understanding of magnitude of the problem and poor financial resources, the risk are still largely unmanaged in most of developing countries like India. While going through the literature, it is quite clear that apart from injury due to hard objects present in solid waste; a lot of factors play the role to decide the occupational health and safety for MSW workers. Work related health issues reported from developed countries are directly applicable to developing countries like India, but risk levels can be multiplied in latter because protective measures are seldom implemented in these countries. Due to lack of research in

the past in India, it is evident that most of the literature survey and citing of example come from foreign authors. But in other countries particularly in developed countries, they are using the latest equipment to handle the solid waste, working environment and climate of those countries different than India.[8,9,51] Scenario in India is quite opposite to those countries. So study on risk of health related problem among door to door waste handler is more required in India. Surat city is the cleanest city of country. SWM project is very well implemented in Surat Municipal Corporation, Gujarat. But study of work related health problem among door to door handler till not done. These work related hazards can be prevented, if risk assessment and then risk management properly implemented. The emphasis could be given to the worker which is exposing to waste directly.

1.4 Objectives of study

- To study the prevalence of occupational related morbidities among the door to door solid waste collectors.
- To study the factors related to reported morbidities among door to door solid waste collectors.

CHAPTER– 2

METHODOLOGY

2.1 Study design

This is a Cross-Sectional study.

2.2 Study setting

The study was conducted in solid waste management project of Surat city, Gujarat. 894 workers are engaged in this project. These solid waste workers are collecting Household solid waste as door to door bases.

2.3 Sample size estimation

As per Urban Paper, 2006 of World Bank Group recorded prevalence of various morbidities. The lowest morbidities in solid waste worker were skin problems which is around 30% in Mumbai dump site solid waste workers. These values were taken in account because of absence of any available data on morbidities among Door To Door solid waste collectors in Surat and Gujarat State. Sample size estimation was done using EpiInfo version 3.3 (statcalc.exe). The result was as follow: (*Calculated by Epi Info state cal)* Study population size: 894, Expected frequency: 30 percent (Ref. Urban paper, 2006), Worst acceptable: 25.00 percent, Confidence level: 95 percent, Sample size: 230. The advice sample size is 230; however, it is increased to 300.

2.4 Sample selection procedure

Simple random sampling done.

Inclusion criteria: Door To Door Solid Waste Workers define as people who are engaged in the Door To Door solid waste collection. A job experience of minimum one year is made mandatory.

Exclusion criteria: Critically ill worker who require immediate medical intervention.

2.5 Data collection technique

Data is collected from the participant by Interview method with help of semi-structured interview schedule.

Interview Schedule is developed from pre-existing validated questionnaire like:

- OSHA Respirator Medical Evaluation Questionnaire (Mandatory)- 1910.134 App C. http://www.osha-slc.gov/OshStd_data/1910_0134_APP_C.htm
- Englehardt JD, Fleming LE, Bean JA, Huren AN, Nicolette J, Rogers J, Danits M. Solid waste management health and safety risk: Epidemiology and assessment to support risk reduction 2000. Florida centre for hazardous waste management. www.floridacentre.org

The interview schedule is administered in Gujarati language and made up of various sections. The study makes use of a semi-structured interview schedule for collection the information from participants. Section 1 had question regarding socio-demographic factors like age, sex, education, and income etc. In section 2 contain questions pertaining to non-occupational exposures like tobacco (smoke/smokeless) habits, presence of industry near home, and so on. In third section, the duration of exposure is included which is measured by asking duration of job, working hours, and so on. In last section is dedicated to capturing the various morbidities in form of symptoms, self responded and if possible clinical records.

The pretesting of interview schedule was done from 15th June 2009 till 30th June 2009. The data collection was done from 01st July 2009 till 31st August 2009 without interruption. The principal investigator was collecting the data after obtaining the inform consent from each participant, and no other person employed for same purpose. All this procedure conducted in workplace or home of participant.

Validation of symptoms complexes: Validity of the symptoms complexes asked to assess diagnosed various morbidities. Validation is done by comparing the results of interview schedule with gold standard as the clinical records if participants having.

2.6 Data storage

Along with data collection the data were entered in Epidata version 3.1 and then imported to SPSS for Windows version 17.0 for analysis purpose. The hard copies of interview schedule are stored in a lock chamber under the vigilance of principal investigator. The privacy and confidentiality strictly maintained.

2.7 Data analysis

Data were entered with Epidata version 3.1 and scrutinized in same software and then export to SPSS for window version 17.0 for analysis purpose. The base line characteristics were analysed by descriptive statistical principal, for example mean age, sex, population, educational status, income, etc. Bivariate and multivariate analyses were performing in SPSS.

2.8 Operational definitions of work related risks [109]

Based on the symptoms identified and reported by MSW workers, the following operational definitions made for various disorders for further analysis.

Musculoskeletal disorders: Presence of any one of musculoskeletal symptoms during past 3 months defined as; Pain, Ache or Discomfort in one of nine body regions (neck, shoulders, elbows, wrists or hands, upper back, low back, hips or thighs, knees, and ankles or feet). Joint stiffness, Swelling and pain, Deformity and immobility in one of mention nine regions. Due to this pain/stiffness difficult to move arms, legs, head movement, waist movement, bending knees, and squatting to grounds. Muscle Spasm,

Muscular cramp or involuntary muscle contraction which causes shortening of flexor muscles and cause for severe pain.

Respiratory disorders: Presence of any one of respiratory symptoms during past 3 months; Dry cough, Cough with phlegm, Chest tightness, Itching nose, Running nose, Sneezing, Wheeze, Wheeze and breathlessness, Sore throat, Fever.

Chronic Bronchitis: Cough with or without phlegm for a period greater than 3 episode in last year OR Wheezing OR morning cough/sputum for greater 3 episodes in last year. Each episode greater or equal 2 months.

Asthma: As reported by the subject and confirmed by diagnosis OR currently under medication of asthma OR being woken up by shortness of breath at night.

Tuberculosis: AS diagnosed by a physician and reported by subject.

Chronic obstructive airway disease (COPD): AS diagnosed by physician or reported by subject OR Nocturnal dyspnoea at rest and cough with phlegm or wheeze.

Rhinitis: Sneezing OR Itching nose OR Nasal secretion.

Allergic Rhinitis: Sneezing OR Itching nose OR Nasal secretion OR Itchy watery eyes.

Gastrointestinal disorders: Presence of any one of gastrointestinal symptoms during past 3 months; Nausea and/or Vomiting. Acute Peptic Disease (Pain in Epigastria region of abdomen). Any other self reported or diagnosed by physician, diseases like Hepatitis A, Hepatitis B, and Warm infestation and other GIT diseases.

Injuries: Self reported or medically diagnosed any of the injury/injuries in past 3 months. Cutting injury, Cut and lacerated injury (CLW), puncture wounds, Excoriation, lacerated, Bruise, Contusion, Fracture, and any others injuries.

Eye disorders: Any self reported or diagnosed eye problem during working hours, in past 3 months. Burning of eyes, Soreness of eyes, eye injury and any other eye problems.

Skin disorders Any of self reported or medically diagnosed skin disorders.

Other symptoms: Like head ache, decrease appetite, insomnia.

2.9 Predictor variables

Demographic variables:	Age, sex, place of residence, place of nativity.
Socioeconomic variables:	Education status, Monthly personal income, previous occupation, Part Time Job.
Behavioral variables:	Smoking, smokeless tobacco and alcohol.
Passive smoking:	At work place and home.
Job characteristics:	Duration in the job, Duration of work hours, nature of employment, training before joining job, Job-rotation, Handling of waste (Manual handlings or use of any equipment), place of handling waste, Type of work (Collection of waste, Collection and segregation).
Safety measures:	Use of safety measures (Mask, Gloves, Gumboots, Uniform, and Goggles)
Personal hygiene:	Habit of washing oneself and changing clothes after work, taking lunch/snacks during working hours.

2.10 Outcome variable

Work related morbidities among door to door solid waste collectors which were diagnose by operational definition. These morbidities are; Injuries, Musculoskeletal disorders, Respiratory disorders. Gastrointestinal disorders, Skin disorders, Eye problems. Work related risks are measured by Self-responded.

2.11 Ethical considerations

Confidentiality: The identity of the participant was kept anonymous after the stage of data entry. The SPSS sheet containing the data had only the interview number/id. A separate list of name and address of the subject along with their interview number/id is kept strictly confidential and not exhibited during data analysis.

Privacy: The interview was conducted in the workplace or home of subject. An isolated setting was ensured. Information from the study was not passed on to manager private agency of solid waste management or any corporation official.

Consent: Inform written consent in Gujarati was obtained from the participant before commencement of interview. The participant had freedom to withdraw from the study and this information is provided in the consent.

Referral: Participant with severe morbidity of any nature was referred to Surat Municipal Corporation hospital and /or Government medical college, Surat. The doctor for consultation was pre-arranged.

CHAPTER – 3

RESULTS

The cross sectional survey was carried out among the door to door solid waste collectors of solid waste management project of Surat Municipal Corporation (SMC) during period from 1st July to 31st August 2009. A total 300 workers took part in survey. The nature of the work of the waste collectors is such that they collect the waste from their assigned areas, sorted the waste and emptied the vehicle at the dumping site (referred as transportation) of each zone.

The sample population was selected from the various zones of Surat Municipal Corporation (SMC); with the number of participants from each zone proportionate to the number of workers in each zone. The final sample from the seven zone of SMC were as follows 13.3 percent from central zone, 23.3 percent from east zone, 13.3 percent from west zone, 10.0 percent from Athwa zone, 13.0 percent from Limbayat zone, 13.7 percent from Udhna zone and 13.3 percent from North zone. Analysis of data was carried out in concordance with study objectives and result presented in detail in this chapter. The main outcome variables studied were injuries, musculoskeletal, respiratory, gastrointestinal (GIT), eye and skin disorders. The general characteristics of sample are presented first followed by nature and type of morbidities and then association with the various predictor variables.

3.1 Sample characteristics

3.1.1 Demographic characteristics of sample population

The mean age of sample population was 30.67 years (SD 8.61 years). Out of the total 300 participants 90.3 percent were men and only 9.7 percent women. Among the study population workers 10.3 percent belonged to Surat city and 3.3 percent to Surat district. Majority of the workers were migrants from various parts of Gujarat and neighbouring state of Maharashtra, Rajasthan and Madhyapradesh.

Table 3.1 Demographic characteristics of sample population

Variables	Frequency (N=300)	Percentage (%)
Age		
18 – 25 yrs	116	38.7
26 – 35 yrs	108	36.0
36 – 45 yrs	61	20.3
46 – 55 yrs	15	5.0
Mean ± SD (years)	30.67 ± 8.61	
Sex		
Male	271	90.3
Female	29	9.7
Place of nativity		
Surat district	41	13.66
Migrants	259	86.34
Place of residence		
Slum	203	67.7
Non-slum	97	32.3

Around two thirds of the percent of the workers lived in the slum area whereas around one third were from non slum areas. 66.1 percent of the male workers and 82.8 of the female workers were slum dwellers.

3.1.2 Socioeconomic characteristics of sample population

Table 3.2 Socio-economic characteristics of sample population

Variables	Frequency (N = 300)	Percentage (%)
Education attained		
No formal education	114	38.0
Primary school	129	43.0
Secondary school	54	18.0
Intermediate	3	1.0
Monthly personal income		
< 3500 Rs/month	164	54.7
> 3500 Rs/month	136	45.3
Mean income ± SD (Rupee/month)	3520.83 ± 669.50	
Previous occupation		
No (unemployed)	179	59.7
Yes	121	40.3
Additional part time jobs		
No	249	83.0
Yes	51	17.0

More than one third of workers had no formal education and only less than one in five had attended secondary school and above. Majority of female workers (86.2 percent) had no formal education as compared to about 33 percent among male workers.

The mean income of sample population was Rupee 3520.83 per month (SD Rupee 669.50). The maximum income reported was Rupees 6000 per month and the minimum reported was Rupees 1800 per month. The income of male and female workers showed considerable disparity. The mean income of males per month was Rupee 3646.88 (SD Rupee 519.16) as compared to females who had Rupee 2344.83 per month (SD Rupee 775.79). The maximum income of male was 6000/month and that of the female was 4000 per month.

About 60 percent of the workers had no history of previous employment. Door to door waste handling under SMC is the first employment that they had undertaken. Those who were employed earlier worked as farmer, labourers in textile or other industries. Only 10.3 percent women had history of previous occupation as compared to 43.5 percent of the male. All the 300 workers who were surveyed had an 8 hour per day job of door to door waste handling under the SMC. However 16.7 percent had some part time jobs in addition to their waste handling job with SMC including work as street sweepers and as labourers in diamond and textile industries. About one in five male had additional part time jobs whereas only one percent female had any jobs outside the SMC.

3.1.3 Non-occupational exposures

Use of tobacco and alcohol were assessed among the workers and results were as following. Regarding tobacco use, ever use of tobacco, current use tobacco and also exposure to passive smoking at home and office were assessed.

3.1.3.1 Ever use of tobacco

Ever use of tobacco among the workers was found to be 75 percent. Majority of the workers (86 percent) were tobacco chewers where as 10 percent had smoking habit and only three percent workers used both. Only less than one percent had ever used snuff.

Table 3.3 Tobacco and alcohol use habits among waste collectors, Surat

Variables	Frequency (N = 300)	Percentage (%)
Ever use tobacco	226	75.3
Types of ever use tobacco (N = 226)		
Smoking	23	10.17
Chewing	195	86.28
Both (Smoking & Chewing)	6	2.65
Snuff	2	0.88
Current use tobacco	219	73.0
Types of current use tobacco (N = 219)		
Smoking	19	8.67
Chewing	193	88.12
Both (Smoking & Chewing)	5	2.3
Snuff	2	0.91
Passive smoking at work place (N = 300)	41	13.7
Passive smoking at home (N = 300)	47	15.7
Alcohol drink habit (N=300)	90	30.00

3.1.3.2 Current use of tobacco

The prevalence of current use of tobacco was very high among workers at 73.0 percent. Among the current users the proportion of tobacco chewers was very high (88 percent) while nine percent were smokers and only two percent consumed both. Only two workers had habit of using snuff.

Regarding type of tobacco products used, the most common smoked form was biddies (83.3 percent) and cigarettes accounted for 12.5 percent and less than five percent used both. More than two thirds of the smokers smoked 10 or more biddies/cigarettes per day. Around 60 percent of the chewers used Gutka, about one in four used Miraj (raw tobacco) and rest chewed products like Pandherpuri (seven percent), pan with tobacco (six percent) and Khaini (three percent).

Out of the 29 female workers, 32 percent currently used tobacco in contrast to about 80 percent of the males. Among current female tobacco users 78 percent used tobacco in the chewing form and 22 percent in the form of snuff.

3.1.3.3 Passive smoking at workplace and home

Passive smoking among workers at workplace was about 14 percent and was about 16 percent at home. Female were two times more exposed at work place and about three times more exposed at home and was exposed to more passive smoking compared to the males.

3.1.3.4 Use of alcohol among the workers

About one in three of the respondents had the habit of consuming alcohol. All the workers who consumed alcohol all were male and almost all (97 percent) consumed locally brewed liquor. More than half of those who consumed alcohol had the habit of drinking alcohol daily. About 42 percent consumed alcohol often, about 47 percent consumed alcohol from one to three days per month and about one in three one to four days a week and about one in five once in a month.

3.1.3.5 Industry/factory near home

About a quarter of the respondents lived near a factory or industry.

3.1.4 Duration of work in door to door waste collection

Table 3.4 Duration of work among waste collectors in Surat

Variables	Frequency (N = 300)	Percentage (%)
Years of experience in waste collection as a job		
1 – 2 years	127	42.3
3 – 5 years	126	42.0
> 5 years	47	15.7
Years of experience in door to door waste collection job at SMC		
One year of job (inexperience group)	72	24.0
More than one years of job (experience group)	228	76.0
Hours spend in vehicle in order to complete assigned job		
12 – hours	37	12.3
8 – hours	263	87.7
Total hours of work in a week		
84 – hours	37	12.3
56 – hours	263	87.7

The respondents were asked about the duration of work in door to door waste collection, years in door to door collection system of SMC, hours spend in the solid waste collection vehicle, hours taken to complete the routinely assigned job, number of working days in week and total number of hours of work per week.

3.1.4.1 Duration of work involving door to door waste handling, years in door to door collection system of SMC

Workers with more than five years of experience were only about one in five. About 42 percent of the workers were relatively new to waste handling with only one to two years of service. Almost all the workers had done waste handling for first time during their current job the SMC.

3.1.4.2 Hours spend in solid waste vehicle and hours complete to assign job

The mean hours spent in solid waste collection vehicle and time taken to complete the assigned task was about eight and a half hours per day (SD $\pm$ 1.38 hours). The door to door waste collectors on an average spent eight to twelve hours per day in the solid waste collecting vehicle in order to complete the daily assigned job. It was found that about 90 percent of the workers spent eight hours in the vehicle in order to complete the daily assigned job while around ten percent had spent 12 hours. During this job hours they collected the waste from their assigned areas, sorted the waste and emptied the vehicle at the dumping site (referred as transportation) of each zone.

3.1.4.3 Number of working days per week and total working hours per week

Most waste collectors worked seven days of the week. It was found that about 90 percent of the workers spent about 56 hours and around ten percent of them work for 84 hours per week.

3.1.5 Job related factors

Under this heading, detail discussed are – nature of employment, training before joining job, availability of protocol for handling waste at work place, type of waste collected, waste collected per day, methods of collecting waste, manual sorting of waste, supervision for usage personal protective equipment (PPE), awareness regarding personal protective equipment, usage of personal protective equipments, incentive for using protective equipments, job rotation, and personal hygiene during working hours.

Table 3.5 Job related factors among waste collectors, Surat

Variables	Frequency (N = 300)	Percentage (%)
Nature of employment		
Permanent	217	72.3
Temporary	83	27.7
Training before job		
No	166	55.3
Yes	134	44.7
Availability of protocol for handling waste		
No	98	32.7
Yes	202	67.3
Type of waste handled		
House to house	231	77.0
Mixed waste	69	23.0
Waste collected per day		
<3 ton	166	55.3
>3 ton	134	44.7
Mean $\pm$ SD (ton/day)	3.3 $\pm$ 1.346	
Methods of collecting waste		
Manually	276	92.0
Both(equipment+manually)	24	8.0
Sorting of waste		
No	27	9.0
Yes	273	91.0

3.1.5.1 Nature of employment

Among the respondents almost three fourth of workers were permanent employees. Permanent employees were assigned fixed routes, better pay and facilities like protective equipments and training as compared to about one third of the temporary

workers. It was found that about three fourths of the female workers were temporary workers and around one in three of the males were temporary workers.

3.1.5.2 Training before joining job

Training before joining job was received by less than fifty percent of the waste collectors. Only half of the permanent employees had undergone any pre induction training and less than one third (30.1 percent) of temporary waste collectors had received any training.

3.1.5.3 Protocol for handling waste at work place

Among the door to door waste collectors almost 67 percent followed waste handling protocols as specified by the Municipal Solid Waste Rules, 2000 and almost 33 percent did not follow any protocol during working hours. It was seen that almost all (99 percent) of workers who had received training before joining job followed the protocols whereas only less than half of those who were untrained followed any protocol. Among the workers who had more than one year of experience in current job more than three fourths followed the protocols for waste handling as compared to less than one third of those workers who had one year of experience. Almost three fourth of permanent workers followed protocol for door to door solid waste collection.

3.1.5.4 Type of waste collected

Out of 300 door to door waste collectors, 77 percent collected waste from houses and 23 percent collected waste from houses as well as commercial site (mixed waste).

3.1.5.5 Waste collected per day

The mean quantity of waste collection per day by a worker was 3.3 tons per day (SD 1.35 tons) Around 55 percent of door to door waste handlers collected two to three tonnes per day while 40 percent of the waste collectors collected 3 to 5 tonnes per day and only 5 percent waste collectors collected more than 5 tonnes per day.

3.1.5.6 Methods of collecting waste

Among the respondents 92 percent of the waste handlers collected the waste manually while eight percent of them used some sort of equipments like spade, fork lift, etc. which were provided by employers.

3.1.5.7 Sorting of wastes

The corporation has instructed the workers to sort the waste into wet and dry biodegradable waste and also into non-biodegradable waste at source of collection. Majority of waste collectors (92 percent) who sorted the waste according this direction involved in risky practice like sorting the waste for sellable, usable and eatables for their personal use. Nine percent of workers who did not indulge in such risky practices had received training before joining job.

3.1.5.8 Provision of personal protective equipment (PPE) by employers

About 54 percent of workers were provided with PPE. Among the companies 120 workers of company A 84.16 percent were provided with PPE while out of 120 workers of Company B only 11 percent of the workers provided with PPE and out of 60 workers of Company C only ten percent were provided with PPE.

3.1.5.9 Usage of personal protective equipments

In the sample population, only one third of the workers were using personal protective equipments. Among them all workers used gumboots and uniform, about 90 percent used helmets, 13 percent used gloves and only two percent used goggles. Among the workers who used PPE nearly 84 percent were permanent and 16 percent were temporary workers. Majority of workers (81.8 percent) who used some PPE were the ones who received training before joining job.

Regarding the non use of PPE the reasons cited by workers were as follows: 46 percent said that it was because PPE were not provided by employer, 16 percent said they

did not care, 13 percent reported that they were not aware of risk involved, 12 percent to avoid discomfort, 9 percent to save the time and 4 percent mentioned that their equipments were stolen.

3.1.5.10 Supervision for usage the personal protective equipments

Among door to door solid waste handlers about half of the workers reported that they were supervised for the use of personal protective equipments and among them 80.6 percent were permanent workers and about 20 percent were temporary employees (Table provided in Appendix I, Page i to ii).

3.1.5.11 Awareness regarding personal protective requirement

When the door to door solid waste handlers were asked about the personal protective equipments that they would like to be provided with, 73 percent mentioned gloves, about 88 percent mentioned gumboot, 86 percent uniform, 50 percent goggles, 70 percent mask, 62 percent helmet and about 45 percent raincoat.

3.1.5.12 Job rotation and incentives

Less than one third (28 percent) of the waste handlers reported that they were given a change in their routine work. They were given job rotation like driver's job, supervision of daily activities like route checking, management of daily issue with waste collection, etc. However less than three percent of workers who had a change in job perceived any physical comfort while about 98 percent reported that they did not perceive any benefit out of it. None of workers reported that there were any incentives offered to workers for using PPE.

3.1.5.13 Wash/take bath and change clothes before leaving work

Majority of workers **(**91.3 percent) reported they took bath and about 96 percent that they changed their clothes every day before leaving the work place while about nine

percent said that they took bath and about four percent said they changed clothes frequently. Only two workers said that they never changed cloths before leaving the work place. About 35 percent reported that they took bath to clean the dirt from the body, two percent to remove foul odour, nearly 33 percent for both the above, 26 percent to be protected from disease and four percent to avoid itching.

3.1.6 Morbidities

Under this title, discussed morbidities will be – injuries, musculoskeletal, respiratory, gastrointestinal (GIT), eye and skin disorders. Tables are attached in Appendix I, Page ii to v.

3.1.6.1 Injuries in past three months

In sample population, 77.7 percent reported some kind injury in past three months. Among those who reported injuries, 63.2 percent had single injury while 36.8 percent sustained multiple injuries which include more than one injury in a person, like cuts, punctured wounds, bruises, contusions, cut-lacerated wounds (CLW).

Among the reported injuries 42.30 percent were cutting injury, 4.30 percent punctured wound, 6.40 percent bruise, 2.56 percent fracture, 0.40 percent contusion, 2.13 percent CLW, strain/sprain and dog bite, and 0.85 percent burns. Nearly one third of all injuries (28.20) percent were infected and had pus/ slough.

The reason cited for having sustained injuries according to the workers were nature of work (59 percent), improper garbage disposal by residents (52 percent), lack of personal protective equipments (22.2 percent), percent throwing of waste by resident while they are at work (21 percent), careless passing of vehicles while working during busy traffic (4 percent), lack of visibility of the driver of the waste truck due to its unique shape (3 percent), lack of training and non-observance safety procedures (2 percent).

3.1.6.2 Skeletomuscular disorders

In sample population, 71.0 percent reported some kind of skeletomuscular disorders in past three months. The reported skeletomuscular disorders were; 68 percent back pain 37 shoulder pain, 12 percent wrist-hand pain, two percent neck pain, one percent hip and seven percent knee pain. While workers had difficulties in movement were; 34 percent with movement of arms and other movements of head and neck, knee movements especially bending of the knee, 18 percent had difficulties in climbing stairs and carrying more weight. About 54 percent perceived some weakness in arms, hand, legs and feet.

3.1.6.3 Respiratory disorders

Among the respondent 62.3 percent reported some kind of respiratory disorders in past three months. The main respiratory symptoms included cough with phlegm (77 percent), 47 percent had chest tightness, 29 percent had wheeze with breathlessness, 23 percent reported running nose, 21 percent sneezing, 12 percent dry cough, about 19 percent itching of the nose and about six percent sore throat.

The main respiratory illnesses reported by door to door solid waste handlers were; Allergic rhinitis by 14 percent, chronic bronchitis by eight percent, Asthma by three percent, Tuberculosis (1.3 percent), about 0.5 percent reported rhinitis. One percent of asthma cases were on medication and was also confirmed by diagnosis. Symptoms indicative of COPD as defined by OSHA guidelines were not reported by any workers. With regards to seasonal variation of symptoms related respiratory disorders nearly 57 percent noticed increased severity. 47.5 percent perceived increase during monsoon season, 4.2 percent during summer season and 5.3 percent during winter season. The rest of the 43 percent of workers did not perceive any seasonal change in their symptoms.

3.1.6.4 Gastrointestinal disorders

Among the respondent about 40 percent reported GIT which included acute peptic disease by 60 percent, diarrhoea by 58 percent, 36 percent with nausea/vomiting,

32 percent had worm infestation, 20 percent reported dysentery. Eleven percent of the workers reported jaundice in the past three months. The workers who reported diarrhoea said that they had experience more diarrhoea during the middle of the week. With regards to severity of symptoms related gastrointestinal disorders nearly 75 percent noticed seasonal variations. About 40 percent felt an increase during the summer season and 36 percent during monsoon season. About 25 percent of the remaining workers did not perceive any seasonal change in their symptoms.

3.1.6.5 Eye disorders

In the sample population, 36.3 percent workers reported eye disorders. Among the eye disorders reported were burning eyes among 95 percent, redness of eye in 36 percent, eye injuries (28 percent), dimness of vision among 48 percent and watery discharge among 28 percent.

3.1.6.6 Skin disorders

In sample population, 30.0 percent workers reported skin problems and among the skin disorders reported majority had allergic rash (85 percent) and 42 percent had dermatitis.

3.1.6.7 Other **general complaints reported** were fever with headache by around 25 percent and headache by ten percent of the workers.

3.2 Bivariate analysis

For better understanding and interpretation of results the independent variables were analysed with specific predictor variables like demographic and socioeconomic, non-occupational exposure, duration of exposure and job related factors. Each independent variable was cross-tabulated with each morbidity (dependent variable) and association was noted. The association was considered significant if p value was less than 0.05 or nearly significant (p value less than 0.1).

Unadjusted for other variables, it was found that eighteen independent variables were associated with injury in the past three months, twelve independent variables associated with skeletomuscular disorder and gastrointestinal and eye disorder in past three months, fourteen independent variables associated with respiratory disorder in past three months and ten independent variables associated with skin disorder. Tables are attached in Appendix II, Page i to viii and Appendix IV, Page i to xii.

3.2.1 Factors associated with injuries

Table 3.6 Association of injuries with risk factors among waste collectors, Surat

Independent variable	Chi square	Unadjusted odds ratio (95% confidence interval)	P value
Place of residence	3.938	0.568 (0.323 - 0.997)	0.047*
Monthly Income	7.964	0.452 (0.259 - 0.790)	0.005*
Habit of consuming alcohol	4.039	2.000 (1.028 - 3.888)	0.039*
Daily consumption of Alcohol	4.794	3.857 (1.087 - 13.689)	0.029*
Years in door to door collecting job	7.713		0.021*
Worker having one year of job	8.322	0.308 (0.134 - 0.710)	0.004*
Training before joining job	12.320	0.370 (0.210 - 0.652)	0.000*
Protocol for handling waste	11.802	0.296 (0.144 - 0.610)	0.001*
Waste collected per day	5.705	0.513 (0.295 - 0.891)	0.017*
Method of collecting waste	42.703	0.070 (0.026 - 0.186)	0.000*
Sorting material from waste	69.030	30.756 (10.130 – 93.380)	0.000*
Instruction regarding usage of PPE	11.015	0.379 (0.211 – 0.680)	0.001*
Usage of protective equipment	13.119	0.362 (0.207 – 0.634)	0.000*
Usage of Gloves	14.961	0.097 (0.025 – 0.382)	0.000*
Usage of Gumboot	5.578	0.119 (0.015 – 0.940)	0.018*
Usage of Uniform	5.578	0.119 (0.015 – 0.940)	0.018*
Usage of Mask	37.854	0.052 (0.018 – 0.156)	0.000*
Usage of Helmet	9.291	0.128 (0.029 – 0.575)	0.002*

Door to door waste handlers who had habit of consuming alcohol had two times and among them those who were daily drinkers had four times higher chances of having sustained injuries. The risky practice of sorting waste increased the risk by about thirty one times.

3.2.2 Factors associated with skeletomuscular disorders

Table 3.7 Association of skeletomuscular disorder with risk factors among waste collectors, Surat

Independent variable	Chi-square	Unadjusted odds ratio (95% confidence interval)	P value
Place of residence	5.822	0.530 (0.315 - 0.891)	0.016*
Monthly Income	4.787	0.572 (0.346– 0.946)	0.029*
Habit of consuming alcohol	2.869	1.640 (0.922-2.910)	0.090
Nature of employment	5.268	2.036 (1.101-3.765)	0.022*
Training before joining job	4.340	0.588 (0.356- 0.971)	0.032*
Protocol for handling waste	4.052	0.562 (0.319- 0.989)	0.044*
Method of collecting waste	14.219	0.212 (0.089- 0.505)	0.000*
Sorting material from waste	10.162	3.490 (1.560- 7.808)	0.001*
Instruction regarding usage of PPE	4.201	0.589 (0.355- 0.979)	0.040*
Usage of protective equipment	12.933	0.391 (0.233- 0.658)	0.000*
Usage of Mask	9.984	0.242 (0.097- 0.603)	0.002*

Door to door waste handlers who had habit of consuming of alcohol had three times higher chances of skeletomuscular disorders. While risky practice of sorting waste increased the risk by about thirty one times, temporary workers had about two times higher risk of skeletomuscular disorders.

3.2.3 Factors associated with respiratory disorders

Table 3.8 Association of respiratory disorders and risk factors among waste collectors, Surat

Independent variable	Chi square	Unadjusted OR (95% CI)	P value
Place of residence	7.104	0.513 (0.312-0.841)	0.008*
Current use of tobacco	3.034	1.582 (0.942-2.657)	0.082
Training before joining job	6.365	0.546 (0.340-0.875)	0.012*
Protocol for handling waste	4.042	0.590 (0.352-0.989)	0.044*
Method of collecting waste	19.136	0.136 (0.049-0.375)	0.000*
Sorting material from waste	20.332	6.886 (2.686-17.652)	0.000*
Instruction regarding usage of PPE	5.258	0.576 (0.358-0.925)	0.022*
Usage of protective equipment	17.929	0.346 (0.210-0.570)	0.000*
Usage of Gloves	10.280	0.068 (0.009-0.546)	0.001*
Usage of Gumboot	3.667	0.347 (0.114-1.060)	0.055
Usage of Uniform	3.667	0.347 (0.114-1.060)	0.055
Usage of Mask	20.361	0.081 (0.023-0.289)	0.000*
Taking lunch during working hours	3.498	0.603 (0.353-1.027)	0.061

Current users of tobacco had higher chances of respiratory disorders. The risky practice of sorting the material from the waste was increased the risk respiratory disorders about seven times among the door to door waste handlers.

3.2.4 Factors associated with gastrointestinal disorders

Table 3.9 Association of gastrointestinal disorders and risk factors among waste collectors, Surat

Independent variable	Chi square	Unadjusted OR (95% CI)	P value
Sex	6.954	2.798 (1.270-6.163)	0.008*
Monthly Income	8.798	0.488 (0.302-0.786)	0.003*
Waste collected per day	3.357	0.644 (0.402-1.302)	0.067
Method of collecting waste	5.617	0.284 (0.095-0.854)	0.018*
Sorting material from waste	9.904	5.823 (1.712-19.803)	0.002*
Usage of protective equipment	10.579	0.422 (0.249-0.715)	0.001*
Usage of Gloves	3.800	0.160 (0.020-1.278)	0.051
Usage of Gumboot	7.187	0.249 (0.008-0.723)	0.007*
Usage of Uniform	7.187	0.249 (0.086-0.723)	0.007*
Usage of Mask	6.527	0.212 (0.059-0.759)	0.011*
Usage of Helmet	11.755	0.212 (0.090-0.542)	0.001*
Taking lunch in working hours	10.340	0.439 (0.265-0.729)	0.001*

Female waste handlers had about three times higher risk for GIT disorders. Risky practice of sorting material from waste increased the risk about six times more.

3.2.5 Factors associated with eye disorders

Table 3.10 Association of eye disorders and risk factors among waste collectors, Surat

Independent variable	Chi-square	Unadjusted OR(95% CI)	P value
Monthly income	8.960	0.478 (0.293-0.778)	0.003*
Habit of consuming Alcohol	5.935	1.868 (1.126-3.097)	0.015*
Nature of employment	11.877	2.459 (1.464-4.131)	0.001*
Training before joining job	3.445	0.635 (0.393-1.027)	0.063
Protocol for handling waste	5.781	0.546 (0.333-0.897)	0.016*
Sorting material from waste	5.939	3.549 (1.209-10.683)	0.015*
Instruction usage protective equipment	7.390	0.518 (0.321-0.834)	0.007*
Usage of protective equipment	14.605	0.346 (0.198-0.603)	0.000*
Usage of Gumboot	10.481	0.188 (0.064-0.555)	0.001*
Usage of Uniform	10.481	0.188 (0.064-0.555)	0.001*
Usage of Helmet	13.585	0.193 (0.077-0.483)	0.000*
Taking lunch during working hours	4.479	0.579 (0.348-0.963)	0.034*

3.2.6 Factors associated with skin disorders

Table 3.11 Association of skin disorders and risk factors among waste collectors, Surat

Independent variable	Chi square	Unadjusted OR (95% CI)	P value
Age	6.661		0.084
Monthly Income	2.962	0.643 (0.388-1.065)	0.085
Current use of tobacco	3.196	1.714 (0.946-3.108)	0.074
Habit of consuming alcohol	4.837	1.793 (1.062-3.028)	0.028*
Waste collected per day	4.318	0.584 (0.351-0.972)	0.038*
Separate things from waste	7.212	5.946 (1.377-25.666)	0.007*
Usage of Gumboot	8.374	0.224 (0.077-0.653)	0.004*
Usage of Uniform	8.374	0.224 (0.077-0.653)	0.004*
Usage of Mask	8.148	0.143 (0.032-0.641)	0.004*
Usage of Helmet	10.485	0.239 (0.097-0.587)	0.001*

3.3 Multivariate analysis (Binary logistic regression)

Multivariate regression, carried out to estimate the predictors in context of morbidities (injury, skeletomuscular disorders, respiratory disorders, gastrointestinal disorders, eye disorders and skin disorders in past three months). The analysis measures the effect of change in variation of the one variable (independent) on the others variables in the model. The purpose of the multivariate analysis was to understand how important, both individually and when acting to gather, the independent variable were for explaining the variation in dependent variable. The net bearing effect of different independent variable was explained in terms of odds ratio (OR). The model selected examined changes in each one of the outcome variables (morbidities) against independent variables. Analysis was done by backward stepwise (likelihood ratio) model in SPSS for Window version 17.0. The results obtained in bivariate analysis were subjected to logistic regression analysis, after adjusting for major confounders. Detailed tables of multivariate analysis are given in Appendix III, Page i to vi and Appendix IV, Page i to xii.

3.3.1 Multivariate analysis for injury in past three months

Table 3.12 Significant independent variables found in multivariate analysis for injury among waste collectors, Surat

Characteristic	Adjusted OR	95% confidence interval		P value
		Lower limit	Upper limit	
Place of resident	0.325	0.087	1.218	0.086
Habit of consuming alcohol	13.131	2.039	84.551	0.002
Years in door to door waste collection job	0.269	0.086	0.846	0.017
One year in waste collection job	0.547	0.313	0.956	0.011
Nature of employment	27.072	1.492	491.228	0.008
Training before joining job	0.115	0.007	1.855	0.084
Protocol for handling waste not followed	37.396	1.207	1158.412	0.020
Sorting material from waste	60.870	8.598	430.921	0.000
Usage protective equipments	13.590	1.077	171.445	0.024
Change in job from waste collection	0.070	0.010	0.496	0.002

It was found that temporary workers had about twenty seven times risk of injury and workers who did not follow protocol had about thirty seven times higher risk of injury. The waste handlers who indulged in risky practice of sorting waste had about sixty one times more risk of injury.

3.3.2 Multivariate analysis for skeletomuscular disorders in past three months

After adjusting for other factors, result showed that female waste handlers had about three times higher risk of skeletomuscular disorders. The workers who had education status above the secondary level had about seven time times higher risk of skeletomuscular disorders while waste handlers who had additional part time jobs had about seven times higher risk. The workers who were new to job had about four times higher risk of skeletomuscular disorders.

Table 3.13 Significant independent variables for skeletomuscular disorders among waste collectors, Surat

Variable	Odd ratio after adjusted confounders	95% confidence interval		P value
		Lower limit	Upper limit	
Sex	2.582	0.925	7.208	0.056
Place of residence	0.547	0.313	0.956	0.035
Education status	4.394	1.379	13.998	0.007
Monthly income	0.042	0.003	0.563	0.005
Additional Part time job	6.681	0.820	54.416	0.052
Consumption of alcohol habit	1.814	0.090	3.346	0.052
Years in door to door waste collection job	3.725	0.955	14.530	0.046
One year in the waste collection job	0.051	0.022	1.039	0.048
Training before joining job	0.285	0.061	1.340	0.093
Methods of collection of the waste	0.558	0.346	0.900	0.015

3.3.3 Multivariate analysis for respiratory disorders in past three months

Table 3.14 Significant independent variables for respiratory disorders among waste collectors, Surat

Variable	Odd ratio after adjusted confounders	95% confidence interval		P value
		Lower limit	Upper limit	
Place of residence	0.352	0.114	1.091	0.063
Additional part time jobs	6.293	0.770	51.398	0.078
Passive smoking at workplace	7.096	0.842	59.829	0.052
Industry or factory near home	4.894	1.226	19.535	0.018
Years in job of waste collection	0.507	0.236	1.092	0.077
Training before joining job	0.096	0.017	0.545	0.003
Type of handling the waste	0.596	0.401	0.886	0.005
Sorting materials from the waste	13.391	2.432	73.739	0.001
Change of job from waste collection	0.361	0.114	1.141	0.078
Usage of mask	0.101	0.022	0.473	0.001
Usage of helmet	37.655	4.316	328.530	0.000
Change clothes before leaving work	0.267	0.057	1.239	0.080

There is about six times higher risk of respiratory disorders among the waste handlers who had additional part time jobs. Workers who were exposed to passive smoking at work place had seven times more risk of having respiratory disorders. The waste handlers who were living near industry/factory had five times higher chance of respiratory disorders. The workers who were engage with the risky practice of sorting material from the waste had about thirteen time higher chance of respiratory disorders while workers who were not using helmet had about thirty eight times higher risk of respiratory disorders.

3.3.4 Multivariate analysis for gastrointestinal disorders in past three months

Table 3.15 Significant independent variables for gastrointestinal disorders among waste collectors, Surat

Variable	Odd ratio after adjusted confounders	95% confidence interval		P value
		Lower limit	Upper limit	
Age	0.516	0.262	1.019	0.047
Sex	2.994	1.149	7.799	0.029
Place of residence	0.016	0.265	0.090	0.012
Monthly personal income	0.139	0.038	0.504	0.002
Additional part time jobs	3.592	1.051	12.274	0.034
Currently using of tobacco product	1.530	1.050	1.898	0.029
Habit of consuming alcohol	1.669	1.092	3.004	0.011
One year of job in waste collection	0.248	0.052	1.178	0.074
Years in waste collection job	3.681	1.268	10.690	0.012
Time to take complete assign job	1.565	1.470	5.219	0.002
Methods of collecting waste	3.823	1.069	11.393	0.057
Sorting materials from waste	3.659	1.903	14.831	0.049
Take bath before leaving workplace	15.634	1.209	33.684	0.026
Change clothes before leaving workplace	0.325	0.113	0.937	0.033
Taking food during working hrs	4.589	1.256	16.764	0.001

After adjusting for other factors female waste handlers had about three times higher risk of GIT disorders. The workers had additional part time jobs had about four times higher risk of GIT disorders. Tobacco users and those who consumed alcohol had about two times higher risk of GIT disorders. The waste handlers who spent 12 hours per

day to complete their work had two time higher risk of GIT disorders. Manual handlers had about four times higher risk of GIT disorders while workers who indulged in the risky practice of sorting waste had about four times higher risk of GIT disorders.

3.3.5 Multivariate analysis for eye disorders in past three months

Table 3.16 Significant independent variables for eye disorders among waste collectors, Surat

Variable	Odd ratio after adjusted confounders	95% confidence interval		P value
		Lower limit	Upper limit	
Age	5.782	1.025	32.621	0.021
Habit of consuming alcohol	1.786	1.054	3.027	0.031
One year in the waste collection job	0.017	0.000	0.642	0.010
Nature of employment	2.215	1.294	3.794	0.004
Training before joining the job	121.735	1.338	1107.51	0.014
Protocol for the waste collection followed	0.043	0.001	1.516	0.061
Waste collected per day	28.010	1.173	669.111	0.017
Usage of protective equipment	0.412	0.232	0.729	0.002
Usage of helmet	0.007	0.000	0.463	0.004
Change in job from waste collection	0.034	0.001	0.976	0.020

3.3.6 Multivariate analysis for skin disorders in past three months

Table 3.17 Significant independent variables for skin disorders among waste collectors, Surat

Variable	Odd ratio after adjusted confounders	95% confidence interval		P value
		Lower limit	Upper limit	
Age	0.205	0.042	0.990	0.016
Years in job of the waste collection	7.617	1.002	57.884	0.024
Waste collected per day	0.066	0.005	0.919	0.015
Nature of employment	1.016	0.000	1.547	0.064
Training before joining the job	0.060	0.005	0.678	0.007
Sorting material from the waste	4.722	1.035	21.556	0.029
Wash/take bath before going home	13.314	0.764	232.170	0.038

Table 3.16 shows significant risk factors for eye disorders. Habit of consuming alcohol increases the risk of eye disorders by two times. Temporary workers had double the risk of eye disorders. Workers who had no training before joining job had high risk of eye morbidities.

Table 3.17 shows significant risk factors for skin disorders. The risky practice of sorting waste increased risk of skin disease by about five times. The workers who were new to job had about eight times higher risk of skin disorders. Those workers who did not take bath everyday before leaving work had about thirteen times risk of suffering from skin disorders.

CHAPTER - 4

DISCUSSION AND CONCLUSION

This study was aimed at assessing the prevalence of occupational related morbidities and the factors related to the reported morbidities among the door to door solid waste collectors of solid waste management project of Surat Municipal Corporation (SMC), Gujarat, India. The major morbidities that were studied were injuries, musculoskeletal, respiratory, gastrointestinal, skin and eye conditions and their association to individual personal and work characteristics. The reported morbidity was collected and its relation to various individual sociodemographic, personal and occupational practices has been analysed. The findings are discussed here.

The survey was conducted among three hundred workers of which about 90 percent were male and about ten percent of women. This is a reflection of the overall staff pattern of employees in the Surat Corporation which has a total of 894 workers of which only 60 (6.7 percent) are female.

4.1 Injuries

More than three fourths of the door to door waste handlers of the corporation reported having sustained at least an injury in the past three months. Majority of those injured had single injury whereas slightly more than one third had multiple injuries. The most common type of injury reported was cutting injury by around 42.3 percent and the rest included punctured wounds, percent bruise, percent contusion, lacerated wounds, sprain, fractures, burns and dog bites. This is similar to findings from earlier studies like the one conducted in Denmark among waste collectors which reported that major occupational injuries were of cutting injury and cutting-contusion injury (29 percent).[52] In the United Kingdom waste industry also reported injury rate was very high in waste collection process which was around 2,500 per 100,000 workers.[51]

One of the reasons cited by the more than half of the workers for their injuries was the improper disposal of waste by the residents and about one in five indicated that residents also throw on them while they are at work. Other studies like that done by the Florida centre for solid and hazardous waste management have also reported such behaviours that contribute to the occupational morbidity of solid waste workers.[81] The main cause of injuries among waste collectors in Denmark was found to be improper wrapping of garbage.[52]

The workers cited that working barefooted on tarred roads that melt during summers and having to work unprotected in narrow roads during hours of heavy traffic also predisposed them to injuries like burns, accidents, fractures and dog bites. It has been previously recorded that working conditions of the workers including barefoot is a factor that is related to injuries among municipal solid waste workers.[8,9] The unique shape of the waste trucks is a factor that was also cited as a factor that affected the visibility of the drivers, of the workers who work behind the vehicles. This issue has been a point of discussion of earlier reports like ETUDEST RECHERCHES from Brazil.[17] and may require engineering controls.

Some of the occupational practices were found to be associated with history of injuries in the past three months among the workers. Those who did not follow any protocol (OR= 3.375, CI: 1.638, 6.955), did not have training before joining job (OR= 2.701, CI: 1.534, 4.757), who did not use personal protective equipments (PPE) (OR= 2.638, CI: 1.470, 4.732), who had no supervision of usage of PPE (OR= 2.638, CI: 1.470, 4.732) and who were new to job (OR= 3.242, CI: 1.408, 7.465) were found to have higher risks of injuries. Use of gloves (OR= 0.097, CI: 0.015, 0.382), gumboots (OR= 0.119, CI: 0.015, 0.940), uniform (OR= 0.119, CI: 0.015, 0.940), mask (OR= 0.052, CI: 0.018, 0.156) and helmet (OR= 0.128, CI: 0.029, 0.575) were also associated with lower number of injuries.

The corporation required the workers to sort wastes into wet and dry biodegradable waste and non-biodegradable waste at source of collection since the consumers do not do it effectively. Majority of the workers (91 percent) do manual sorting as per the corporation's instructions; however about 67 percent of the workers did so manually without proper usage of PPE. In total violation of the norms the waste collectors reported sorting the waste and collecting sellable, usable and even eatables for personal use. This indicates the severity of a large proportion of workers being exposed to contamination with biological, chemical and other contaminants.

Use of alcohol was associated with injuries among the workers (OR= 2.000, CI: 1.028, 3.888) and those who consumed alcohol daily had four times the risk of an ordinary worker.

4.2 Skeletomuscular disorders

Among the door to door waste handlers of the corporation more than three fourths reported of a skeletomuscular disorder in the past three months. The major conditions reported were back pain by about 68 percent, slightly more than half felt weakness of arms, hand, legs and feet, one third had problems of movements on moving arms, head and bending and other movements of the knee, one third had shoulder pain and other complaints included wrist and hand pain, and difficulty in climbing stairs and carrying weight. Similar conditions were also reported by earlier studies;[56,89] cross sectional study from Iran for example, reported about 65 percent of the waste collectors studied with skeletomuscular disorders of which about fifty percent was backache and about 25 percent with shoulder pain and the prevalence noted was higher among solid waste workers than general population.[56]

Waste handlers who did not following the protocol for handling waste (OR= 1.779, CI: 1.011, 3.131), who did not have training before joining job (OR= 1.702, CI: 1.030, 2.812), who sorted the waste (OR= 3.490, CI: 1.560, 7.808), who handled the

waste manually (OR= 4.722, CI: 1.980, 11.260), and who did not use PPE (OR= 2.554, CI: 1.521, 4.290) were found to have significantly higher morbidity due to skeletomuscular conditions. Temporary workers were found to have two times higher risk of skeletomuscular disorders (OR= 2.036, CI: 1.101, 3.765). It could be due to the fact that the temporary workers were likely to be given different routes each day, less likely to access and use PPE (19.3 percent) and only one third had received training before joining the job.

4.3 Respiratory disorders

About sixty two percent of the workers had some kind of respiratory disorders among them. The major complaints reported were cough with phlegm by slightly more than three fourths, chest tightness by about half, running nose and sneezing by about a quarter wheeze with breathlessness by about one third of the study population. Similar findings have been reported by earlier studies from Europe as well as India.[8,9,108] Studies done in Mumbai and Kolkata reported 73 and 71 percent of respiratory disorders among the waste collectors.[8,9] One of the major causes linked to vulnerability of waste handlers to respiratory disorders has been exposure to vehicle exhaust and aerosol containing micro-organisms.[108]

Significant factors related to respiratory morbidity among the workers included not following the protocols (OR =1.694, CI: 1.011, 2.838), not receiving training before joining the job (OR =1.832, CI: 1.142, 2.938), manual handling of waste (OR =7.357, CI: 2.663, 20.324) and no use of PPE (OR =2.888, CI: 1.754, 4.755). Not using mask (OR =12.343, CI: 3.455, 44.099) and helmet (OR =1.528, CI: 0.648, 3.604) increased the risk considerably. They are both protective by covering the nose and reducing exposure to aerosols.

Other factors that were specially relevant to respiratory disorders were that workers who had an industry or factory near their homes had higher risks compared to others.

Sorting of waste was seen to increases the risk of respiratory morbidities by about seven time (OR= 6.886, CI: 2.686, 17.652), and current use of tobacco among door to door waste handlers of SMC increased their risk of developing respiratory disorders by two times.

4.4 Gastrointestinal disorders

Out of 300 respondents about forty percent reported GIT disorders in the past three months. The most common morbidities reported were diarrhoea by about 60 percent and nausea/vomiting by about forty percent in this study. About 11 percent waste handlers reported jaundice. Diarrhoea has been noted as a common gastrointestinal disorder among waste collectors by other studies also.[8,9,76] One of the most probable reasons cited is bio-aerosol exposure or ingestion by oral route.[76] Workers working on empty stomach were found to have almost five times more risk of having a gastrointestinal disorder.

Symptoms suggestive of acute peptic diseases were reported by about 60 percent of the workers and were significantly related to current use of tobacco and alcohol consumption. Workers who collected less than three tons of waste per day (OR= 1.552, CI: 1.096, 2.488), manually handled waste (OR= 3.519, CI: 1.171, 10.569), worked with an empty stomach (OR= 2.277, CI: 1.372,3.779), and who do not use PPE like gloves (OR= 6.269, CI: 0.783, 50.205), gumboots (OR= 4.011, CI: 1.383, 11.630), uniform (OR= 4.011, CI: 1.383, 11.630), mask (OR= 4.714, CI: 1.317, 16.871) had significantly higher GIT morbidity.

Sorting of waste was seen to increases the risk of GIT disorders by about six times among the door to door waste collectors.

Female workers had three times higher risk of GIT disorders than the male (OR= 2.798, CI: 1.270, 6.163). Similar difference between men and women was reported by some earlier studies also.[79]

4.5 Skin and eye disorders

More than one third of the workers (36.3 percent) had disorders in this study. This is almost double the prevalence than studies done among waste pickers in Nepal.[8,9]

The risk factors found for eye disorders among the waste handlers of SMC were protocols not being followed (OR= 1.831, CI: 1.115, 3.005), no training before joining the job (OR= 1.574, CI: 0.974, 2.544) no use of PPE (OR= 2.893, CI: 1.658, 5.047) like helmet (OR= 5.192, CI: 2.071, 13.019) uniform (OR= 5.306, CI: 1.803, 15.615) and working in empty stomach (OR= 1.727, CI:1.039, 2.872). The risky behaviour of sorting waste is increases the risk of eye disorders about four times among the waste handlers of SMC. Alcohol consumption and current use of tobacco also increased the risk of eye disorders by about two times.

Skin disorders were also reported by one third of the similar to those reported from Kathmandu and Kolkata in earlier studies.[8,9] Workers who handled less than 3 tonnes of waste (OR= 1.712, CI: 1.029, 2.849) did not use PPE like uniform (OR= 1.528, CI: 1.085, 2.637), mask (OR= 7.018, CI: 1.560, 31.575) and helmet (OR= 4.190, CI:1.704, 10.303) were at significant risk than the other workers. Sorting of waste was seen to the risk of skin disorders by about four times. However, the most important factor that seems to be protective for workers from developing skin conditions seems to having a bath before leaving the workplace.

4.6 Common factors related to the morbidities

Use of personal protective equipments (PPE) was found to be a significant factor which was associated with most of the morbidities studied. Usage of mask and helmet were significantly associated with lesser respiratory morbidities due to obvious protection from aerosols. The use of helmets and other protective equipments were also significantly related to lower chances of eye disorders probably by reducing the exposure to aerosols and lesser chances of injury. Inappropriate or non-use of personal protective equipments

are major contributor to occurrence of occupational morbidities among waste handlers.[51,83]

Enforcement of safety rules and protocols and supervision regarding usage of PPE are found to increase the compliance of workers[51] and reduce occupational morbidities among workers.[9,19,51,102] Frequent instructions to workers on the usage of PPE has also been found protective for workers.[8]

Supervision of usage of PPE in this study was low with only 52 percent workers having received instructions about usage of PPE.

Provision of PPE by employers is a significant factor in reducing occupational morbidities among door to door waste handlers.[5,9,19,51,104] In this study only 33.2 percent were provided with PPE and most of the temporary employees were not provided PPE.

Among the three companies to whom the waste disposal were contracted to, workers who were employed with companies who provide less personal protective equipments, training and supervision were found to have significantly higher morbidities. (Table in Appendix II, Page xiii). The company that had training, supplied PPE and had good supervision for all employees had significantly lower morbidities among its employees.

In addition to provision of PPE effective training programs sensitive to the worker's perception of risk and their attitude to use are necessary in order to increase use of PPE among workers.[54,83,104] Only half of the door to door waste handlers in this study received any training before joining the job. Temporary workers constituted about one third of the workers and only a third of them received any training. Training before joining job was found to be a significant risk factor for morbidities related to respiratory, skeletomuscular, skin and eye disorders.

Two factors that were significantly increased the morbidities among workers were lesser number of years of experience as waste collectors and temporary employment. Those who had more than a years experience were found to have lower number of injuries, respiratory disorder, gastrointestinal disorders, skeletomuscular, eye and skin disorders. Experience workers have been found to be more knowledgeable about the risks related to their work and more willing to comply with safety and regulation than the inexperience workers.[19,102] It has also been documented that there is a potential lack of experience and skill among the newer workers in recognising and responding to hazards[102,103] and that competence levels after induction training may be at various levels and increases with experience.[51] This also reflects the importance of the need for repeated trainings during the course of the employment.

Temporary workers were at significantly higher risk of having injuries, eye and skin disorders. This could be related to their inexperience at work, comparatively lower access to and usage of PPE, lower chances of being trained before or after joining the job etc. Workers in the younger age groups (26-35 years) were found to be at higher risk of developing GIT, eye and skin disorders.

Method of handling of waste by waste handlers has been documented as a major determinant of occupational morbidities related to solid waste handling.[8,9] Manual handling of waste increases the risk of exposure to biological and chemical hazards and the risk of morbidities and injuries.[8,9,69,70,80,105,106] In this study, manual handling of waste and the method of sorting of waste by the workers into sellable, usable and eatable things for personal use is associated with higher risk of almost all morbidities.

Personal hygiene practices of waste collectors are a significant factor that affects the adverse health effects among waste collectors.[107] Taking bath and changing clothes before leaving workplace were significant factors that reduced the risk for particularly gastrointestinal, respiratory and skin disorders among workers in this study.

Consumption of alcohol and tobacco use were found to be related to almost all the morbidities studied which is in tune with the earlier studies.[8,9] Use of alcohol and tobacco as reported by the workers during the survey was to mostly avoid the bad odour and appearance of the waste among which they were working. This needs to be studied further and necessary behavioural change interventions made for reducing the hazards due to such substance abuse among the waste handlers.

Workers who resided in slums were found to have high risk of developing respiratory, GIT, injuries and skeletomuscular disorders. This may be indicative of their poor socio-economic conditions such as poor housing, sanitation, malnutrition and also restricted access to health care.[8,9] There were significantly more smokers (76 percent) and alcohol users (66 percent) among the slum dwellers.

Having part time jobs in addition to waste collection were found to be associated with higher risk of having respiratory, GIT and skeletomuscular disorders. This could be due to the fact that most of them were working in polluted environments mainly as sweepers and cleaners in industries and factories predisposing them to additional exposures to hazards and increased work load.[17]

Rotation of job was a factor that was found by earlier studies to be beneficial for skeletomuscular disorders among waste handlers. However in this study, change in jobs by the employers periodically were associated with lower risks of eye disorders and injuries. This could be due to the reduction to harmful exposures and condition.

Workers who collected less than three tonnes of waste per day were found to have higher risk of skin and eye disorders. This could be due to the fact that lesser the amount of waste the more the empty space in the vehicle resulting in higher levels of exposure to bio aerosol and volatile organic compounds.[34] The low loading truck were found to be associate with higher levels of bioaerosols compared to high loading truck causing more morbidities among waste handlers in earlier studies.[35,108]

4.7 Strength of study

This study adds to the limited available knowledge base on the morbidities of door to door waste handlers. There was only a single investigator reducing the inter observer variability. Standard operational definitions according to the OSHA were used to assess the self reported.

4.8 Limitations of study

The most important limitation of study was in assessment of morbidities in door to door waste handlers. All the morbidities were on the based on self-reporting. Medical evaluation was not done. The absence of more objective measurements like blood, stool and urine investigations, spirometry was not feasible in present setting and available resources.

Exposure element like aerosol, volatile organic compounds and organic dusts in the workplace environment would have added to accuracy in the measurement of exposure. But due to lack of resources and laboratory back up this was not possible. In addition all the limitations of the cross sectional study including limitations in establishing cause and effect relationship and temporality exists for this study.

4.9 Policy implication of study

The study finding indicated once again that waste collection was a job that could be related to considerable occupation related morbidity. It indicates an urgent need to implement effective intervention by employers and the health professionals for waste collectors. Company which had provided training, PPE, supervision for implementation of protocols was found to have significantly lower morbidity among its employees.

Provision of personal protective equipments, training with particular focus on temporary and younger workers, continued and periodic updated training for all

employees, supervision of usage of PPE and implementation of protocols are to be made mandatory. Periodic monitoring of PPE and its usage and replacement of old and damaged PPE should also be made compulsory. Incentives and other schemes for motivating workers to PPE and periodic change in jobs or job rotation, reduction in work load and mechanisation of the various processes are the other possible policy options to reduce morbidity among waste collectors. In addition benefits like medical care, compensation and insurance to those with severe morbidities has to be ensured.

Strict monitoring and surveillance of the morbidity and sickness absenteeism among the workers should be done, database maintained and reviewed by the corporation periodically.

Provision of appropriate facilities for emergency first aid care and preventive measures such as vaccination for hepatitis A and B, tetanus, anti-rabies must be made compulsory. Training of medical professionals of the corporation must be given routine training in occupational medicine and other knowledge updated to provide better services

Improving the living standards of the workers with regard to their housing, sanitation, nutrition and interventions to counter other risky personal habits must be a key objective of any Corporation's short term or long term policies. This is critical to improve the health of its employees involved in one of the most dangerous jobs in the world which is solid waste handling.

In addition to the policies aimed at workers, focused and sustained strategies to inform people regarding safe disposal and segregation of waste at source is absolutely essential for any long term success in reduction of morbidity among the waste collectors.

4.10 Conclusion

There is considerable morbidity among the door to door solid waste collectors which could be related to the exposure to the physical, chemical and biological toxins during their work and their work characteristics. Use of personal protective equipments, risky personal habits like smoking and consumption of alcohol were factors that were common to most morbidity. Manual sorting of wastes that the workers were engaged predisposed them to significantly higher levels of morbidity. Additional research is needed to further characterise the exposures and establish the health effects due to the various exposures and work practices of the door to door waste handlers.

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Appendix - I

Table 1. Job related factors of door to door waste handlers, Surat

Variables	Frequency (N = 300)	Percentage (%)
Nature of employment		
Permanent	217	72.3
Temporary	83	27.7
Training before job		
No	166	55.3
yes	134	44.7
Protocol for handling waste		
No	98	32.7
Yes	202	67.8
Types of handling waste		
House to house	231	77.0
Mixed waste	69	23.0
Waste collected per day		
<3 ton	166	55.3
>3 ton	134	44.7
Mean + SD (ton/day)	3.3 + 1.346	
Methods of collecting waste		
Manually	276	92.0
Both (equipment+manually)	24	8.0
Sorting material from the waste		
No	27	9.0
yes	273	91.0
Instruction for usage of protective equipments		
No	145	48.3
yes	155	51.7
Usage of protective equipments		
No	201	66.8
Yes	99	33.2
Types of protective use (N = 99)		
Gloves	13	13.13
Gumboot	99	100
Uniform	99	100
Mask	27	27.27
helmet	88	88.88
Goggles	2	2.02
Change in job (job rotation)		
No	216	72.0
yes	84	28.0
Wash/take bath before leaving for home		
Frequently	26	8.7
Every day	273	91.3
Change cloths before leaving for home		
Never	2	0.66
Frequently	11	3.66
Every day	287	95.66
Taking food (lunch/snacks) during working hours		
No	88	29.3
Yes	212	70.7

Table 2. Morbidities among door to door waste handlers, Surat

Morbidities in past three months	Frequency (N = 300)	Percentage (%)
Injury	234	77.7
Skeletomuscular disorders	213	71
Respiratory disorders	187	62.3
Gastrointestinal (GIT) disorders	118	39.3
Eye disorders	109	36.3
Skin disorders	90	30.0

Table 3. Injury in past three months

Types of injury (N = 234)	Frequency	Percentage (%)
Multiple injuries	86	36.8
Cutting injury	99	42.3
Punctured wounds	10	4.3
Bruise	15	6.4
Fracture	6	2.56
Contusion	1	0.4
Cut-lacerated wounds	5	2.13
Strain/sprain	5	2.13
Dog bite	5	2.13
Burns	2	0.85

Table 4. Skeletomuscular disorders in past three months

Skeletomuscular disorders (N = 213)	Frequency	Percentage (%)
Pain in joints		
Neck pain	5	2.16
Wrist-hand pain	25	11.73
Shoulder pain	78	36.61
Back pain	145	68.07
Hip pain	3	1.40
Knee pain	14	6.57
Weakness in arms, hand and legs	114	53.52
Difficulties in motions		
Difficulties in movements	72	33.80
Difficulties in moving arms	72	33.80
Difficulties in climbing stairs of vehicle	37	17.37
Difficulties in carrying more weight	37	17.37

Table 5. Respiratory disorders in past three months

Respiratory disorders (N=187)	Frequency	Percentage (%)
Dry cough	23	12.30
Cough with phlegm	147	76.60
Chest tightness	87	46.52
Itching nose	36	19.25
Running nose	43	22.99
Sneezing	40	21.39
Wheeze	3	1.6
Wheeze with breathlessness	54	28.87
Sore throat	12	6.4
Fever	12	6.4
Fever with headache	48	25.66
Headache	17	9.1

Table 6. Respiratory disease prevalence among the workers (N = 300)

Respiratory diseases	Frequency	Prevalence
Asthma	10	3.3
Tuberculosis	4	1.3
Allergic rhinitis	42	14.0
Chronic bronchitis	23	7.6
Rhinitis	1	0.5
Chronic obstructive pulmonary disease	0	0

Table 7. Gastrointestinal track (GIT) disorders in past three months

GIT disorders in past three months (N=118)	Frequency	Percentage (%)
Nausea/vomiting	42	35.59
Diarrhoea	69	58.47
Dysentery	24	20.33
Warm infestation	38	32.20
Acute peptic disease	71	60.16
Prevalence of jaundice among the workers (N =300)	33	11

Table 8. Eye disorders in past three months

Disorders of eye in past three months (N = 109)	Frequency	Percentage (%)
Redness of eye	39	35.77
Burning eyes	103	94.50
Eye injuries	30	27.52
Dimness of vision	52	47.70
Watery discharge	30	27.52

Table 9. Skin disorders in past three months

Skin disorders in past three months (N = 90)	Frequency	Percentage (%)
Dermatitis	38	42.22
Allergic rash	76	84.44

Table 10. Other important analyses

	Training before joining job (%)	Protocol for handling waste (%)	Instructions for using protective equipments (%)	Using protective equipments (%)
Contracted companies				
Company C (N=120)	19 (15.8)	54 (45)	25 (20.8)	8 (6.7)
Company B (N=60)	12 (20)	39 (65)	12 (20)	2 (3.3)
Company A (N=120)	103 (85.8)	109 (90.8)	118 (98.3)	89 (74.2)
Years in door to door job				
1 – 2 years (N=127)	46 (36.2)	51 (40.2)	56 (44.1)	37 (29.1)
3 – 5 years (N=126)	63 (50)	108 (85.7)	72 (57.1)	48 (38.1)
>5 years (N=47)	25 (53.2)	43 (91.5)	27 (57.4)	14 (29.79)
One year in door to door waste collection				
1 year of job (inexperience group) (N=72)	21 (29.2)	23 (31.9)	29 (40.3)	21 (29.2)
>1 year (experience group) (N=228)	113 (49.6)	179 (78.5)	126 (55.3)	78 (34.5)
Nature of employment				
Permanent (N=217)	109 (50.2)	161 (74.2)	125 (57.6)	83 (38.2)
Temporary(N=83)	25 (30.1)	41 (49.4)	30 (36.14)	16 (19.3)
Training before joining job				
No (N=166)	-	70 (42.2)	28 (16.9)	18 (10.84)
Yes (N=134)	-	132 (98.5)	127 (81.9)	81 (60.4)
Waste collected per day				
<3 ton (N=166)	69 (41.6)	101 (60.8)	73 (47.1)	46 (27.7)
>3 ton (N=134)	65 (48.5)	101 (75.4)	82 (52.9)	53 (39.8)
Methods of collecting waste				
Manually (N=276)	111 (40.2)	178 (64.5)	131 (47.46)	77 (27.9)
Both (N=24) (equipment+manually)	23 (95.8)	24 (100.0)	24 (100.0)	22 (91.7)
Sorting of waste				
No (N=27)	27 (100.0)	27 (100.0)	27 (100.0)	24 (88.9)
Yes (N=273)	107 (39.2)	175 (64.1)	128 (46.88)	75 (27.5)

	Training before joining job (%)	Protocol for handling waste (%)	Instructions for using protective equipments (%)	Using protective equipments (%)
Instruction for using protective equipments				
No (N=145)	7 (4.8)	63 (43.4)	-	3 (2.1)
Yes (N=155)	127 (81.9)	139 (89.7)	-	96 (61.9)
Using protective equipments				
No (N=199)	53 (26.6)	114 (57.3)	59 (38.1)	-
Yes (N=99)	81 (81.8)	88 (88.9)	96 (61.9)	-
Types of equipments users				
Gloves users (N=13)	100.0	100.0	100.0	-
Gumboot users (N=99)	81 (81.8)	88 (88.9)	96 (97.0)	-
Helmet users (N=88)	75 (85.2)	80 (90.9)	87 (98.9)	-
Mask users(N=27)	24 (88.9)	25 (92.6)	27 (100.0)	-
Uniform users (N=99)	99 (81.8)	88 (88.9)	96 (97.0)	-
Protocol for handling waste				
No (N=99)	2 (2.0)	-	16 (16.2)	11 (11.2)
Yes (N=202)	132 (65.3)	-	139 (68.8)	88 (43.6)
Place of handling waste				
House to house (N=231)	105 (45.5)	156 (67.5)	121 (52.4)	81 (35.1)
Mixed waste (N=69)	29 (42.0)	46 (66.7)	34 (49.3)	18 (26.1)
Wash/take bath before going home				
Frequently (N=26)	6 (23.1)	14 (53.8)	7 (26.9)	5 (19.23)
Every day (N=273)	128 (46.88)	188 (68.86)	147 (54.0)	94 (34.43)
Change cloths before going home				
Never + Frequently (13)	0	4 (27.3)	0	0
Every day (287)	134 (46.68)	198 (69.0)	155 (54.0)	99 (34.49)
Taking lunch/snacks during working hours				
No (N=88)	28 (31.8)	53 (60.2)	31 (36.4)	36 (41.0)
Yes (N=212)	106 (50.0)	149 (70.3)	123 (58.0)	63 (29.71)
Age				
18 – 25 yrs (N=116)	57 (49.1)	72 (62.1)	65 (56.0)	40 (34.5)
26 – 35 yrs (N=108)	46 (42.6)	73 (67.6)	50 (46.3)	30 (27.8)
36 – 45 yrs (N=61)	26 (42.6)	45 (73.8)	34 (55.7)	23 (37.7)
46 – 55 yrs (N=15)	5 (33.3)	12 (80.0)	6 (40.0)	6 (40.0)
Sex				
Male (N=271)	118 (43.5)	182 (67.2)	140 (51.7)	97 (35.8)
Female (N=29)	16 (55.2)	20 (69.0)	15 (51.7)	2 (6.9)
Education attained				
No formal education (N=114)	41 (36.0)	74 (64.9)	52 (45.6)	30 (26.3)
Primary school (N=129)	65 (50.4)	91 (70.5)	67 (51.9)	44 (34.1)
Secondary school (N=54)	26 (48.1)	34 (63.0)	34 (63.0)	23 (42.6)
Intermediate (N=3)	2 (66.7)	3 (100.0)	2 (66.7)	(3) 100.0
Monthly personal income				
<3500 Rs/month	26 (15.9)	80 (48.8)	32 (19.5)	12 (7.3)
>3500 Rs/month	108 (79.4)	122 (89.7)	123 (90.4)	87 (64.0)

Appendix - II

Table 1. Relation of injuries in past three months with risk factors

Place of residence	Injuries in past three months		Total	Unadjusted Odds ratio	95% Confidence Interval (CI)	P value
	No (%)	Yes (%)				
Slum*	38 (18.7)	165 (81.3)	203 (67.7)			
Non-slum	28 (28.9)	69(71.1)	97 (32.3)	0.568	0.323 –0.997	0.047*
Monthly income						
< 3500 Rs/month*	26 (15.9)	138 (84.1)	164 (54.7)			
< 3500 Rs/month	40 (29.4)	96 (70.6)	136 (45.3)	0.452	0.259 –0.790	0.005*
Consumption of alcohol habit						
No *	53 (25.2)	157 (74.8)	210 (70.0)			
Yes	13 (14.4)	77 (85.6)	90 (30.0)	2.000	1.028 –3.888	0.039*
Daily drinking alcohol						
No*	9 (24.3)	28 (75.7)	37 (41.6)			
Yes	4 (7.7)	48 (92.3)	52 (58.4)	3.857	1.087-13.689	0.029*
Years in door to door job						
1-2 years*	21 (16.5)	106 (83.5)	127(42.3)			
3-5 years	28 (22.2)	98 (77.8)	126(42.0)	0.978	0.563-1.700	0.973
>5 years	17 (36.2)	30 (63.8)	47 (15.7)	0.424	0.217-0.830	0.011
One year in door to door job						
One year of job*	7 (9.7)	65 (90.3)	72 (24.0)			
More than one year of job	59 (25.9)	169 (74.1)	228(76.0)	0.308	0.134 –0.710	0.004*
Training before joining job						
No*	24 (14.5)	142(85.5)	166(55.3)			
Yes	42 (31.3)	92 (68.7)	134(44.7)	0.370	0.210 –0.652	0.000*
Protocol for handling waste						
No*	10 (10.2)	88 (89.8)	98 (32.7)			
Yes	56 (27.7)	146 (72.3)	202(67.3)	0.290	0.144 –0.610	0.001*
Waste collected per day						
< 3 tonnes*	28 (16.9)	138(83.1)	166(55.3)			
> 3 tonnes	38 (28.4)	96(71.6)	134(44.7)	0.513	0.295 –0.891	0.017*

(* Reference category)

Methods of collecting waste	Injuries in past three months		Total	Unadjusted Odds ratio	95% Confidence Interval (CI)	P value
	No (%)	Yes (%)				
Manually*	48 (17.4)	228 (82.6)	276(92.0)			
Both	18 (75.0)	6 (25.0)	24 (8.0)	0.070	0.026 – 0.186	0.000*
Sorting material from waste						
No*	23 (85.2)	4 (14.8)	27 (9.0)			
Yes	43 (15.8)	230 (84.2)	273(91.0)	30.756	10.130-93.380	0.000*
Instruction for usage of equipments						
No	20 (13.8)	125 (86.2)	145(48.3)			
Yes	46 (29.7)	109 (70.3)	155(51.7)	0.379	0.211-0.680	0.001*
Usage of protective equipments						
No*	32 (15.9)	169 (84.1)	201(67.0)			
Yes	34 (34.3)	65 (65.7)	99 (33.0)	0.362	0.207-0.634	0.000*
Usage of gloves						
No*	25 (24.5)	77 (75.5)	102(88.7)			
Yes	10 (76.9)	3 (23.1)	13 (11.3)	0.097	0.025-0.382	0.000*
Usage of gumboot						
No*	1 (5.9)	16 (94.1)	17 (14.7)			
Yes	34 (34.3)	65 (65.7)	99 (85.3)	0.119	0.015-0.940	0.018*
Usage of uniform						
No*	1 (5.9)	16 (94.1)	17 (14.7)			
Yes	34 (34.3)	65 (65.7)	99 (85.3)	0.119	0.015-0.940	0.018*
Usage of mask						
No*	14 (15.7)	75 (84.3)	89 (76.7)			
Yes	21 (77.8)	6 (22.2)	27 (23.3)	0.053	0.018-0.156	0.000*
Usage of helmet						
No*	2 (7.1)	26 (92.9)	28 (24.1)			
Yes	33 (37.5)	55 (62.5)	88 (75.9)	0.128	0.029-0.575	0.002*

(* Reference category)

Table 2. Relation of skeletomuscular disorders with risk factors

Place of Residence	Skeletomuscular disorders in past three months		Total	Unadjusted Odds ratio	95% Confidence Interval (CI)	P value
	No (%)	Yes (%)				
Slum*	50 (24.6)	153 (75.4)	203(67.7)			
Non-slum	37 (38.1)	60 (61.9)	97 (32.3)	0.530	0.315-0.891	0.016*
Monthly income						
< 3500 Rs/month*	39 (23.8)	125 (76.2)	164 (54.7)			
< 3500 Rs/month	48 (35.3)	88 (64.7)	136 (45.3)	0.572	0.346-0.946	0.029*
Nature of employment						
Permanent*	71 (32.7)	146 (67.3)	217 (72.3)			
Temporary	16 (19.3)	67 (80.7)	83 (27.7)	2.036	1.101-3.765	0.022*
Training						
No*	40 (24.1)	126 (75.9)	166 (55.3)			
Yes	47 (35.1)	87 (64.9)	134 (44.7)	0.588	0.356-0.971	0.037*
Protocol for handling waste						
No*	21 (21.4)	77 (78.6)	98 (32.7)			
Yes	66 (32.7)	136(67.3)	202(67.3)	0.562	0.319-0.989	0.044*
Methods of collecting waste						
Manually*	72 (26.1)	204 (73.9)	276(92.0)			
Both	15 (62.5)	9 (37.5)	24 (8.0)	0.212	0.089-0.505	0.000
Sorting materials from waste						
No*	15 (55.6)	12 (44.4)	9.0 (27)			
Yes	72 (26.4)	201 (73.6)	273(91.0)	3.490	1.560-7.808	0.001
Instruction for usage equipments						
No*	34 (23.4)	111(76.6)	145(48.3)			
Yes	53 (34.2)	102 (65.8)	155(51.7)	0.589	0.355-0.979	0.040
Usage of protective equipments						
No*	45 (22.4)	156 (77.6)	201(67.0)			
Yes	42 (42.4)	57 (57.6)	99 (33.0)	0.391	0.233-0.658	0.000
Usage of mask						
No*	29 (32.6)	60 (67.4)	89 (76.7)			
Yes	18 (66.7)	9 (33.3)	27 (23.3)	0.242	0.097-0.603	0.002

Table 3. Relation of respiratory disorders with risk factors

Place of Residence	Respiratory disorders in past three months		Total	Unadjusted Odds ratio	95% Confidence Interval (CI)	P value
	No (%)	Yes (%)				
Slum*	66 (32.5)	137 (67.5)	203 (67.7)			
Non-slum	47 (48.5)	50 (51.5)	97 (32.3)	0.513	0.312-0.841	0.008
Training						
No*	52 (31.3)	114(68.7)	166(55.3)			
Yes	61 (45.5)	730 (54.5)	134(44.7)	0.546	0.340-0.875	0.012
Protocol for handling waste						
No*	29 (29.6)	69 (70.4)	98 (32.7)			
Yes	84 (41.6)	118 (58.4)	202 (67.3)	0.590	0.352-0.989	0.044
Methods of collecting waste						
Manually*	94 (34.1)	182 (65.9)	276 (92.0)			
Both	19 (79.2)	5 (20.8)	24 (8.0)	0.136	0.049-0.375	0.000
Sorting of materials from waste						
No*	21 (77.8)	6 (22.2)	27 (9.0)			
Yes	92 (33.7)	181 (66.3)	273 (91.0)	6.889	2.69-17.65	0.000
Instruction for using equipments						
No*	45 (31.0)	100 (69.0)	145 (48.3)			
Yes	68 (43.9)	87 (56.1)	155 (51.7)	0.576	0.358-0.925	0.022
Usage of protective equipments						
No*	59 (29.4)	142 (70.6)	201 (67.0)			
Yes	54 (54.5)	45 (45.5)	99 (33.0)	0.346	0.210-0.570	0.000
Usage of gloves						
No*	46 (45.1)	56 (54.9)	102 (88.7)			
Yes	12 (20.7)	1 (7.7)	13 (11.3)	0.068	0.009-0.546	0.001
Usage of mask						
No*	35 (39.3)	54 (60.7)	89 (76.7)			
Yes	24 (88.9)	3 (11.1)	27 (23.3)	0.081	0.023-0.289	0.000
Nativity Group						
Surat city & district*	10 (24.4)	31 (75.6)	41 (13.7)			
Migrant	103(39.8)	156 (60.2)	259 (86.3)	0.489	0.230-1.039	0.059
Current use tobacco						
No*	45.7 (37)	54.3 (44)	27.0 (81)			
Yes	34.7 (76)	65.3 (143)	73.0 (219)	1.582	0.942-2.657	0.082
Taking food during working Hrs.	**Respiratory disorders in past three months**		**Total**	**Unadjusted Odds ratio**	**95% Confidence Interval (CI)**	**P value**
	No (%)	**Yes (%)**				
No*	26 (29.5)	62 (70.5)	88 (29.3)			
Yes	87 (41.0)	125 (59.0)	212(70.7)	0.603	0.353-1.027	0.061
Usage gumboot						
No*	5 (29.4)	12 (70.6)	17 (14.7)			
Yes	54 (54.5)	45 (45.5)	99 (85.3)	0.347	0.114-1.060	0.055
Usage uniform						
No*	5 (29.4)	12 (70.6)	17 (14.7)			
Yes	54 (54.5)	45 (45.5)	99 (85.3)	0.347	0.114-1.060	0.055

(* Reference category)

Table 4. Relation of GIT disorders with risk factors

Sex	GIT disorders in past three months		Total	Unadjusted Odds ratio	95%Confidence Interval (CI)	P value
	No (%)	Yes (%)				
Male*	171(63.1)	100(36.9)	271 (90.3)			
female	11 (37.9)	18 (62.1)	29 (9.7)	2.798	1.270-6.163	0.008
Monthly income						
<3500 Rs/m*	87 (53.0)	77 (47.0)	164 (54.7)			
>3500 Rs/m	95 (69.9)	41 (30.1)	136 (45.3)	0.488	0.302-0.786	0.003
Waste collected per day						
<3 ton*	93 (56.0)	73 (44.0)	166 (55.3)			
>3 ton	89 (66.4)	45 (33.6)	134 (44.7)	0.644	0.402-1.032	0.067
Methods of collecting waste						
Manually*	162(58.7)	114(41.3)	276 (92.0)			
Both	20 (83.3)	4 (16.7)	24 (8.0)	0.284	0.095-0.854	0.018
Sorting material from waste*						
No	24 (88.9)	3 (11.1)	27 (9.0)			
Yes*	158(57.9)	115(42.1)	273 (91.0)	5.823	1.712-19.803	0.002
Usage of protective equipments						
No*	109(54.2)	92 (45.8)	201 (67.0)			
yes	73 (73.7)	26 (26.3)	99 (33.0)	0.422	0.249-0.715	0.001
Usage gloves						
No*	67 (65.7)	35 (34.3)	102 (88.7)			
Yes	12 (15.2)	1 (7.7)	13 (11.3)	0.160	0.020-1.278	0.051
Usage gumboot	**GIT disorders in past three months**		**Total**	**Unadjusted Odds ratio**	**95%Confidence Interval (CI)**	**P value**
	No (%)	**Yes (%)**				
No*	7 (41.2)	10 (58.8)	17 (14.7)			
Yes	73 (73.7)	26 (26.3)	99 (85.3)	0.249	0.086-0.723	0.007
Usage uniform						
No*	7 (41.2)	10 (58.8)	17 (14.7)			
Yes	73 (73.7)	26 (26.3)	99 (85.3)	0.249	0.086-0.723	0.007
Usage mask						
No*	56 (62.9)	33 (37.1)	89 (76.7)		0.059	0.011
Yes	24 (88.9)	3 (11.1)	27 (23.3)	0.212		
Usage helmet						
No*	12 (42.9)	16 (57.1)	28 (24.1)			
Yes	68 (77.8)	20 (22.7)	88 (75.9)	0.221	0.090-0.542	0.001
Taking food during working Hrs.						
No*	41 (46.6)	47 (53.4)	88 (29.3)			
Yes	141(66.5)	71 (33.5)	212(70.7)	0.439	0.265-0.729	0.001

(* Reference category)

Table 5. Relation of eye disorders with risk factors

Monthly income	Eye disorders in past three months		Total	Unadjusted Odds ratio	95%Confidence Interval (CI)	P value
	No (%)	Yes (%)				
<3500 Rs/m*	92 (56.1)	72 (43.9)	164(54.7)			
>3500 Rs/m	99 (72.8)	37 (27.2)	136(45.3)	0.478	0.293-0.778	0.003
Consuming Alcohol habit						
No*	143(68.1)	67 (31.9)	210(70.0)			
Yes	48 (53.3)	42 (46.7)	90 (30.0)	1.868	1.126-3.097	0.015
Nature of employment						
Permanent*	151(69.6)	66 (30.4)	217(72.3)			
Temporary	40 (48.2)	43 (51.8)	83 (27.7)	2.459	1.464-4.131	0.001
Protocol for handling waste						
No*	53 (54.1)	45 (45.9)	98 (32.7)			
Yes	138(68.3)	64 (31.7)	202(67.3)	0.635	0.333-0.897	0.016
Sorting materials from waste						
No*	23 (85.2)	4 (14.8)	27 (9.0)			
Yes	168(61.5)	105(38.5)	273(91.0)	3.594	1.209-10.683	0.015
Instruction for usage of equipments	**Eye disorders in past three months**		**Total**	**Unadjusted Odds ratio**	**95%Confidence Interval (CI)**	**P value**
	No (%)	**Yes (%)**				
No*	81 (55.9)	64 (44.1)	145(48.3)			
Yes	110(71.0)	45 (29.0)	155(51.7)	0.518	0.198-0.603	0.007
Usage protective equipments						
No*	113(56.2)	88 (43.8)	201(67.0)			
Yes	78 (78.8)	21 (21.2)	99 (33.0)	0.346	0.198-0.603	0.000
Usage gumboot						
No*	7 (41.2)	10 (58.8)	17 (14.7)			
Yes	78 (78.8)	21 (21.2)	99 (85.3)	0.188	0.064-0.555	0.001
Usage uniform						
No*	7 (41.2)	10 (58.8)	17 (14.7)			
Yes	78 (78.8)	21 (21.2)	99 (85.3)	0.188	0.064-0.555	0.001
Usage helmet						
No*	13 (46.4)	15 (53.6)	28 (24.1)			
Yes	72 (81.8)	16 (18.2)	88 (75.9)	0.193	0.077-0.484	0.000
Taking foods during working Hrs.						
No*	48 (54.5)	40 (45.5)	88 (29.3)			
Yes	143(67.5)	69 (32.5)	212(70.7)	0.579	0.348-0.963	0.034

(* Reference category)

Table 6. Relation of skin disorders with risk factors

Age group	Skin disorders in past three months		Total	Unadjusted Odds ratio	95%Confidence Interval (CI)	P value
	No (%)	Yes (%)				
18 - 25	81 (69.8)	35 (30.2)	116 (38.7)	1.013	0.611-1.682	0.959
26 – 35*	69 (63.9)	39 (36.1)	108 (36.0)			
36 – 45	46 (75.4)	15 (24.6)	61 (20.3)	0.713	0.375-1.357	0.302
46 -55	14 (93.3)	1 (6.7)	15 (5.0)	0.157	0.020-0.215	0.043
Consuming Alcohol habit						
No*	155 (73.8)	55 (26.2)	210(70.0)			
Yes	55 (61.1)	35 (38.9)	90 (30.0)	1.793	1.062-3.028	0.028
Waste collected /day						
<3 ton*	108 (65.1)	58 (34.9)	166(55.3)			
>3 ton	102(76.1)	32 (23.9)	134(44.7)	0.584	0.351-0.972	0.038
Sorting materials from waste						
No*	25 (92.6)	2 (7.4)	27 (9.0)			
Yes	185 (67.8)	88 (32.2)	273(91.0)	5.946	1.377-25.666	0.007
Usage gumboot	**Skin disorders in past three months**		**Total**	**Unadjusted Odds ratio**	**95%Confidence Interval (CI)**	**P value**
	No (%)	**Yes (%)**				
No*	7 (41.2)	10 (58.8)	17 (14.7)			
Yes	75 (75.8)	24 (24.2)	99 (85.3)	0.224	0.077-0.653	0.004
Usage uniform						
No*	7 (41.2)	10 (58.8)	17 (14.7)			
Yes	75 (75.8)	24 (24.2)	99 (85.3)	0.224	0.077-0.653	0.004
Usage mask						
No*	57 (64.0)	32 (36.0)	89 (76.7)			
Yes	25 (92.6)	2 (7.4)	27 (23.3)	0.143	0.032-0.641	0.004
Usage helmet						
No*	13 (46.4)	15 (53.6)	28 (24.1)			
Yes	69 (78.4)	19 (21.6)	88 (75.9)	0.239	0.097-0.587	0.001
Monthly income						
<3500 Rs/m*	108(65.9)	56 (34.1)	164(54.7)			
>3500 Rs/m	102(75.0)	34 (25.0)	136(45.3)	0.643	0.388-1.065	0.085
Current use tobacco						
No *	63 (77.8)	18 (22.2)	81 (27.0)			
Yes	147(67.1)	72 (32.9)	219(73.0)	1.714	0.946-3.108	0.074

(* Reference category)

Table 12. Relation of morbidities with contracted companies (Employers)

Contracted companies	Injuries in past three months		Total	Unadjusted Odds ratio	95%Confidence Interval (CI)	P value
	No (%)	Yes (%)				
Company A*	36 (30.0)	84 (70.0)	120 (40.0)			
Company B and C	30 (16.7)	150 (83.3)	180 (60.0)	2.143	1.232-3.726	0.005
	Skeletomuscular disorders in past three months					
	No (%)	**Yes (%)**				
Company A*	45 (37.5)	75 (62.5)	120 (40.0)			
Company B and C	42 (23.3)	138 (76.7)	180 (60.0)	1.971	1.189-3.269	0.008
	Respiratory disorders in past three months					
	No (%)	**Yes (%)**				
Company A*	53 (44.2)	67 (55.8)	120 (40.0)			
Company B and C	60 (33.3)	120 (66.7)	180 (60.0)	1.582	0.984-2.545	0.058
	GIT disorders in past three months					
	No (%)	**Yes (%)**				
Company A*	84 (70.0)	36 (30.0)	120 (40.0)			
Company B and C	98 (54.4)	82 (45.6)	180 (60.0)	1.952	1.198-3.182	0.007
	Eye disorders in past three months					
	No (%)	**Yes (%)**				
Company A*	89 (74.2)	31 (25.8)	120 (40.0)			
Company B and C	102 (56.7)	78 (43.3)	180 (60.0)	2.195	1.326-3.634	0.002
	Skin disorders in past three months					
	No (%)	**Yes (%)**				
Company A*	90 (75.0)	30 (25.0)	120 (40.0)			
Company B and C	120 (66.7)	60 (33.3)	180 (60.0)	1.500	0.895-2.514	0.123

(* Reference category)

Appendix - III

Table 3.16 Significant independent variables found in multivariate analysis for injury in past three months (*Reference category)

Place of residence	Injuries in past three months		Total	Adjusted Odds ratio	95% Confidence Interval (CI)	P value
	No (%)	Yes (%)				
Slum*	38 (18.7)	165 (81.3)	203 (67.7)			
Non-slum	28 (28.9)	69(71.1)	97 (32.3)	0.325	0.087-1.218	0.086
Consuming Alcohol habit						
No *	53 (25.2)	157 (74.8)	210 (70.0)			
Yes	13 (14.4)	77 (85.6)	90 (30.0)	13.131	2.039-84.551	0.002
Years in door to door waste collection job						
1-2 years*	21 (16.5)	106 (83.5)	127 (42.3)			
3-5 years	28 (22.2)	98 (77.8)	126 (42.0)	0.798	0.563-1.700	0.937
>5 years	17 (36.2)	30 (63.8)	47 (15.7)	0.424	0.217-0.830	0.011
One year in waste collection job						
One year in job*	7 (9.7)	65 (90.3)	72 (24.0)			
More than one year of job	59 (25.9)	169 (74.1)	228(76.0)	0.547	0.313-0.956	0.011
Nature of employment						
Permanent*	24.0 (52)	76.0 (165)	72.3 (217)			
Temporary	16.9 (14)	83.1 (69)	27.7 (83)	27.072	1.492-491.228	0.008
Training						
No*	24 (14.5)	142(85.54)	166 (55.3)			
Yes	42 (31.3)	92 (68.7)	134(44.7)	0.115	0.007-1.855	0.084
Protocol for handling waste						
No	10 (10.2)	88 (89.8)	98 (32.7)			
Yes*	56 (27.7)	146 (72.3)	202 (67.3)	37.396	1.207-1158.412	0.020
Sorting materials from waste						
No*	23 (85.2)	4 (14.8)	27 (9.0)			
Yes	43 (15.8)	230 (84.2)	273 (91.0)	60.870	8.598-430.921	0.000
Usage protective equipments						
No	32 (15.9)	169 (84.1)	201 (67.0)			
Yes*	34 (34.3)	65 (65.7)	99 (33.0)	13.590	1.077-171.445	0.024
Change in job from waste collection						
No*	44 (20.4)	172 (79.6)	216 (72.0)			
Yes	22 (26.2)	62 (73.8)	84 (28.0)	0.070	0.010-0.496	0.002

Table 3.17 Significant independent variables found in multivariate analysis for skeletomuscular disorders in past three months (*Reference category)

Sex	Skeletomuscular disorders in paste three months		Total	Adjusted Odds ratio	95% Confidence Interval (CI)	P value
	No (%)	Yes (%)				
Male*	29.9(81)	70.1 (190)	271 (90.3)			
Female	2.0 (6)	79.3 (23)	29 (9.7)	2.582	0.925-7.208	0.056
Place of residence						
Slum*	50(24.6)	153(75.4)	203(67.7)			
Non-slum	37(38.1)	60 (61.9)	97 (32.3)	0.547	0.313-0.956	0.035
Education status						
Below secondary level*	75(30.9)	168(69.1)	243(81.0)			
Above secondary level	12(21.1)	45(78.9)	57(19.0)	4.394	1.379-13.998	0.007
Monthly income						
< 3500 Rs/month*	39(23.8)	125(76.2)	164 (54.7)			
> 3500 Rs/month	48(35.3)	88 (64.7)	136 (45.3)	0.042	0.003-0.563	0.005
Additional part time job						
No *	77(30.9)	172 (69.1)	249 (83.0)			
Yes	10(19.6)	41 (80.4)	51 (17.0)	6.681	0.820-54.416	0.052
Consuming alcohol						
No *	67(31.9)	143(68.1)	210(70.0)			
Yes	20(22.2)	70(77.8)	90 (30.0)	1.814	0.983-3.346	0.052
One year in the waste collection job						
One year in job*	17(23.6)	55 (76.4)	72 (24.0)			
More than one year	70(30.7)	158(69.3)	228 (76.0)	0.051	0.022-1.039	0.048
Training before joining job						
No *	40(24.1)	126 (75.9)	166 (55.3)			
Yes	47(35.1)	87 (64.9)	134 (44.7)	0.285	0.061-1.340	0.093
Methods of collection of the waste						
Manually*	72(26.1)	204 (73.9)	276(92.0)			
Both	15(62.5)	9 (37.5)	24 (8.0)	0.558	0.346-0.900	0.015

Table 3.18 Significant independent variables found in multivariate analysis for respiratory disorders in past three months (*Reference category)

Place of Residence	Respiratory disorders in past three months		Total	Adjusted Odds ratio	95% Confidence Interval (CI)	P value
	No (%)	Yes (%)				
Slum*	66 (32.5)	137 (67.5)	203 (67.7)			
Non-slum	47 (48.5)	50 (51.5)	97 (32.3)	0.352	0.114-1.091	0.063
Part time job						
No *	96 (38.6)	153(61.4)	249(83.0)			
Yes	17 (33.3)	34(66.7)	51 (17.0)	6.293	0.770-51.398	0.078
Passive smoking at workplace						
No*	100(38.6)	159(61.4)	259(86.3)			
Yes	13 (31.7)	28 (68.3)	41(13.7)	7.096	0.842-59.829	0.052
Industry or factory near home						
No *	31 (41.9)	43 (58.1)	74(24.7)			
Yes	82(36.3)	144 (63.7)	226(75.3)	4.894	1.226-19.535	0.018
Years in job of waste collection						
1-2 years*	33.9 (43)	66.1 (84)	42.3 (127)			
3-5 years	40.5 (51)	59.5 (75)	42.0 (126)	0.507	0.236-1.092	0.077
>5 years	40.4 (19)	59.6 (28)	15.7 (47)			
Training						
No*	52 (31.3)	114(68.7)	166(55.3)			
Yes	61 (45.5)	730 (54.5)	134(44.7)	0.096	0.017-0.545	0.003
Type of handling the waste						
Mixed waste*	33.3 (23)	66.7 (46)	23.0 (69)			
House to house	39.0 (90)	61.0 (141)	77.0 (231)	0.596	0.401-0.886	0.005
Sorting materials from the waste						
No*	15 (55.6)	12 (44.4)	9.0 (27)			
Yes	72 (26.4)	201 (73.6)	273(91.0)	13.391	2.432-73.739	0.001
Change of job from waste collection						
No*	78 (36.1)	138(63.9)	216(72.0)			
Yes	35 (41.7)	49 (58.3)	84 (28.0)	0.361	0.114-1.141	0.078
Usage of mask						
No*	35 (39.3)	54 (60.7)	89 (76.7)			
Yes	24 (88.9)	3 (11.1)	27 (23.3)	0.101	0.022-0.473	0.001
Usage helmet						
Yes*	53.4 (47)	46.6 (41)	75.9 (88)			
No	42.9 (12)	57.1 (16)	24.1 (28)	37.655	4.316-328.530	0.000
Change cloths before leaving for home						
Frequently*	27.3 (3)	72.7 (8)	3.7 (11)			
Every day	38.3(110)	61.7 (177)	95.7 (287)	0.267	0.057-1.239	0.080

Table 3.19 Significant independent variables found in multivariate analysis for gastrointestinal disorders in past three months

Age group	Gastrointestinal disorders in past three months		Total	Adjusted Odds ratio	95% Confidence Interval (CI)	P value
	No (%)	Yes (%)				
18-25	71 (61.2)	45 (38.8)	116 (38.7)	1.076	0.328-3.530	0.806
26-35*	58 (53.7)	50 (46.3)	108 (36.0)			
36-45	44 (72.1)	17 (27.9)	61 (20.3)	0.516	0.262-1.019	0.047
46-55	9 (60.0)	6 (40.0)	15 (5.0)	0.523	0.150-1.825	0.425
Sex						
Male*	171(63.1)	100(36.9)	271 (90.3)			
Female	11 (37.9)	18 (62.1)	29 (9.7)	2.994	1.149-7.799	0.029
Place of residence						
Slum*	58.1(118)	41.9 (85)	67.7 (203)			
Non-slum	66.0 (64)	34.0 (33)	32.3 (97)	0.016	0.265-0.090	0.012
Part time job						
No*	154(61.8)	95 (38.2)	249 (83.0)			
Yes	28 (54.9)	23 (45.1)	51 (17.0)	3.592	1.051-12.274	0.034
Currently using of tobacco product						
No*	49 (60.5)	32 (39.5)	81 (27.0)			
Yes	133(60.7)	86 (39.3)	219(73.0)	1.053	1.050-1.898	0.029
Habit alcohol consuming						
No*	133(63.3)	77 (36.7)	210(70.0)			
Yes	49 (54.4)	41 (45.6)	90 (30.0)	1.669	1.092-3.004	0.011
Methods of collecting waste						
Both*	20 (83.3)	4 (16.7)	24 (8.0)			
Manually	162(58.7)	114(41.3)	276(92.0)	3.823	1.069-11.393	0.057
Hour to take complete assign job						
8-hours*	161(61.2)	102(38.8)	263(87.7)			
12-hours	21 (56.8)	16 (43.2)	37 (12.3)	1.565	1.470-5.219	0.002
Sorting materials						
No*	24 (88.9)	3 (11.1)	27 (9.0)			
Yes	158(57.9)	115(42.1)	273(91.0)	3.659	1.903-14.831	0.049
Wash/take bath before leaving job						
Frequently	15 (57.7)	11 (42.3)	26 (8.7)			
Every day	167(60.9)	107(39.1)	274(91.3)	15.634	1.209-33.684	0.026
Change cloths before leaving home						
Frequently*	6 (54.5)	5 (45.5)	11(3.7)			
Every day	175(61.0)	112(39.0)	287(95.7)	0.325	0.113-0.937	0.033
Taking food during working Hrs.						
No*	41 (46.6)	47 (53.4)	88 (29.3)			
Yes	141(66.5)	71 (33.5)	212(70.7)	4.589	1.256-16.764	0.001

Table 3.20 Significant independent variables found in multivariate analysis for eye disorders in past three months

Age group	Eye disorders in past three months		Total	Adjusted Odds ratio	95% Confidence Interval (CI)	P value
	No (%)	Yes (%)				
18-25	75 (64.7)	41 (35.3)	116 (38.7)	0.635	0.098-4.127	0.762
26-35*	66 (61.1)	42 (38.9)	108 (36.0)			
36-45	39 (63.9)	22 (36.1)	61 (20.3)	0.985	0.164-5.902	0.077
46-55	11 (73.3)	4 (26.7)	15 (5.0)	0.400	0.047-3.377	0.641
Habit alcohol consuming						
No*	143(68.1)	67 (31.9)	210 (70.0)			
Yes	48 (53.3)	42 (46.7)	90 (30.0)	1.786	1.054-3.027	0.031
One year in the waste collecting job						
One year of job*	42 (58.3)	30 (41.7)	72 (24.0)			
More than one year of job	149(65.4)	79 (34.6)	228 (76.0)	0.017	0.000-0.642	0.010
Nature of employment						
Permanent*	151(69.6)	66 (30.4)	217 (72.3)			
Temporary	40 (48.2)	43 (51.8)	83 (27.7)	2.215	1.294-3.794	0.004
Training						
Yes*	93 (69.4)	41 (30.6)	134 (44.7)			
No	98 (59.0)	68 (41.0)	166 (55.3)	121.735	1.338-127.51	0.014
Protocol for the waste collection						
No*	53 (54.1)	45 (45.9)	98 (32.7)			
Yes	138(68.3)	64 (31.7)	202(67.3)	0.043	0.001-1.516	0.061
Waste collected per day						
> 3 tonnes*	87(45.5)	47 (35.1)	134 (44.7)			
< 3tonnes	104(62.7)	62 (37.3)	166 (55.3)	28.010	1.173-669.111	0.017
Usage of protective equipments						
No*	113(56.2)	88 (43.8)	201 (67.0)			
Yes	78 (78.8)	21 (21.2)	99 (33.0)	0.412	0.232-0.729	0.002
Usage helmet						
No*	13 (46.4)	15 (53.6)	28 (24.1)			
Yes	72 (81.8)	16 (18.2)	88 (75.9)	0.007	0.000-0.463	0.004
Change in job of waste collection						
No*	136(63.0)	80 (37.0)	216 (72.0)			
Yes	55 (65.5)	29 (34.5)	84 (28.0)	0.034	0.001-0.976	0.020

Table 3.21 Significant independent variables found in multivariate analysis for skin disorders in past three months

Age group	Skin disorders in past three months		Total	Adjusted Odds ratio	95% Confidence Interval (CI)	P value
	No (%)	Yes (%)				
18-25	81 (69.8)	35 (30.2)	116(38.7)	6.829	0.830-56.179	0.926
26-35*	69 (63.9)	39 (36.1)	108(36.0)			
36-45	46 (75.4)	15 (24.6)	61 (20.3)	5.569	0.657-47.292	0.289
46-55	14 (93.3)	1 (6.7)	15 (5.0)	0.205	0.042-0.990	0.016
Years in the waste collecting job						
1-2 years	86 (67.7)	41 (32.3)	127 (42.3)	7.617	1.002-57.884	0.024
3-5 years*	91 (72.2)	35 (27.8)	126(42.0)			
>5 years	33 (70.2)	14 (29.8)	47 (15.7)	1.026	0.823-2.060	0.862
Nature of employment						
Permanent	155(71.4)	62 (28.6)	217(72.3)			
Temporary*	55(66.3)	28 (33.7)	83 (27.7)	1.016	0.000-1.547	0.064
Training						
No*	113(68.1)	53 (31.9)	166(55.3)			
yes	97 (72.4)	37 (27.6)	134(44.7)	0.060	0.005-0.678	0.007
Sorting of from waste						
No*	25 (92.6)	2 (7.4)	27 (9.0)			
yes	185(67.8)	88 (32.2)	273(91.0)	4.722	1.035-21.556	0.029
Wash/take bath before going home						
Frequently*	15 (57.7)	11 (42.3)	26 (8.7)			
Every day	195(71.2)	79 (28.8)	274 (91.3)	13.314	0.764-232.170	0.038
Waste collected /day						
< 3 tonnes*	108(65.1)	58 (34.9)	166(55.3)			
> 3 tonnes	102(76.1)	32 (23.9)	134(44.7)	0.066	0.005-0.919	0.015

Appendix – IV

Table 1. Injury in past three months (*Reference category)

Independent variables	Injury in past three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Place of residence							
Slum*	38 (18.7)	165 (81.3)	203 (67.7)				
Non-slum	28 (28.9)	69(71.1)	97 (32.3)	0.568 (0.323-0.997)	0.047	0.325 (0.087-1.218)	0.086
Alcohol consuming habit							
No *	53 (25.2)	157 (74.8)	210 (70.0)				
Yes	13 (14.4)	77 (85.6)	90 (30.0)	2.000 (1.028-3.888)	0.039	13.131 (2.039-84.551)	0.002
Years in door to door waste collection job							
1-2 years*	21 (16.5)	106 (83.5)	127(42.3)	1.775 (0.995-3.164)	0.050		
3-5 years	28 (22.2)	98 (77.8)	126(42.0)	0.978 (0.563-1.700)	0.937	0.269 (0.086-0.846)	0.017
>5 years	17 (36.2)	30 (63.8)	47 (15.7)	0.424 (0.217-0.830)	0.011		
One year in waste collection job							
One year of job*	7 (9.7)	65 (90.3)	72 (24.0)				
More than one year of job	59 (25.9)	169 (74.1)	228(76.0)	0.308 (0.134-0.710)	0.004	0.547 (0.313-0.956)	0.011
Nature of employment							
Permanent*	24.0 (52)	76.0 (165)	72.3 (217)				
Temporary	14 (16.9)	83.1 (69)	27.7 (83)	1.553 (0.808-2.986)	0.184	27.072 (1.492-491.228)	0.008

Independent variables	Injury in past three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Training before joining job							
No*	24 (14.5)	142(85.5)	166(55.3)				
Yes	42 (31.3)	92 (68.7)	134(44.7)	0.370 (0.210-0.652)	0.000	0.115 (0.007-1.855)	0.084
Protocol for handling waste							
Protocol followers*	56 (27.7)	146 (72.3)	202(67.3)				
No protocol followers	10 (10.2)	88 (89.8)	98 (32.7)	3.375 (1.638-6.955)	0.001	37.396 (1.207-1158.412)	0.020
Sorting material from waste							
No*	23 (85.2)	4 (14.8)	27 (9.0)				
Yes	43 (15.8)	230 (84.2)	273(91.0)	30.756 (10.130-93.380)	0.000	60.870 (8.598-430.921)	0.000
Usage of protective equipments							
Yes*	34 (34.3)	65 (65.7)	99 (33.0)				
No	32 (15.9)	169 (84.1)	201(67.0)	2.763 (1.576-4.842)	0.000	13.590 (1.077-171.45)	0.024
Change in job from waste collection							
No*	44 (20.4)	172 (79.6)	216 (72.0)				
Yes	22 (26.2)	62 (73.8)	84 (28.0)	0.721 (0.400-1.298)	0.275	0.070 (0.010-0.496)	0.002

Table 2. Skeletomuscular disorders in past three months (*Reference category)

Independent variables	Skeletomuscular disorders in paste three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Sex							
Male*	81 (29.9)	190 (70.1)	271 (90.3)				
Female	6 (2.0)	23 (79.3)	29 (9.7)	1.634 (0.641-4.164)	0.299	2.582 (0.925-7.208)	0.056
Place of Residence							
Slum*	50(24.6)	153(75.4)	203 (67.7)				
Non-slum	37(38.1)	60 (61.9)	97 (32.3)	0.530 (0.315-0.891)	0.016	0.547 (0.313-0.956)	0.035
Education status							
Below secondary level*	75(30.9)	168(69.1)	243 (81.0)				
Above secondary level	12(21.1)	45(78.9)	57(19.0)	1.674 (0.838-3.346)	0.142	4.394 (1.379-13.998)	0.007
Monthly income							
< 3500 Rs/month*	39(23.8)	125(76.2)	164 (54.7)				
> 3500 Rs/month	48(35.3)	88 (64.7)	136 (45.3)	0.572 (0.346-0.946)	0.029	0.042 (0.003-0.563)	0.005
Additional part time job							
No *	77(30.9)	172 (69.1)	249 (83.0)				
Yes	10(19.6)	41 (80.4)	51 (17.0)	1.835 (0.874-3.853)	0.105	6.681 (0.820-54.416)	0.052

Independent variables	Skeletomuscular disorders in paste three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Alcohol consuming habit							
No *	67(31.9)	143(68.1)	210 (70.0)				
Yes	20(22.2)	70(77.8)	90 (30.0)	1.640 (0.922-2.916)	0.090	1.814 (0.983-3.346)	0.052
One year in the waste collection job							
One year in job*	17(23.6)	55 (76.4)	72 (24.0)	0.698 (0.378-1.287)	0.248	0.051 (0.022-1.039)	0.048
More than one year of job	70(30.7)	158(69.3)	228 (76.0)				
Training before joining job							
No *	40(24.1)	126 (75.9)	166 (55.3)	0.588 (0.356-0.971)	0.037	0.285 (0.061-1.340)	0.093
Yes	47(35.1)	87 (64.9)	134 (44.7)				
Methods of collection of the waste							
Manually*	72(26.1)	204 (73.9)	276(92.0)	0.212 (0.089-0.505)	0.000	0.558 (0.346-0.900)	0.015
Both	15(62.5)	9 (37.5)	24 (8.0)				

Table 3. Respiratory disorders in past three months (*Reference category)

Independent variables	Respiratory disorders in past three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Place of residence							
Slum*	66 (32.5)	137 (67.5)	203 (67.7)				
Non-slum	47 (48.5)	50 (51.5)	97 (32.3)	0.513 (0.312-0.841)	0.008	0.352 (0.114-1.091)	0.063
Additional part time job							
No *	96 (38.6)	153(61.4)	249(83.0)				
Yes	17 (33.3)	34(66.7)	51 (17.0)	1.255 (0.665-2.370)	0.483	6.293 (0.770-51.398)	0.078
Passive smoking at workplace							
No*	100(38.6)	159(61.4)	259(86.3)				
Yes	13 (31.7)	28 (68.3)	41(13.7)	1.355 (0.670-2.738)	0.397	7.096 (0.842-59.829)	0.052
Industry or factory near home							
No *	31 (41.9)	43 (58.1)	74(24.7)	1.266 (0.741-2.163)	0.387	4.894 (1.226-19.535)	0.018
Yes	82(36.3)	144 (63.7)	226(75.3)				
Years in job of waste collection							
1-2 years*	33.9 (43)	66.1 (84)	42.3 (127)	1.328 (0.824-2.138)	0.243		
3-5 years	40.5 (51)	59.5 (75)	42.0 (126)	0.814 (0.508-1.305)	0.393	0.507 (0.236-1.092)	0.077
>5 years	40.4 (19)	59.6 (28)	15.7 (47)	0.871 (0.461-1.646)	0.671		

Independent variables	Respiratory disorders in past three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Training before joining job							
No*	52 (31.3)	114(68.7)	166(55.3)				
Yes	61 (45.5)	730 (54.5)	134(44.7)	0.546 (0.340-0.875)	0.012	0.096 (0.017-0.545)	0.003
Sorting material from the waste							
No*	15 (55.6)	12 (44.4)	9.0 (27)				
Yes	72 (26.4)	201 (73.6)	273(91.0)	6.886 (2.686-17.652)	0.000	13.391 (2.432-73.739)	0.001
Change of job from waste collection							
No*	78 (36.1)	138(63.9)	216(72.0)				
Yes	35 (41.7)	49 (58.3)	84 (28.0)	0.791 (0.431-1.324)	0.373	0.361 (0.114-1.141)	0.078
Usage of mask							
No*	35 (39.3)	54 (60.7)	89 (76.7)				
Yes	24 (88.9)	3 (11.1)	27 (23.3)	0.081 (0.023-0.289)	0.000	0.101 (0.022-0.473)	0.001
Usage of helmet							
Yes*	53.4 (47)	46.6 (41)	75.9 (88)				
No	42.9 (12)	57.1 (16)	24.1 (28)	7.800 (1.738-35.012)	0.002	37.655 (4.316-328.530)	0.000
Change cloths before leaving for home							
Frequently*	27.3 (3)	72.7 (10)	3.7 (13)				
Every day	38.3(110)	61.7 (177)	95.7 (287)	0.483 (0.130-1.793)	0.413	0.267 (0.057-1.239)	0.080

Table 4. Gastrointestinal tract (GIT) disorders in past three months (*Reference category)

Independent variables	Gastrointestinal disorders in past three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Age group							
18-25	71 (61.2)	45 (38.8)	116(38.7)	0.964 (0.599-1.551)	0.879	1.076 (0.328-3.530)	0.806
26-35*	58 (53.7)	50 (46.3)	108 (36.0)				
36-45	44 (72.1)	17 (27.9)	61 (20.3)	0.528 (0.285-0.977)	0.040	0.516 (0.262-1.019)	0.047
46-55	9 (60.0)	6 (40.0)	15 (5.0)	1.030 (0.375-2.972)	0.957	0.523 (0.150-1.825)	0.425
Sex							
Male*	171(63.1)	100(36.9)	271(90.3)	2.798 (1.270-6.163)	0.008	2.994 (1.149-7.799)	0.029
Female	11 (37.9)	18 (62.1)	29 (9.7)				
Place of residence							
Slum*	118 (58.1)	85 (41.9)	203 (67.7)				
Non-slum	64 (66.0)	33 (34.0)	97 (32.3)	0.716 (0.432-1.185)	0.193	0.016 (0.265-0.090)	0.012
Additional part time job							
No*	154(61.8)	95 (38.2)	249 (83.0)				
Yes	28 (54.9)	23 (45.1)	51 (17.0)	1.332 (0.725-2.446)	0.355	3.592 (1.051-12.274)	0.034
Currently using of tobacco product							
No*	49 (60.5)	32 (39.5)	81 (27.0)				
Yes	133(60.7)	86 (39.3)	219(73.0)	0.990 (0.588-1.668)	0.970	1.053 (1.050-1.898)	0.029

Independent variables	Gastrointestinal disorders in past three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Alcohol consuming habit							
No*	133(63.3)	77 (36.7)	210(70.0)				
Yes	49 (54.4)	41 (45.6)	90 (30.0)	1.445 (0.876-2.385)	0.149	1.669 (1.092-3.004)	0.011
Methods of collecting waste							
Both*	20 (83.3)	4 (16.7)	24 (8.0)				
Manually	162(58.7)	114(41.3)	276(92.0)	2.478 (1.002-6.130)	0.018	3.823 (1.069-11.393)	0.057
Hour to take complete assign job							
12-hours*	21 (56.8)	16 (43.2)	37 (12.3)				
8-hours	161(61.2)	102(38.8)	263(87.7)	0.832 (0.415-1.668)	0.603	1.565 (1.470-5.219)	0.002
Sorting material from waste							
No*	24 (88.9)	3 (11.1)	27 (9.0)				
Yes	158(57.9)	115(42.1)	273(91.0)	5.823 (1.712-19.803)	0.002	3.659 (1.903-14.831)	0.049
Wash/take bath before leaving job							
Every day*	167(60.9)	107(39.1)	274(91.3)				
Frequently	15 (57.7)	11 (42.3)	26 (8.7)	1.145 (0.507-2.586)	0.745	15.634 (1.209-33.684)	0.026
Change cloths before leaving job							
Frequently*	7 (54.5)	6 (45.5)	11(3.7)	0.747 (0.245-2.279)	0.870	0.325 (0.113-0.937)	0.033
Every day	175(61.0)	112(39.0)	287(95.7)				
Taking food during working Hrs.							
Yes*	141(66.5)	71 (33.5)	212(70.7)	2.277 (1.372-3.779)	0.001	4.589 (1.256-16.764)	0.001
No	41 (46.6)	47 (53.4)	88 (29.3)				

Table 5. Eye disorders in past three months (*Reference category)

Independent variables	Eye disorders in past three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Age group							
18-25	75 (64.7)	41 (35.3)	116 (38.7)	0.933 (0.575-1.514)	0.777	0.635 (0.098-4.127)	0.762
26-35*	66 (61.1)	42 (38.9)	108 (36.0)				
36-45	39 (63.9)	22 (36.1)	61 (20.3)	0.986 (0.549-1.770)	0.961	0.985 (0.164-5.902)	0.077
46-55	11 (73.3)	4 (26.7)	15 (5.0)	0.623 (0.194-2.007)	0.424	0.400 (0.047-3.377)	0.641
Alcohol consuming habits							
No*	143(68.1)	67 (31.9)	210 (70.0)				
Yes	48 (53.3)	42 (46.7)	90 (30.0)	1.868 (1.126-3.097)	0.015	1.786 (1.054-3.027)	0.031
One year in the waste collecting job							
One year of job*	42 (58.3)	30 (41.7)	72 (24.0)				
More than one year of job	149(65.4)	79 (34.6)	228 (76.0)	0.742 (0.432-1.276)	0.280	0.017 (0.000-0.642)	0.010
Nature of employment							
Permanent*	151(69.6)	66 (30.4)	217 (72.3)	2.459 (1.464-4.131)	0.001	2.215 (1.294-3.794)	0.004
Temporary	40 (48.2)	43 (51.8)	83 (27.7)				
Training							
Training before joining job*	69.4 (93)	30.6 (41)	44.7 (134)				
No training before joining job	59.0 (98)	41.0 (68)	55.3 (166)	1.574 (0.974-2.544)	0.063	121.74 (1.338-127.51)	0.014

Independent variables	Eye disorders in past three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Protocol for the Waste collection							
No*	53 (54.1)	45 (45.9)	98 (32.7)				
yes	138(68.3)	64 (31.7)	202(67.3)	0.546 (0.333-0.897)	0.016	0.043 (0.001-1.516)	0.061
Waste collected per day							
> 3 tonnes*	87(45.5)	47 (35.1)	134 (44.7)				
< 3tonnes	104(62.7)	62 (37.3)	166(55.3)	1.104 (0.687-1.773)	0.684	28.010 (1.173-69.111)	0.017
Usage of protective equipments							
No*	113(56.2)	88 (43.8)	201(67.0)				
yes	78 (78.8)	21 (21.2)	99 (33.0)	0.346 (0.198-0.603)	0.000	0.412 (0.232-0.729)	0.002
Usage of helmet							
No*	13 (46.4)	15 (53.6)	28 (24.1)				
yes	72 (81.8)	16 (18.2)	88 (75.9)	0.193 (0.077-0.483)	0.000	0.007 (0.000-0.463)	0.004
Change in job of waste collection							
No*	136(63.0)	80 (37.0)	216(72.0)				
yes	55 (65.5)	29 (34.5)	84 (28.0)	0.896 (0.529-1.520)	0.684	0.034 (0.001-0.976)	0.020

(* Reference category)

Table 6. Skin disorders in past three months (*Reference category)

Independent variables	Skin disorders in past three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Age group							
18-25	81 (69.8)	35 (30.2)	116(38.7)	1.013 (0.611-1.682)	0.959	6.829 (0.830-56.179)	0.926
26-35*	69 (63.9)	39 (36.1)	108(36.0)				
36-45	46 (75.4)	15 (24.6)	61 (20.3)	0.713 (0.375-1.357)	0.302	5.569 (0.657-47.292)	0.289
46-55	14 (93.3)	1 (6.7)	15 (5.0)	0.157 (0.020-0.215)	0.043	0.205 (0.042-0.990)	0.016
Years in the waste collecting job							
1-2 years	86 (67.7)	41 (32.3)	127 (42.3)	1.775 (0.995-3.164)	0.050	7.617 (1.002-57.884)	0.024
3-5 years*	91 (72.2)	35 (27.8)	126(42.0)				
>5 years	33 (70.2)	14 (29.8)	47 (15.7)	0.988 (0.500-1.951)	0.972	1.026 (0.823-2.060)	0.862
Nature of employment							
Permanent*	155(71.4)	62 (28.6)	217(72.3)				
Temporary	55(66.3)	28 (33.7)	83 (27.7)	1.273 (0.740-2.188)	0.383	1.016 (0.000-1.547)	0.064
Training before joining job							
No*	113(68.1)	53 (31.9)	166(55.3)				
Yes	97 (72.4)	37 (27.6)	134(44.7)	0.813 (0493-1.341)	0.417	0.060 (0.005-0.678)	0.007

Independent variables	Skin disorders in past three months		Total	Unadjusted Odds ratio (95% CI)	Unadjusted P value	Adjusted Odds ratio (95% CI)	Adjusted P value
	No (%)	Yes (%)					
Sorting material from waste							
No*	25 (92.6)	2 (7.4)	27 (9.0)				
Yes	185 (67.8)	88 (32.2)	273 (91.0)	5.946 (1.377-25.666)	0.007	4.722 (1.035-21.556)	0.029
Wash/take bath before going home							
Every day*	195 (71.2)	79 (28.8)	274 (91.3)				
Frequently	15 (57.7)	11 (42.3)	26 (8.7)	1.810 (0.797-4.113)	0.152	13.314 (1.764-23.170)	0.038
Waste collected /day							
< 3tonnes*	108 (65.1)	58 (34.9)	166 (55.3)				
> 3 tonnes	102 (76.1)	32 (23.9)	134 (44.7)	0.584 (0.351-0.972)	0.038	0.066 (0.005-0.919)	0.015

(* Reference category)

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES
SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY
THIRUVANANTHAPURAM, KERALA- 695011

INFORMED CONSENT FORM

Dear Sir/Madam

I am Dr. Sanjay S. Das, a post graduate student for Master of Public Health at Achutha Menon Centre for Health Science Studies, SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY. I am undertaking a research project on the *Occupational health problems among door to door solid waste handlers in Surat city, Gujarat;* with special interest in municipal solid waste workers. I will be asking a few questions for this purpose. This will take only 20 minutes of your time. There is no direct benefit from the study but in case morbidity is severe then you will be referred to physician through proper channel if you need so. Again if you need any information regarding your morbidity related queries, I can give you after the interview process is over.

For any other queries related to this study you can contact the following person.

Contact: Dr Anoop Kumar Thekkuveettil, Member Secretary, Institutional Ethics Committee, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, Kerala, 695011. Ph: 0471- 252-0256.

Dr. Sanjay S Das – Mobile No: 9746007180; Email: dasmph@gmail.com

All information provided by you will remain confidential and only use for research purpose only. You are free to refuse to participate in this study or to answer any question. Your co-operation will add greatly to scientific knowledge and benefit the society. If you agree to participate in this study, kindly sign on space provided.

Are you willing to participate in this study?

Yes: ☐ **No:** ☐

Signature of the participant	Signature of witness	Signature of investigator
(Or Thumb impression)	(In case oral consent)	
Date:	Date:	Date:

Interview Schedule

No.....

ZONE.....

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY

Occupational health problems among door to door solid waste handlers in Surat city, Gujarat

GENERAL INFORMATION:

1	Name of the respondent (optional)		
2	Age (In completed years)		
3	Sex:	[Male] 1 [Female] 2	
4	Place of nativity:	[Surat city] 1 [Surat district] 2 [Any other native] (Specify_____) 3	
5	Place of residence:	[Slum] 1 [Non slum] 2	
6	Highest level of Education attained	[No formal schooling] 1 [Up to primary school] 2 [Up to high school] 3 [Up to intermediate] 4 [Up to university] 5 [University completed or higher] 6 [Other] (specify_____) 7	
7	Monthly personal income (RS)		
8	What were your immediate previous occupations? [Before present job]		
9	Are you currently doing any part time job?	[No] 0 [Yes] 1	
10	If yes, What are they? [Specify]		

NON – OCCUPATIONAL EXPOSURE:

11	Have you ever used tobacco in any form?	[No] 0 [Yes] 1 **IF NO SKIP Q. NO 12**	
12	If yes, In which form have you used tobacco?	[smoking] 1 [Chewing] 2 [Both] 3 [Others] (Specify_____)4	
13	Are you currently using any tobacco products?	[No] 0 [Yes] 1 **IF NO SKIP Q. NO 14 TO 17**	
14	If yes, In which form are you currently using tobacco product?	[smoking] 1 [Chewing] 2 [Both] 3 [Others] (Specify_____)4	
15	If smoking, Specify type of smoking;	[cigarette] 1 [Bidi] 2 [Both] 3 [Others] (Specify_____)4	
16	Do you smoke daily?	[No] 0 [Yes] 1	
17	On average, how many cigarettes/bidi do you smoke in a day?		
18	Does anybody in your workplace smoke regularly in your presence? [Passive smoking]	[No] 0 [yes] 1	
19	Does anybody in your home smoke regularly in your presence? [Passive smoking]	[No] 0 [yes] 1	
20	If habit of tobacco chewing, what do you use?	[Pan with tobacco] 1 [Gutkha] 2 [Khaini] 3 [Snuff] 4 [Others] (Specify_____)5	
21	How many of following products you use daily on average?	[Pan with tobacco] 1 [Gutkha] 2 [Khaini] 3 [Snuff] 4 [Others] (Specify_____)5	
22	Do you take any drink containing alcohol?	[No] 0 [yes] 1 **IF NO SKIP Q. NO 23 TO 25**	
23	If yes, do you take daily?	[No] 0 [yes] 1 **IF YES SKIP Q. NO 24**	
24	If no, then how often do you take alcohol?	[1-4 days a week] 1 [5 or more days per week] 2 [1-3 days a month] 3 [Less than once a month] 4	

25	What kind of alcohol drink do you consume?	[Latho] 1 [Mahudo] 2 [Toddy] 3 [Foreign liquor] 4	
26	Are there industries or factories near your home/place of stay?	[No] 0 [yes] 1	

DURATION OF EXPOSURE:

27	How long have you been working in this profession? [In years]	
28	How long are you working in door to door solid waste collection job? (years)	
29	How many hours do you spend in solid waste vehicle in a day? (hours)	
30	How many hours do you take to complete your assign job? (hours)	
31	How many days do you work in a week? (days)	
32	Total hours of work per week?	

JOB RELATED FACTORS:

33	Nature of Employment.	[Permanent] 0 [Temporary] 1	
34	Do you have any training before joining this job?	[No] 0 [yes] 1	
35	Do you have any guidelines (Protocols) for handling waste?	[No] 0 [yes] 1 **IF YES SKIP Q. NO 36**	
36	If no, why not?	[Not aware of risk] 0 [To save the time] 1 [To save the discomfort] 2 [Do not care] 3 [Other] (Specify_____)4	
37	From which places do you handle solid waste daily?	[House to House] 1 [Vegetable market] 2 [Slaughters houses] 3 [Restaurants and Hotels] 4 [Mixed waste] 5 [Any other Places] (Specify_____)6	
38	How much solid waste do you collect per day?	[< 1 tone] 1 [1 to 2 tone] 2 [> 2 to 3 tone] 3 [> 3 to 4 tone] 4 [> 4 to 5 tone] 5 [> 5 tone] 6	
39	How do you collect the waste?	Manually] 0 [Use of equipment] 1 [Both] 2	

40	After collecting the waste do you sorting (useful, sellable and eatable) materials?	[No] 0 [yes] 1	
41	Are you instructed for using protective equipment while handling the waste?	[No] 0 [yes] 1	
42	What kinds of personal protective equipment are you required to wear?	[Gloves] 1	
		[Gum Boots] 2	
		[Uniform] 3	
		[Goggles] 4	
		[Mask] 5	
		[All of the above] 6	
		[Other] (Specify_____)7	
		[Don't know] 8	
43	Are you using protective equipments?	[No] 0 [yes] 1 **IF NO SKIP Q. NO 44**	
44	If yes, Which protective equipments are you using?	[Gloves] 1	
		[Gum Boots] 2	
		[Uniform] 3	
		[Goggles] 4	
		[Mask] 5	
		[All of the above] 6	
		[Other] (Specify_____)7	
		[None of Above] 8	
45	If no, why are you not using protective equipment?	[Not aware of risk] 0	
		[To save the time] 1	
		[To save the discomfort] 2	
		[Do not care] 3	
		[Other] (Specify_____)4	
46	Are there any incentives for you to use of protective equipment?	[No] 0 [yes] 1	
47	If yes, What kind of incentive do you receive to use protective equipment?	[Monetary] 1 [Other] (Specify_____) 2	
48	Are you given any change of job from waste collection?	[No] 0 [yes] 1 **IF NO SKIP Q. NO 49**	
49	If Yes, How does it help you?	[Physically comfort] 1 [Reduce illness] 2 [No benefit at all] 3	
50	Do you wash/ take bath after completing duty before going home?	[Never] 0 [Once in a while] 1 [Frequently] 2 [Every day] 3	

51	What are the reasons to take bath before leaving for home?		
52	Do you change clothes before leaving for home?	[Never] 0 [Once in a while] 1 [Frequently] 2 [Every day] 3	
53	Do you take lunch/snacks (food) during working hours?	[No] 0 [yes] 1	

MORBIDITIES:

54	Did you have any injury in past three months?	[No] 0 [Yes] 1 **IF NO SKIP Q. NO 55 - 56**	
55	If yes, What type of the injuries have you experienced over the past three months?	[Cutting injury] 1	
		[Puncture wound] 2	
		[Contusion(Bruise)] 3	
		[Cut and Lacerated (CLW)] 4	
		[Fracture] 5	
		[Strain/sprain] 6	
		[Other] (Specify_____) 7	
		[None] 8	
56	In your view what are the main reasons for injuries and fatalities among waste collectors?	[lack of visibility around truck] 1	
		[Insufficient training] 2	
		[non-observance safety procedures] 3	
		[Nature of work] 4	
		[Improper disposal of waste by residents] 5	
		[Lack of proper personal protective equipment] 6	
		[careless passing of other vehicle] 7	
		[Weather] 8	
		[Incentive to work quickly] 9	
		[lack of provision of temporary job change due to illness] 10	
		[Other] (Specify_____) 11	
57	Do you have any of musculoskeletal problems in past three months?	[No] 0 [yes] 1 **IF NO SKIP Q. NO 58**	

58	If yes, What kind of musculoskeletal problem you have?	1) Weakness in any of your arms, hands, legs, or feet [No] 0, [Yes] 1	
		2) Difficulty fully moving your arms and legs: [No] 0, [Yes] 1	
		3) Pain or stiffness when you lean forward or backward at the waist: [No] 0, [Yes] 1	
		4) Difficulty fully moving your head up or down: [No] 0, [Yes] 1	
		5) Difficulty fully moving your head side to side: [No] 0, [Yes] 1	
		6) Difficulty bending at your knees: [No] 0, [Yes] 1	
		7) Difficulty squatting to the ground: [No] 0, [Yes] 1	
		8) Difficulty in climbing stairs or a ladder of vehicle and carrying more weight [No] 0, [Yes] 1	
		9) Pain/ Stiffness in Joints; [No] 0, [Yes] 1	
		10) [Neck pain] [No] 0, [Yes] 1	
		11) [Back pain] [No] 0, [Yes] 1	
		12) [Shoulders] [No] 0, [Yes] 1	
		13) [wrist/ hands] [No] 0, [Yes] 1	
		14) [Hip pain] [No] 0, [Yes] 1	
		15) [Knee pain] [No] 0, [Yes] 1	
59	Do you have any respiratory problems in past three months?	[No] 0 [yes] 1 **IF NO SKIP Q. NO 60-61**	

60	If yes, What kind of respiratory problem in past three months?	1) [Dry cough]: [No] 0, [Yes] 1		
		2) [Cough with phlegm]: [No] 0, [Yes] 1		
		3) [Chest tightness]: [No] 0, [Yes] 1		
		4) [Itching nose]: [No] 0, [Yes] 1		
		5) [Running nose]: [No] 0, [Yes] 1		
		6) [Sneezing]: [No] 0, [Yes] 1		
		7) [Wheeze]: [No] 0, [Yes] 1		
		8) [Wheeze and breathlessness]: [No] 0, [Yes] 1		
		9) [Sore throat]: [No] 0, [Yes] 1		
		10) [Fever]: [No] 0, [Yes] 1		
		11) **<u>Asthma</u>**:	[As reported by the subject] [No] 0, [Yes] 1	
			[confirmed by diagnosis] [No] 0, [Yes] 1	
			[currently under medication of asthma] [No] 0, [Yes] 1	
			[**Being woken up by shortness of breath at night during past one year**] [No] 0, [Yes] 1	
		12) **<u>Tuberculosis</u>:**	[AS diagnosed by a physician] [No] 0, [Yes] 1	
			[Reported by subject.] [No] 0, [Yes] 1	

		13) **Rhinitis:** [Sneezing OR Itching nose OR Nasal secretion.] [No] 0, [Yes] 1	
		14) **Allergic Rhinitis:** [Sneezing/Itching nose/ Nasal secretion/Itchy watery eyes] [No] 0, [Yes] 1	
		15) **Chronic Bronchitis** -[AS diagnosed by a physician] [No] 0, [Yes] 1	
		-[Reported by subject.] [No] 0, [Yes] 1	
		-[**Cough with or without phlegm for a period > 3 episodes in last one year OR wheezing OR morning cough/ sputum For > 3episodes**] (one episode means > 2 month) [No] 0, [Yes] 1	
		16) Chronic Obstructive Pulmonary Disease (COPD): - [AS diagnosed by a physician] [No] 0, [Yes] 1	
		- [Reported by subject.] [No] 0, [Yes] 1	
		- [**Nocturnal dyspnoea at rest and cough with phlegm or wheeze**] [No] 0, [Yes] 1	
		17) [Any Other Medically Diagnosed Disease] (Specify_____)	
61	In which season you have more respiratory problem?	- [Winter season.] 1 - [Summer season.] 2 - [Monson season.] 3 - [Don't know] 4	

62	Do you have any of the gastrointestinal problems in past three months?	[No] 0 [yes] 1 **IF NO SKIP Q. NO 63 TO 65**	
63	If yes, What kind of gastrointestinal problem in past three months?	1) [Vomiting] [No] 0, [Yes] 1	
		2) [Diarrhoea] [No] 0, [Yes] 1	
		3) [Dysentery] [No] 0, [Yes] 1	
		4) [Warm infestation] [No] 0,[Yes] 1	
		5) [Burning Pain in abdomen (APD)]: [No] 0, [Yes] 1	
		6) [Any others, please specify]	
64	In which season you have more diarrhoea?	[Winter season] 1 [Summer season] 2 [Monsoon season] 3 [Don't know] 4	
65	Which day of week you have diarrhoea?	[Early working days of week] 1 [Middle working days of week] 2 [End working days of week] 3 [Don't know] 4	
66	Do you have any eye problem during solid waste collection?	[No] 0 [yes] 1 **IF NO SKIP Q. NO 67**	
67	If yes, what kinds of eye problem do you have during solid waste collection?	[Redness of eyes] [No] 0, [Yes] 1	
		[Burning eyes] [No] 0, [Yes] 1	
		[Eye injury] [No] 0, [Yes] 1	
		[Any other problem] (specify_____)	
68	Do you have any skin problem in last one year?	[No] 0 [yes] 1	
69	If yes, what kind of skin problem during last one year?	- [Self reported] [Dermatitis] 1 [Allergic rash] 2 [Any Others, Specify]3 - [Medically diagnosed]	

DATE: .....

PLACE: ..... **SIGNATURE OF THE INVESTIGATOR**