# OCCUPATIONAL HEALTH HAZARDS OF SOLID WASTE IN SANITARY WORKERS OF BHAKTAPUR MUNICIPALITY

**A thesis**

**submitted in partial fulfilment of the requirements for**

**the Degree of Master of science in Zoology with special paper Parasitology**

**By**

**Chanchala Duwal**

**TU exam roll no: 5868**

**TU Red No.: 5-2-37-856-2002**

**Batch: 2064/065**

**To**

**Central Department of Zoology**

**Institute of Science and Technology**

**Tribhuvan University, Kritipur**

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## DECLARATION

I hereby declare that the work presented in this dissertation has been done myself and has not been submitted elsewhere for the award of any degree. All source of information have been specifically acknowledged by reference to the author or institution.

Date: 2068-04-05

Chanchala Duwal

TRIBHUVAN UNIVERSITY
☎ 01-4331896
CENTRAL DEPARTMENT OF ZOOLOGY
Kirtipur, Kathmandu, Nepal.

Ref.No.:

## LETTER OF RECOMMENDATION

This is to certify that Miss Chanchala Duwal has successfully completed the dissertation work entitled **'Occupational health hazards of solid waste in sanitary workers of Bhaktapur Municipality'** as a partial fulfilment of Master's degree of Science in Zoology with special paper Parasitology under my supervision. It is my pleasure to recommend this original work for the partial fulfilment of Master of Science in Zoology at Tribhuvan University.

Prof. Dr. Ranjana Gupta
Head and Supervisor
Central Department of Zoology
Institute of Science and Technology
Tribhuvan University, Kirtipur
Kathmandu, Nepal

Date: July 22, 2011

☎ 01-4331896

TRIBHUVAN UNIVERSITY

# CENTRAL DEPARTMENT OF ZOOLOGY

Kirtipur, Kathmandu, Nepal.

Ref.No.:

## CERTIFICATE OF APPROVAL

We the member of expert committee, evaluated the dissertation work entitled **'Occupational health hazards of solid waste in sanitary workers of Bhaktapur Municipality'**, and approved that Miss Chanchala Duwal is qualified for awarding Master's Degree of Science in Zoology with Parasitology as a special paper.

**EXPERT COMMITTEE**

Prof. Dr. Ranjana Gupta
Head of Department and Supervisor
Central Department of Zoology
Tribhuvan University
Kirtipur, Kathmandu

Internal Examiner

External Examiner

Date: August 15, 2011

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## ABSTRACT

The study was conducted among sanitary workers of Bhaktapur Municipality, Nepal from December 2009 to September 2010. The study design was descriptive cross sectional and was designed in three categories; questionnaires filling, health check up and stool examination. The sample size for these three studies was 60. The collected data was analyzed in SPSS 11.5 version. The most common health complication/problem was musculoskeletal disorder (MSD) found in 41(73.2%). The 2nd and 3rd were gastrointestinal disorder (GIS) found in 24(42.9%) and respiratory problem found in 20(35.7%) respectively. The least common health complication/problem was cancer found in only 1(1.8%). MSD was most prevalence in compositors, waste pickers and sweepers. Out of 7 compositors, all of them (100%) were suffering from MSD. Out of 12 waste pickers, 10(83.3%) of them were suffering and out of 18 sweepers, 15(83.3%) of them were suffering. The least suffering group from MSD were drivers. Gastrointestinal disorder was most prevalence in waste pickers (75%) and waste loaders (61%). Respiratory problem was mostly reported in sweepers (50%) and waste pickers (41.7%). Higher number of waste pickers (58.3%) and compositors (42.9) were suffering from chest pain. It was found that there is significant difference in infections/health problems due to professions. (Oneway ANOVA, P=0.05, d.f.=4,20, F=3.74). The findings show that there is no significant risk of infections/health problems to safety practitioners (P=0.05, d.f.=6, Chi square =11.81) and significant difference of infections/health problems with job duration (P=0.05, d.f.=4, Chi square=9.488). They have no practice of regular health check up and only 17% were vaccinated against the Hepatitis B. Out of 60 stool samples 28(46.66%) was positive of intestinal parasites. The most common intestinal parasite was *Ascaris lumbricoides* 18(30.0%). Other parasites detected include *Trichuris trichiura* 5(8.88%), *Ancylostoma duodenale* 4(6.66%), *Entamoeba histolytica* 3(5.0%), *Giardia lamblia* 3(5.0%) and *Strongyloides stercoralis* 2(3.33%). 100% of respondents who have no practice of hand washing were infected with intestinal parasites and 79% of respondents who do not use soap were infected with intestinal parasites. Waste pickers (69.2%) and waste loader (50.0%) were found to be most infected group with intestinal parasites among sanitary workers.



**Key words:** Occupational health, Occupational health hazards, Sanitary workers, Solid waste, Intestinal parasite

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| | |
|---|---|
| **AIDS** | : Aids Acquired Immune Syndrome |
| **APL** | : Alternative Pollutant Limit |
| **CVD** | : Cardiovascular disorder |
| **GDP** | : Gross Domestic Product |
| **GIS** | : Gastrointestinal |
| **GRW** | : Garbage Recycling Workers |
| **HAV** | : Hepatitis A Virus |
| **HIV** | : Human Immunodeficiency Virus |
| **HWCs** | : Household Waste Collectors |
| **HWW** | : Hazardous waste workers |
| **ICIMOD** | : International Centre for Integrated Mountain Development |
| **ILO** | : International Labour Organization |
| **LBP** | : Lower Back Pain |
| **MET** | : Most Exposed Individuals |
| **MSD** | : Musculoskeletal disorder |
| **MSW** | : Municipal Solid Waste |
| **MSWWs** | : Municipal Solid Waste Workers |
| **NHRC** | : Nepal Health and Research Council |
| **NSD** | : Neurological disorder |
| **PPE** | : Personal Protective Equipment |
| **PPR** | : Prevalence Proportion Ratio |
| **SWM** | : Solid Waste Management |
| **TB** | : Tuberculosis |
| **UVR** | : Ultraviolet Radiation |
| **VOC** | : Volatile Organic Compound |
| **WHO** | : World Health Organization |

# INTRODUCTION

## 1.1 Occupational health

Health is defined as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity". Overall health is achieved through a combination of physical, mental, emotional, and social well-being, which, together is commonly referred to as the Health Triangle (WHO, 2006).

Occupational Health is the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations by preventing departures from health, controlling risks and the adaptation of work to people, and people to their jobs (ILO/WHO, 1950).

Occupational health deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards. The health of the workers has several determinants, including risk factors at the workplace leading to cancers, accidents, musculoskeletal diseases, respiratory diseases, hearing loss, circulatory diseases, stress related disorders and communicable diseases and others (WHO 2011).

### *1.1.1: Occupational health hazard*

Occupational health hazards refer to the potential risks to health and safety for those who work outside the home.

According to the World Health Organization, this represents about 70 percent of adult men and up to 60 percent of adult women throughout the world. In addition, an estimated additional 40 million adults enter the global workforce each year. Workplace environmental hazards are therefore a threat to a large proportion of the world population.

The ILO estimates approximately 250 million workers meet occupational accidents and 160 million people suffering from occupational diseases each year. Approximately 1.1 million people die of occupational accidents and diseases each year of course, the specific occupational health hazards faced by this large and growing number of people depends on the region and its economic standing.

However, the following are some of the most common occupational health hazards faced by workers worldwide: injuries, respiratory diseases, cancer, musculoskeletal disorders, reproductive disorders, cardiovascular diseases, mental and neurological illnesses, eye damage and hearing loss, as well as communicable diseases.

One of the most common work-related injuries to occur globally is the development of musculoskeletal disorders caused by heavy-weight lifting and performing tasks that require repetitive motions. These occupational health hazards are also responsible for the most incidents of disability claims, whether temporary, long-term, or permanent. Muscle injuries due to physical stress most often occur in occupations such as mining, construction and farming. Also grouped into this category of occupational health hazards are ergonomically poor working conditions and equipment.

Exposure to some 200 biological agents, viruses, bacteria, parasites, fungi, moulds and organic dusts occurs in selected occupational environments. The hepatitis B and hepatitis C viruses and tuberculosis infections (particularly among healthcare workers), asthma (among persons exposed to organic dust) and chronic parasitic diseases (particularly among agricultural and forestry workers) are the most common occupational diseases resulting from such exposures. Blood-borne diseases such as HIV/AIDS and hepatitis B are now major occupational hazards for healthcare workers.

Some chemical substances such as benzene, chromium, nitrosamines and asbestos, physical hazards such as ultraviolet radiation (UVR) and ionizing radiation, and biological hazards such as viruses are the carcinogenic agents at work. The most common cancers resulting from these exposures are cancers of the lung, bladder, skin, mesothelium, liver, haematopoietic tissue, bone and soft connective tissue (WHO, 1997).

Occupational skin diseases are among the three most frequent groups of occupational diseases. In some sectors, for example agriculture, construction, hairdressing, healthcare, occupational skin diseases are a major health problem causing high rates of sickness absence and permanent disability. Occupational skin cancer is becoming a bigger problem, particularly in the context of increased exposure to solar UV radiation (CREOD, 2011).

Psychological stress caused by time and work pressure has become more prevalent during the past decade. Monotonous work, work that requires constant concentration, irregular working hours, shift-work, and work carried out at risk of violence ( for example, police or prison work), isolated work or excessive responsibility for human or economic concerns, can also have adverse psychological effects. Psychological stress and overload have been associated with sleep disturbances, burn-out syndromes and depression. Epidemiological evidence exists of an elevated risk of cardiovascular disorders, particularly coronary heart disease and hypertension in association with work stress. Severe psychological conditions (Psycho traumas) have been observed among workers

involved in serious catastrophes or major accidents during which human lives have been threatened or lost (WHO, 1997).

### *1.1.2: Occupational health hazards of solid waste*

The removal of municipal solid waste is a job associated with a variety of physical, chemical, and biological hazards. Municipal solid waste workers (MSWWs) have a risk of fatal occupational injuries that is much higher than for the general workforce. Among this group of workers, non-fatal injuries are mainly musculoskeletal. Other common injuries are fractures, ocular trauma, and bites, and diseases include skin and gastrointestinal disorders. Workers at municipal solid waste incinerators are exposed to a variety of concerning substances, such as heavy metals, respirable quartz dust, dioxins, furans, and mutagens. Workers can be protected by using safety procedures on and around garbage trucks and with personal protective equipment. The burden of morbidity due to occupational exposure to bio-aerosols and carcinogens among MSWWs is unknown (Dorevitch & Marder , 2001).

There is a large workforce employed in waste collection, sorting and disposal. Workers may be exposed to the same potential hazards as the general population, although the amount of exposure and risk may differ. The type of work varies between waste management options with some, such as landfill and incineration, being more automated than others, such as waste collection, sorting and recycling. The incidence of occupational accidents in waste collection workers has been found to be higher than the general workforce (Paulsen, 1994).

The work of waste collectors involves considerable heavy lifting as well as other manual handling of containers, increasing the risk of musculoskeletal problems. It has been suggested that increased exposure to bio-aerosols and volatile compounds may lead to elevated incidence of work-related respiratory, gastrointestinal and skin problems in waste collections compared to the general workforce (Poulsen, 1995).

### *1.1.3: Occupational hazards associated with waste handling*

*1.1.2.1: Infections*

- Skin and blood infections resulting from direct contact with waste, and from infected wounds.
- Eye and respiratory infections resulting from exposure to infected dust, especially during landfill operations.

- Different diseases that results from the bites of animals feeding on the waste.
- Intestinal infections that are transmitted by flies feeding on the waste.

*1.1.2.2: Chronic Diseases*

- Incineration operators are at risk of chronic respiratory diseases, including cancers resulting from exposure to dust and hazardous compounds.

*1.1.2.3: Accidents*

- Bone and muscle disorders resulting from the handling of heavy containers. Infecting wounds resulting from contact with sharp objects.
- Poisoning and chemical burns resulting from contact with small amounts of hazardous chemical waste mixed with general waste.
- Burns and other injuries resulting from occupational accidents at waste disposal sites or from methane gas explosion at landfill sites (UNEP, 1996).

### *1.1.3: Occupational health and safety*

Occupational safety and health is the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace, and which could impair the health and well-being of workers, also taking into account the possible impact on the surrounding communities and the general environment.

Although definitions of occupational safety and health may be presented in different ways, they all have the same meaning and aim at the same fundamental goal of protecting and promoting the health and well-being of workers, as well as protecting the general environment, through preventive actions in the workplace. The concept of occupational safety and health is still new to the people of Nepal.

### *1.1.4: Waste*

The UK Environment Agency classifies waste as either controlled waste or non-controlled waste. Controlled waste includes waste generated from households (municipal solid waste), commercial and industrial organizations and from construction and demolition. Non-controlled waste includes waste generated from agriculture, mines and quarries and from dredging operations.

Municipal solid waste (MSW) consists of many different things including food and garden waste, paper and cardboard, glass, metals, plastics and textiles. These are also

generated by commercial and industrial organizations although large volumes of chemical and mineral waste are produced in addition, depending on the sector (Rushton, 2003).

Examples of inorganic wastes are appliances, newspapers, clothing, food scrapes, boxes, disposable tableware, office and classroom paper, furniture, wood pallets, rubber tires, and cafeteria wastes. Municipal solid waste does not include industrial wastes, agricultural wastes, and sewage sludge (U.S. Energy Information Administration).

*1.1.4.1: Hazardous waste*

Certain types of waste are defined as hazardous because of the inherent characteristics (e.g. toxic, explosive). The three largest waste streams in this category are oils and oily wastes, construction and demolition waste and asbestos, and wastes from organic chemical processes (Rushton, 2003).

A WHO exposure assessment expert group suggested that priority pollutants should be defined on the basis of toxicity, environmental persistence and mobility, bioaccumulation and other hazards such as explosive (WHO, 2000).

In addition to the substances above, they suggested that landfill site investigations should consider metals, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), chlorinated hydrocarbons, pesticides, dioxins, asbestos, pharmaceuticals and pathogens. Waste incineration also produces a large number of pollutants from the combustion of sewage sludge, chemical, clinical and municipal waste, which can be grouped as particles and gases, metals, and organic compounds (Harrad & Harrison, 1996).

Ten pollutants considered having the greatest potential impact on human health based on environmental persistence, bioaccumulation and amount emitted and/or on inherent toxicity were cadmium, mercury, arsenic, chromium, nickel, and dioxins, PCBs, PAHs, PM10 and SO2 (IEH,1997).

*1.1.4.2: Waste management in Bhaktapur District of Nepal*

The new Local Self-Governance Act (1999) makes the municipalities totally responsible for solid waste management. Most of the municipalities in Nepal have community development sections which are responsible for all aspects of waste management.

In Bhaktapur Municipality there is a sanitation section under the community development sections as the city cleaning unit and is fully responsible for the management of Municipal solid waste. Under the sanitation section there are 17 ward units of the

Bhaktapur Municipality. Among them local community groups provide waste management services under an annual contract to the municipality in 12 of the 17 wards. However, the municipality still has overall responsibility for waste management in the five remaining wards. The community contractors range in size from three to seven employees, and are allocated to the wards according to population of each ward. Each group is responsible for one ward in order to facilitate effective waste management. The municipality also allocates one waste inspector to each of the wards. Group contractors in all 12 wards are responsible for household waste collection, street sweeping and the collection of municipal solid waste from various unofficial collection points.

Bhaktapur municipality has been working systematically towards effective street sweeping, collection and transporting of waste. The services that are provided are the same in all wards, whether provided by the municipality or by a contractor. Every day waste is collected and the streets are swept according to definite schedules, at 6.00 a.m., 12.00 noons and 4.00 p.m. However, in tourist areas, street sweeping and waste collections are scheduled at four times each day – 6.00 a.m., 12.00 noon, 4.00 p.m. and 6.00 p.m.

According to the data provided by the Municipality and the field survey conducted in May 2008, the average per capita household waste generation rate is 0.30kg/capita/day and the total daily waste generation is 25 tons (Bhaktapur municipality, 2008)

The composition of household waste at source is: 75% organic or biodegradable waste, 2.25 % paper, 3 % textiles, 3.4 % plastic, 0.3 % metal, 1.05 % glass, 11.0 % construction debris and 4.0 % other materials (Bhaktapur municipality, 2008).

Two power tiller trailers (capacity 1 ton) and eight small trucks (capacity 700 kg) are mainly used for transporting solid waste. In addition, four pickups, each having a capacity of 3 tons, two tippers of capacity 3 tons, eight small pickups of capacity 700 kg, one backacter loader, one suction tanker and one jetting tanker make up the waste management fleet (Bhaktapur municipality, 2008 data). Bhaktapur municipality disposes its waste on one bank of the Hanumante River at a point 5 km southwest of the centre of the municipality. 25 tons of wastes are dumped there each day (Bhaktapur municipality, 2008). This means that 100 per cent of the waste is collected.

The Bhaktapur Compost Plant, which was established by the municipality with assistance from GTZ, is currently composting about 10 percent of the city's waste. The plant is located in Bhelukhel in ward 11 of the city. At the plant, mixed waste is placed in long windrows that are approximately 2 m wide and 1.5 m high. The waste is turned after a

few months and when the compost is ready, it is screened manually using inclined screens. The compost is sold to farmers. This is the largest compost plant in Nepal. But nowadays it is not in working condition.

Bhaktapur municipality is also operating a small paper recycling plant, which produces a variety of items such as folders, notebooks, photo albums, cards, etc

### *1.1.5: Legalisation related to the worker's health:*

- The Labor Act, 1991 Chapter 5 of this Act deals with occupational health and safety. Section 27 of Chapter 5 requires the management to make certain arrangements such as the removal of waste accumulated during production process and prevention of accumulation of dust, fume, vapour, and other impure materials, which would adversely affect health of workers. Section 28 and 29 require management to provide protective clothing and devices to workers handling chemical substances and other hazardous and explosives substances. In order to prevent accidents, section 30 of the Act requires the proprietor to make arrangements for fire safety equipment and emergency equipment Section 31 requires the placement of sturdy fences around hazardous machines and equipment operated by industry.
- The Local Self-Governance Act, 1999 makes municipalities responsible for managing domestic solid waste. The Act does not require the local governments to manage hazardous waste but empowers them to fine anyone up to Rs. 15000.00 for haphazard dumping of solid waste.
- Present 3-year interim plan (2064-2067) has set some strategic programs and visions to make workplace safe, healthy and productive by promoting and developing occupational safety and health as an integral part of all the industrial enterprises and workplaces. Government of Nepal allocates about 20 million rupees annual budget for occupational safety and health project. Occupational Safety and Health Project sets following programs to be implemented as the integral part of the project.
- Training program on occupational safety and health for social partners.
- Capacity enhancement training program for officers affiliated with occupational safety and health.
- Orientation program for employers.
- Educational program on HIV/AIDS and STDs at work places.

- Labour education programs.
- The Labour Act, 2048 (1992) Section 5 of Chapter II of the Labour Act restricts to employ to work any minor or a woman unless otherwise prescribed during the hours between 6.00 pm and 6.00 am.
- Chapter III of this Act contains sections 16– which provide restrictions on the working hours for the worker. It limits the working hours for adults to no more than eight hours a day or forty-eight hours a week. It provides for a weekly holiday with pay and compulsory intervals of rest. It also provides overtime payment and restricts to allow workers for overtime for more than four hours a day but not exceeding twenty hours a week.
- Chapter V of this Act contains sections 27– which entirely pertain to the health and safety of workers in the establishment. They prescribe arrangements for sanitation and cleanliness, modern lavatories, disposal and destruction of waste, adequate ventilation and lighting, and control of temperature, protection from dust, fumes and other impurities, avoidance of overcrowding in any room of the establishment, provisions for drinking water and extinguishing fire.
- The Act also includes the provision for medical examination of workers at least once a year in the establishment involved in processes, which are likely to cause health hazards. It provides a number of accident preventive measures, such as protection of eyes, protection against chemical hazards and fire, guarding against dangerous machinery, prohibition on lifting a heavy load, and safety measures for pressure plants.

# II

# OBJECTIVES

## 2.1: General objective

To assess the occupational health hazards of solid waste among the sanitary workers of Bhaktapur Municipality, Nepal.

## 2.2: Specific objectives

- To assess the knowledge, attitude and practices (KAP) of sanitary workers regarding health hazards caused by solid waste.
- To assess the occupational health complications/diseases among the sanitary workers.
- To determine the risk factor of occupational health hazard among sanitary workers.

## 2.3: Significance of study

By understanding and over-viewing the above mentioned occupational health a hazard, this study is an attempt to know the health problems of the sanitary workers of Bhaktapur Municipality. This study will provide us the following outcomes:

- It will help us to know the health status, sanitary condition, education, socio-economic status of the sanitary workers.
- It will bring awareness to the sanitary workers from the health hazards of the solid waste.
- It will help the sanitary workers to make the habit of making health profile of their own.
- It will motivate the Municipality itself to make the improved management on the behalf of the sanitary workers.
- It will also play role in making Bhaktapur as a clean city of the country.
- It will help to determine the rate of intestinal parasitic infection among the sanitary workers.

# III

# LITERATURE REVIEW

## 2.1: World-wide Literature Review for Occupational Health Hazard

Bhattacharyya (2011), reported that large fraction of staff was suffering from chest and abdomen pain, musculoskeletal movement restriction, abnormal blood pressure and skin problem. Many staffs were addicted to bad habits like drinking and chewing tobacco. Abnormality in pulmonary function test and respiratory problem has been observed to a large extent among collection staff and waste pickers. Erythrocyte sedimentation rate and C-reactive protein test reveal sign of inflammation among municipal solid waste workers.

Athanasiou et al. (2010), conducted the study in One hundred and eighty-four municipal employees of Keratsini (104 MSWWs and 80 controls) participated in a cross-sectional study. All participants were asked to fill in a slightly modified version of the Medical Research Council questionnaire. Lung function was evaluated by spirometry. Spirometry revealed reduced mean forced vital capacity (FVC) and forced expiratory volume in 1 s (as a percentage of predicted values) in MSWWs compared with controls. After adjustment for smoking status, only the decline in FVC was statistically significant ($P < 0.05$). Prevalence of all respiratory symptoms was higher in MSWWs than in controls.

Khruakhorn et al. (2010), found the past 6-month prevalence of self-reported LBP(lower back pain) was 22.3% (95% CI: 19.4-25.2). The result of multivariate analysis showed that habitual physical activity level were found to be independent factors associated with the LBP (p-value = 0.048 by LRT) after adjusted for gender nutritional level and work activity in a day. The physical activity as athletic level appeared to be the protective effect when compared to sedentary level (adjusted OR 0.43, 95% CI: 0.20-0.94).

Giri (2010), found that eye problems were most predominant, seen in 70.6% workers followed by musculoskeletal problems (68.0%), while 58.0% workers presented with gastrointestinal and 52.6% with respiratory ailment, with obstructive pattern observed in 38 (48.1%) subjects being the major finding. 52% workers had skin problems and injuries were observed in 39 (26.0%) workers including minor injuries such as cuts, abrasions and lacerations. The large proportion of workers suffered from work related symptomatic

morbidities mainly of eye, respiratory, musculoskeletal system, gastrointestinal and skin. The study was performed by developing a semi-structured interview schedule and clinical examination. Results were analysed using Statistical Package of Social Sciences (SPSS) 13.0.

Jamaluddin (2010), studied that sanitary workers are lifting heaps of garbage and hazardous solid waste from the metropolis without having any gloves, masks or long shoes. They are highly exposed to deadly virus, bacteria, and dangerous communicable diseases. About 5,500 regular sanitary staff and 5,000 work-chargers (daily wagers) are working in Solid Waste Management (SWM) department of the city district govt Lahore (CDGL). The sanitary workers confided to The Nation that more than 50 per cent of them were suffering from communicable diseases including Hepatitis B and C and the lives of their near and dear ones were at risk of catching the virus. It has been learnt the sanitary workers interact with a number of people in 24 hours and if they are not vaccinated or treated properly they may become a tool of spreading the diseases in the city.

Kalahasthi et al.(2010), found that the morbidity conditions such as respiratory (34%), musculo-skeletal (24.5%), past illness (12.7%), dermatological (11.8%), gastrointestinal (9.8%), injuries due to contact with sharp objects & heavy equipments (7.8%) and nose and eye (4.9%) problems were observed in HWW. The levels of serum pro-inflammatory cytokines such as IL-8 *(P=0.041)* & TNF-α *(P=0.040)* significantly increased in landfill area workers and subjects having respiratory symptoms. Using questionnaire the respiratory morbidity and other work related problems in HWW was carried. The levels of pro-inflammatory cytokines in study subjects were determined by using Enzyme-linked-immunosorbent assay kits (Pierce Biotechnology, USA). The differences of serum pro-inflammatory cytokines levels between the groups were computed by using non-parametric Mann-Whitney U test. SPSS 10.0 for windows version of statistical software was used in the analysis.

Perez-Padron et al. (2010), found that psychological distress was positively related to somatic symptoms in all the models even after adjusting for sex and age. This association also remained significant for self-perceived environmental working conditions in the two final models. 23% of the dentists had psychological distress. The mean score for the SCL-90-R somatic subscale was 0.55 points (Standard Deviation: 0.50).

Oyelola et al.(2009), studied that the uncontrolled burning of solid wastes at Olusosun disposal site, Lagos State, Nigeria creates smoke that affects the environment while the gas emission causes a public nuisance. The study correlates the exposure factors (smoke, odor and dust) with health hazards of its workers. The correlation analysis between sex of workers, years of service, different ailments and exposure factors showed a positive correlation between eye irritation and dust at 0.05 and also between difficulty in breathing and smoke at 0.01 levels of significance; likewise between typhoid and dysentery and also malaria and dysentery at 0.01 and 0.05 levels of significance respectively. The percentage of research diseases as they affect the dumpsite workers and the scavengers are 86% eye irritation, 66% difficulty in breathing, 48% asthma, 90% cough, 10% pneumonia, 82% malaria, 46% typhoid, 44% dysentery, 42% cholera and 96% fatigue. This shows that open dump solid wastes disposal affects the health of the dumpsite workers.

Dimri (2008), studied on death of a sanitary worker. He has not noted public figure. Alas, he played a very important part in public life. He was a sanitary worker whose primary duty was to clean dingy sewer lines. As he enjoyed no luxuries of glove, protective mask, adequate education, so the moment he got in, toxic gases struck him. There hundreds of N.P.O.s and N.G.O.s working for the betterment of sanitary workers but still much need to be done. If such an untoward incident can happen in urban parts, then what about rural areas? Life is still gruesome for millions of sanitary workers who do their jobs manually. Unlike western world, here they not only face social ostracism, but also face extreme penury. Nevertheless, the recent incident shows that life is still stagnated for them.

Mehrdad et al. (2008), performed a study to evaluate musculoskeletal disorders among municipal solid waste workers. A cross sectional study was designed. The survey instrument for measurement of musculoskeletal symptoms was adapted from the Standardized Nordic Questionnaire that translated into Farsi language. A total of 65% (n=142) of participants reported that they had been troubled with musculoskeletal symptoms in one or more of the 9 defined body regions during the last 12 months. Prevalence of symptoms in low back, knees, shoulders, upper back and neck were 45, 29, 24, 23 and 22% respectively. Foreign workers reported more musculoskeletal symptoms

in all body parts than Iranian workers. The differences between prevalence of symptoms between two groups were significant in all parts of body except knees. The study found that solid waste workers have more musculoskeletal disorders than general population. Meanwhile these symptoms were more common among foreign workers. The risk of disease was increased with the increasing years of working as solid waste worker and smoking. Relationship between musculoskeletal disorders and education or marriage status of workers was not found.

Roy & Dasgupta (2008), studied on health status of women engaged in a home-based "Papad-making" industry in a slum area of Kolkata. Most of them belonged to poor socioeconomic status. Sixty per cent were in this occupation for more than 10 years and they spent 5 hours for this work daily over and above their household job. Musculoskeletal problem was their commonest health problem. Pallor, angular stomatitis, pedal oedema, chronic energy deficiency was found on examination. Personal hygienic measures taken were far from satisfactory.

Tiwari (2008), estimated 1.2 million scavengers in the country are involved in the sanitation. Apart from the social atrocities that these workers face, they are exposed to certain health problems by virtue of their occupation. These health hazards include exposure to harmful gases such as methane and hydrogen sulphide, cardiovascular degeneration, musculoskeletal disorders like osteoarthritic changes and inter-vertebral disc herniation, infections like hepatitis, leptospirosis and helicobacter, skin problems, respiratory system problems and altered pulmonary function parameters.

Dearwent et al. (2006), studied on health effects of hazardous waste. Since 1995, the Agency for Toxic Substances and Disease Registry (ATSDR) has evaluated environmental contaminants and human health risks at nearly 3000 sites. Hazardous substances at these sites include newly emerging problems as well as historically identified threats. ATSDR classifies sites according to the degree of hazard they represent to the public. Less than 1% of the sites investigated are considered urgent public health hazards where chemical or physical hazards are at levels that could cause an immediate threat to life or health. Approximately 20% of sites have a potential for long-term human exposures above acceptable risk levels. At almost 40% of sites, hazardous substances do not represent a public health hazard. Completed exposure pathways for contaminants in

air, water, and soil have been reported at approximately 30% of evaluated sites. The most common contaminants of concern at these sites include heavy metals, volatile organic compounds, and polychlorinated biphenyls.

Dounias & Rachiotis (2006), conducted a study among 151 municipal workers (72 solid-waste workers, and 79 workers not exposed to waste). Total antibodies against Hepatitis A virus (HAV) were measured, and socio-demographic information was collected using a self-administered questionnaire. Univariate analysis has shown that occupational exposure to waste, age, duration of employment and educational status were significantly associated with the prevalence of anti-HAV(+). Municipal Solid Waste Workers had a higher prevalence of anti-HAV(+) in comparison with municipal workers not exposed to waste. Duration of employment was significantly associated anti-HAV(+). Multivariate analysis revealed an independent association of anti-HAV(+) with occupational exposure to waste and ageing. Our results suggest a potential causal role of occupational exposure to waste, in the development of HAV infection.

Hernando et al. (2006), studied on health effects associated with organic dust exposure during the handling of municipal solid waste. Municipal solid waste is a collection of discarded liquid and solid materials that serves as a breeding ground for bacteria and fungi. Individuals involved in the collection, transport, transfer and management of this waste may be exposed to elevated concentrations of biological aerosols. Based on the nature of the work environment and the knowledge of bioaerosol related health effects in other occupations, the handling of municipal solid waste can be expected to result in adverse health outcomes. Only limited research has been performed to date evaluating the relationship between organic dust exposure and adverse health effects in these workers. The majority of this work has been conducted in Europe, with little performed in the United States. Although not extensive, the existing body of research suggests that there is an association between the performance of job tasks involving the handling of municipal solid waste and various respiratory, dermatologic and gastrointestinal health effects. While increased incidences of specific adverse health outcomes have been documented in this group of workers, the limited nature of exposure assessment in this body of research does not allow for strong evidence based conclusions to be drawn regarding exposure levels and associated health effects. Based on this review it is concluded that the detailed characterisation of organic dust exposure experienced by municipal solid waste workers is

necessary in order to both improve understanding of resultant health effects and develop strategies to improve occupational health.

Karaman et al. (2006), studied the incidence of intestinal parasites in the municipal sanitary workers who are regarded as a high risk group in Malatya. Cellophane slides and faecal samples from 241 workers were examined and intestinal parasites were found in 93 (39.0%). The most common parasite was *Entamoeba coli* (34). Other parasites detected include *Enterobius vermicularis* (32), *Giardia intestinalis* (22), *Blastocystis hominis* (8), *Iodamoeba butschlii* (5), *Entamoeba histolytica* (2), *Taenia sp.* (2), *Chilomastix mesnili* (2), *Dientamoeba fragilis* (2), *Entamoeba hartmanni* (1), *Trichomonas intestinalis* (1) *Hymenolepis nana* (1), and *Ascaris lumbricoides* (1).

Kuijer et al. (2005), carried out a 1-year prospective study among refuse collectors, using standardized questionnaires. Job rotation was performed between collecting two-wheeled containers and driving a refuse truck. The experimental groups of rotating refuse collectors at $t_0$ and $t_1$ (group R-R) and non-rotating refuse collectors at $t_0$ and rotating refuse collectors at $t_1$ (group NR-R) were compared with a reference group of non-rotating refuse collectors at $t_0$ and $t_1$ (group NR-NR). The adjusted need for recovery of group R-R was marginally significantly lower than need for recovery of the reference group. Groups R-R and NR-R had a more than two times higher risk for complaints of the low back than the reference group.

Ray et al. (2005), examined the respiratory and general health of workers employed in a municipal solid waste (MSW) disposal at an open landfill site in India. Ninety-six landfill workers of Okhla landfill site, Delhi, and 90 controls matched for age, sex, and socioeconomic conditions were enrolled. Health data was obtained from questionnaire surveys, clinical examination and laboratory investigations. Lung function was evaluated by spirometry. Compared with matched controls, landfill workers had significantly higher prevalences of both upper and lower respiratory symptoms, and they suffered more often from diarrhoea, fungal infection and ulceration of the skin, burning sensation in the extremities, tingling or numbness, transient loss of memory, and depression. Spirometry revealed impairment of lung function in 62% of the landfill workers compared to 27% of the controls. Sputum cytology showed squamous metaplasia, abundance of inflammatory cells, alveolar macrophages (AM) and siderophages (macrophages with iron deposits),

and high elastase enzyme activity in neutrophils and AM of a majority of landfill workers, indicating adverse cellular lung reaction. Hematological profiles of these workers depicted low hemoglobin and erythrocyte levels with high total leukocyte, eosinophil and monocyte counts. Erythrocytes with target cell morphology were abundant in 42% of the landfill workers compared to 10% of the controls. Toxic granulation in neutrophils, an indication of infection and inflammation, was recorded in 94% of the landfill workers and in 49% of the controls. The results demonstrated higher prevalence of respiratory symptoms, inflammation of the airways, lung function decrement and a wide range of general health problems in MSW disposal workers.

Tooher et al. (2005), conducted a review of the literature relating to the need for vaccination against infectious disease in the solid waste industry, focusing on hepatitis A, hepatitis B and tetanus. Databases (Medline, PreMedline, EMBASE, CINAHL, Current Contents, Cochrane Database, HTA Database, DARE, and OSHROM) were searched up to and including August 2003. Articles were included in the review if they reported the prevalence of immunity to hepatitis A, hepatitis B or tetanus in solid waste workers or the incidence of clinical infection with any of these diseases. Papers about hazardous or medical waste, incineration or other infectious diseases were excluded. Forty four papers constituted the evidence database. Only one paper studied the prevalence of antibodies to hepatitis A and hepatitis B in solid waste workers compared with sewage plant workers and office workers, and no difference was found between these groups of workers. There was some evidence to support a theoretical risk of infection with hepatitis A, B and tetanus; however, no studies could be found of the risk of these diseases in solid waste workers. No single cases of these diseases being acquired occupationally in solid waste management were identified in the literature. Workers in the solid waste industry may theoretically be at increased risk of acquiring infectious diseases occupationally. However, at present no studies could be found which have documented this risk.

Chaudhry et al. (2004), conducted the study on 93 sanitary and housekeeping workers. Among them are 66 male and 10 female sanitary workers and 17 are female housekeepers. A cross sectional study of all the above-mentioned workers was conducted using a structured open and closed ended questionnaire. Data was compiled and analyzed using SPSS ver 10.0software. This study revealed that 46% of workers were illiterate and 49% had attended primary school. None of the sanitary workers received any training in

handling of hospital wastes. They were not routinely inspected for identification of their health problems. They were not provided with protective equipment and were never vaccinated against hepatitis B. Although some form of segregation of hazardous and non-hazardous wastes was practiced in CMH, Rawalpindi, majority (56%) of them collected and carried the two kinds of wastes in the same vehicle. 48% of them reported of sustaining one or more injuries at work. Frequently reported injuries were: cuts (47%), pricks (34%), falls (15%) and burns (4%). 26% of them reported of contracting skin diseases from wastes, while 12% caught ENT disorders, 9% gastro-intestinal disorders, 6% respiratory diseases and 8% hepatitis.

Donoghue (2004), reported the physical, chemical, biological, ergonomic and psychosocial occupational health hazards of mining and associated metallurgical processes. Mining remains an important industrial sector in many parts of the world and although substantial progress has been made in the control of occupational health hazards, there remains room for further risk reduction. This applies particularly to traumatic injury hazards, ergonomic hazards and noise. Vigilance is also required to ensure exposures to coal dust and crystalline silica remain effectively controlled.

How-Ran Guo et al. (2004), found that the musculoskeletal disorder (MSD) is a common problem among workers. In spite of the numerous reports on MSD in various specific groups of workers, few data on the prevalence in the general working population are available except for back pain. They analyzed the information collected through a nationwide survey in Taiwan in 1994 to estimate the prevalence of MSD by age, gender, and education level and identify high-risk industries. In the survey, a standard questionnaire was distributed to a representative sample of 22,475 non-self-employed workers in Taiwan. National estimates were obtained by applying a weight to each participant. Among the sampled workers, 18,942 (84.3%) participated, and 37.0% (standard error=0.4%) had MSD. Female workers had a significantly higher overall prevalence than male workers (39.5% vs. 35.2%, $p<0.05$). Education and age also had significant associations with MSD ($p<0.001$ in both genders). “Lower back and waist” were the most frequently affected body parts (18.3% among males and 19.7% among females), but the prevalence of MSDs of the neck, shoulders, hands and wrists were also above 10%. The top ten high-risk major industries for MSD of various body parts for each gender were identified, and some industries, including “Basic Metal Industries” and

“Buildings Construction,” were among the top ten for multiple body parts. Our study showed that MSDs of body parts other than the back are also prevalent, especially in the neck, shoulders, hands and wrists.

Rushton (2003), reported that raised incidence of low birth weight births has been related to residence near landfill sites, as it has the occurrence of various congenital malformations. There is little evidence for an association with reproductive or developmental effects with proximity to incinerators. Studies of cancer incidence and mortality in populations around landfill sites or incinerators have been equivocal, with varying results for different cancer sites. Waste management workers have been shown to have increased incidence of accidents and musculoskeletal problems.

Dorevitch & Marder (2001), conducted a study on occupational hazards of municipal solid waste workers. The removal of municipal solid waste is a job associated with a variety of physical, chemical, and biological hazards. Municipal solid waste workers (MSWWs) have a risk of fatal occupational injuries that is much higher than for the general workforce. Among this group of workers, non-fatal injuries are mainly musculoskeletal. Other common injuries are fractures, ocular trauma, and bites, and diseases include skin and gastrointestinal disorders. Workers at municipal solid waste incinerators are exposed to a variety of concerning substances, such as heavy metals, respirable quartz dust, dioxins, furans, and mutagens. Workers can be protected by using safety procedures on and around garbage trucks and with personal protective equipment. The burden of morbidity due to occupational exposure to bio-aerosols and carcinogens among MSWWs is unknown.

Mulloy (2001), studied on toxic hazards and solid waste of sewage workers. The wastewater treatment process brings the worker in contact with multiple pathogens, toxic gases, chemicals, and physical hazards. Issues such as the prevalence of hepatitis A among wastewater treatment workers in the U.S. have not been well studied. There remains a controversy on the need to offer hepatitis A pre-exposure immunization. Health effects to some exposures, such as gram-negative bacteria and endotoxins, have been well studied among other workers, and preventive measures, such as permissible endotoxin levels, that have been established for these workers should be adopted for the wastewater treatment environment.

Rogers (2001), found that municipal healthcare workers are at risk for a variety of occupational health hazards as a result of daily exposure to work-related biological, chemical, enviromechanical, physical, and psychosocial agents. In addition, this population of workers has not been well studied, so the actual risk may be substantially underreported

Thorn & Kerekes (2001), reported that work in sewage water plants can involve exposure to different types of microorganisms and chemicals. The bacterial exposure is dominated by bacteria that naturally occur in nature. However, different bacteria and viruses that give rise to infections can be present in this environment and thus there exists a risk of infection, especially of hepatitis A. Investigations suggest that gastrointestinal tract symptoms are more common among employees at sewage treatment plants than among controls. Respiratory symptoms, fatigue, and headache have also been reported in several investigations. The cause of the symptoms is unknown, although certain data suggest that they are caused by inflammation. The results suggest that endotoxin in Gram-negative bacteria may be one of the causative agents. As regards cancer, some studies report an increased risk of stomach cancer and a few studies report an increased risk of cancer in the larynx, liver or, prostate or of leukemia.

Yang et al. (2001), reported that household waste collection presents a risk for the development of chronic respiratory symptoms (cough, phlegm, wheezing, and chronic bronchitis), musculoskeletal symptoms (low back pain and elbow/wrist pain), and injuries caused by sharp objects. Household waste collectors (HWCs) are potentially exposed to a variety of bioaerosols and toxic materials. The survey was done by questionnaire and it was completed by 533 HWCs and 320 office workers.

Huren et al. (1999), reported that municipal solid waste workers in Florida were most commonly exposed to musculoskeletal and dermal injury risks such as strains or sprains, contusions, fractures, and lacerations. Strains or sprains represented 47.7% of all the reported injuries, similar to the proportion found for other Florida industrial workers (45.7%). Waste collectors (drivers or helpers) had a higher risk of injury than other workers in the MSW industry. Whilst injury rates for all Florida industrial workers

decreased, the injury rates of MSW workers almost doubled from 1993 to 1997. It was noted that workers' compensation claims represent only a fraction of total injuries.

Kiviranta et al. (1999), studied exposure of workers to airborne microorganisms and volatile organic compounds (VOC) in different types of waste treatment situations during summer time. Microorganisms were collected as stationary samples using a six-stage Andersen impactor, while for VOCs both personal and stationary sampling was conducted. The exposure at the waste handling facility was considerably greater than at landfill sites or in waste collection. The concentrations of viable fungi were maximally 105 cfu/m3, and the concentrations of both total culturable bacteria and Gram-negative bacteria exceeded the proposed occupational exposure limit values (OELV), being 104 and 103 cfu/m3, respectively. Exposure to VOCs in the waste handling facility was three times higher than at the landfill sites. The use of personal protective equipment at work, thorough hand washing and hanging clothes after the work shift are strongly recommended in the waste handling facility and the landfill sites.

Sigsgaard (1999), reported an increased prevalence of respiratory symptoms such as chest tightness and toxic alveolitis, gastrointestinal and skin symptoms among GRW (Garbage recycling workers ) compared to other blue-collar workers. He noted that under normal circumstances with a good hygiene and use of the proper protective equipment by an educated work force, garbage handling induces a small but significant risk of occupational asthma. The majority of the asthma cases we have experienced in Denmark have been due to a poor perception of the risks related to organic dust exposure.

Yu GP et al. (1998), studied on the association between potential risk factors and the prevalence of pulmonary tuberculosis in Shanghai Bureau of Sanitation. The study identified a total of 202 cases among 30,289 subjects, and showed that smoking in particular heavy smoking had a strong association with tuberculosis after simultaneous adjustment for other factors. Using a multivariate binomial regression, the factors adjusted included the age, sex, history of contact, area of housing and type of work. The relative risk of heavy smokers compared with non-smokers was 2.17 (95% confidence interval 1.29-3.63). The study showed that although males and old age were associated with a higher risk of tuberculosis than females and young age respectively, these differences were due to the smoking factor. The study also found that the risk of

tuberculosis among the subjects with previous patient contacts was twice as high as that among the non-contacts.

Hansen et al. (1997), conducted a nationwide survey among Danish waste collectors evaluates self-reported respiratory symptoms with focus on chronic bronchitis. Altogether 1,515 (76%) male Danish waste collectors and a comparison group of 423 park workers completed a questionnaire on work conditions and health problems. He found that increased prevalence proportion ratios (PPR) appeared for cough (PPR = 1.3), itching nose (1.9), wheeze (1.4), and chronic bronchitis (2.3). The PPR of bronchitis increased significantly with increasing estimated concentrations of all selected microbial Parameters (viable fungi, fungal spores, total microorganisms). In conclusion, this cross-sectional study showed that waste collectors compared to park workers have moderately increased prevalence's of several respiratory problems. The causes are probably exposure to vehicle exhaust and aerosols containing microorganisms.

James (1992), studied risks posed by composting of municipal solid waste (MSW) depend on the assessment approach used. Occupational risks at present are not overtly serious— only nausea, eye irritation, etc. are reported from inhalation, the chief exposure pathway—but details are lacking on outcomes of pathogenic, chemical and physical threats, including potential secondary problems with organisms developed in compost, their endotoxins, and metabolic products such as aflatoxin. Potential risk pathways of public exposure to MSW compost are dominated by children's lead ingestion, but "dioxins" and other persistent organic carcinogens are also of dietary concern. Risks to the "most exposed individual" (MET) may differ substantially from those based on the Alternative Pollutant Limit (APL) approach.

Frisvold et al. (1987), reported that the lack of field toilets on agricultural job sites increases the probability of gastrointestinal disorders by 60%. Adverse living conditions significantly increase the probability of gastrointestinal, respiratory, and muscular problems. These three health problems do not appear to increase the probability that a worker's family is on welfare or lower workers' earnings. Respiratory problems, however, substantially increase the probability that the worker receives unemployment compensation.

Sarto et al.(1987), carried out a study on determination of ethylene oxide (EtO) in the working environment and induction of sister chromatid exchanges (SCE) and unscheduled DNA synthesis (UDS) in peripheral lymphocytes of 10 exposed sanitary workers and 10 control subjects matched for sex, age, and smoking habits are reported. The relationship between the external dose of EtO and the frequency of SCE was determined in the above group and in a group of 41 sanitary workers previously studied. The 10 newly examined workers were exposed to EtO concentrations (1.84 ppm as time-weighted average) intermediate between the high (10.7 ppm) and low (0.35 ppm) levels of exposure of the two previously examined groups (19 and 22 workers, respectively). A statistically significant ($p < 0.002$) increase of SCE frequency was observed between the present control and exposed groups. The indelibility of unscheduled DNA synthesis by gamma rays was lower in the lymphocytes of the exposed workers than in controls, but the difference was not statistically significant. A significant relationship between the frequency of SCE and the level of EtO exposure for the three exposed groups was demonstrated by two different statistical methods. It is suggested that the present Italian threshold limit value for EtO (3 ppm) may not protect the exposed workers against possible genotoxic effects and that even a chronic exposure to 1 ppm may not be devoid of genotoxic risk.

**2.2: Literature Review for Occupational Health Hazard in Nepal**

Pandey (2011), studied on solid waste management practice and health implication of Kathmandu metropolitan city, Nepal. He found that waste handling practice in Kathmandu is labor intensive and disposal system does not meet environmental standard. Mixture of organic to inorganic and hazardous to non-hazardous wastes is the composition of municipal waste of Kathmandu. Waste management practice has severe health impact to municipal waste workers. Over the past several generations, people of specific castes (Pode, Chyame) have been working as municipal waste workers and are entitled ‘kuchikar’ officially. This research examines occupational health problems of these waste workers. Findings are based on the survey of 61 waste workers of Kathmandu Metropolitan City.

Poudel et al. (2005), carried out a study on adoption of National Health Care waste management Guideline at Health Care Institution. It was found that some staff members

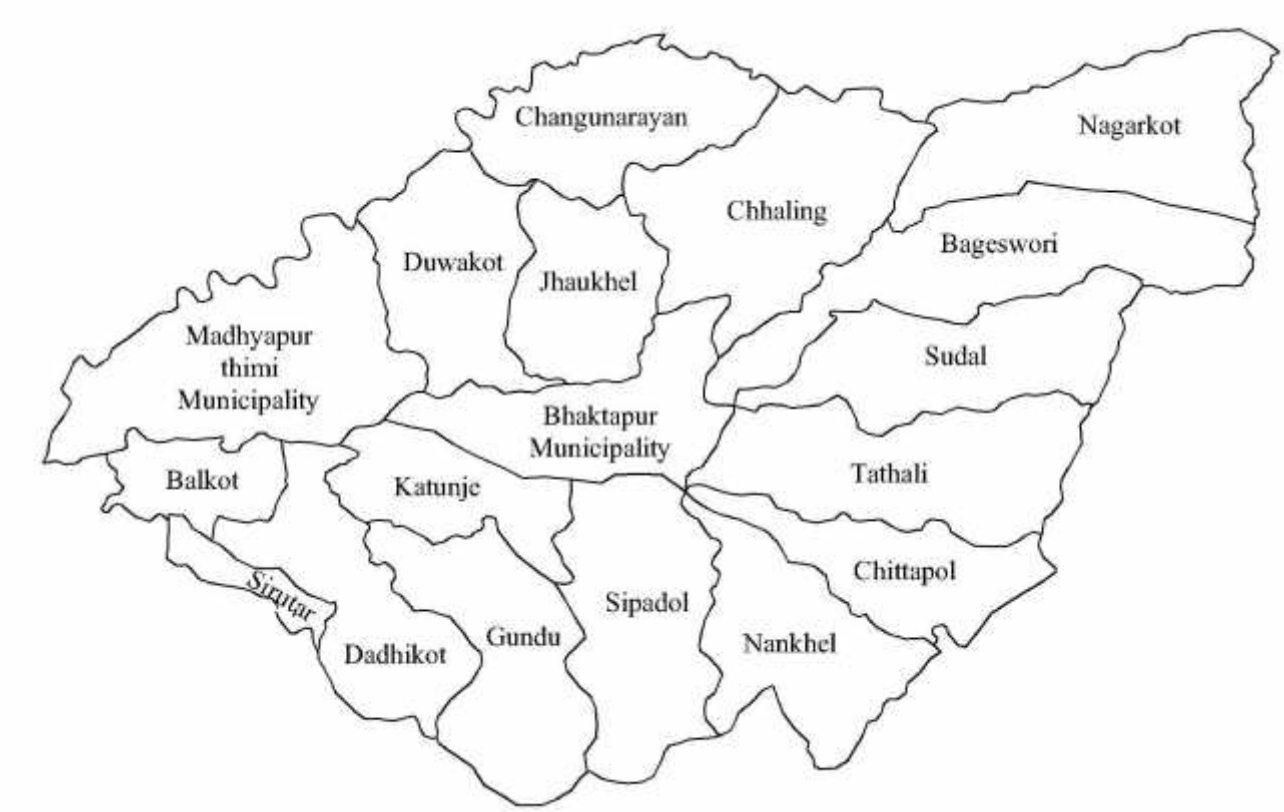
interviewed was complaining various infectious diseases such as viral infection, diarrhoea, dysentery etc. during their working period.

Ghimere (2008), reported that almost majority of the workers (58.95%) had satisfactory knowledge, 26.03% had good knowledge and 15.02% had need to improve knowledge about occupational health hazard. Majority 37.57% of workers had satisfactory practice of using safety measures, 28.90% and 25.43% workers had good practice and need to improve practice of following safety measures respectively. The remaining 8% had no any practice of following safety measures.

Maharjan (2008), reported that almost 73% of the vegetable growers apply pesticide on vegetable farms. The result reveals that knowledge of hazardous effect from the pesticide was limited. High risk practices include frequent handling of pesticide, home storage, and short re-entry interval. Among them only 52% use at least one personal protection equipment (PPE) during application of the pesticide while 48% does not use it. Among total vegetable growers who use pesticide, 33% of them have experienced various symptoms of health hazards.

Bhandari & Adhikari (2006), found that the employees of Nepal Telecom were adversely affected by some common occupational health hazards such as mechanical, chemical, biological and so on. The survey was done by questionnaire and observation checklist.

## SKETCH OF BHAKTAPUR DISTRICT



# IV

# MATERIALS AND METHODS

## 4.1: Materials required

### *4.1.1: Equipments*

- Compound microscope, Blank slides, Cover slips, Application sticks, Measuring cylinder, Electric balance, Vials, Slide holder, Paper towel, Centrifuge, Pipettes, Forceps, Gloves, Mask, Apron.

### *4.1.2: Chemicals*

- Formaline, Ethanol, Normal saline, Lugol's soln(1%), Potassium dichromate (2.5%), Soap, Phenol

## 4.2: Study Area: Bhaktapur (Khwopa)

Nepal is surrounded by the People's Republic of China to the north and India to the south, east and west. For a relatively small country the landscape is uncommonly diverse, ranging from the humid Terai region in south to the lofty Himalayas in the north. Nepal is popular for mountaineering and it has pride of having eight of the world's ten tallest mountains, including the highest point on Earth, Mount Everest, called Sagarmatha in Nepali on the border with China.

Geographically Nepal is located between the latitude of 26° and 31°north, and longitudes 80° and 89°east.It is of roughly rectangular shape, 800 kilometres long and 200 kilometres wide, with an area of 147,181 km2 . Nepal is divided into 14 zones and 75 districts, grouped into five development regions. Bhaktapur district where the study was carried out is a small district of Kathmandu valley in Bagmati zone.

Bhaktapur (27.67°N 85.43°E) also known as Bhadgaon or Khwopa , is an ancient Newari town . It is located in Bhaktpur District in the Bagmati Zone at 13 km east of Kathmandu. Bhaktapur literally 'The City of Devotees', is well known for its medieval art and architecture, culture, festivals, traditional dances and typical Newar lifestyles so Bhaktapur is listed as a World Heritage by UNESCO. It occupies an area of around 119 km² at an altitude of 1,401 meters above sea-level. Historically it was found in the 12th century (Bronchure of Bhaktapur Municipality, 2004). It was set up in the time of King Anand Dev Malla and was planned and constructed in the shape of a conch, one of the emblems of Lord Vishnu (Maskay, 1962).

Bhaktapur situated on the Hanumantee and khasankhunun rivers and bordered by rich farmland, almost entirely a Hindu Newar city. At the time of the 2001 Nepal census, it had population of 72,543 and average family size 5.8 (district profile analysis, 2059 B.S Bhaktapur).

The economy of Bhaktapur, like that of Nepal as a whole, is fundamentally agricultural. The city is surrounded by farmlands. The main crops grown in Bhaktapur are rice, wheat, maize, potatoes and large variety of vegetables crops.

Newars in Bhaktapur have, in addition to their given names, a surname that is their name. The Bhaktapur Municipality's registry of the city's population has about 350 thar - designation last names for the city's Newar population. The thars are arranged in twenty distinct levels ranked from Brahman to untouchable.

A Bougle's definition, "caste system divides a whole society into a large number of hereditary groups, distinguished from one another and connected together by three characteristics separation in matters of marriage and contact, division of labour, each group having, in theory or by tradition, a profession from which their members can depart only within certain limits; and finally hierarchy, which ranks the groups as relatively superior or inferior to one another" (Leby, 1992).

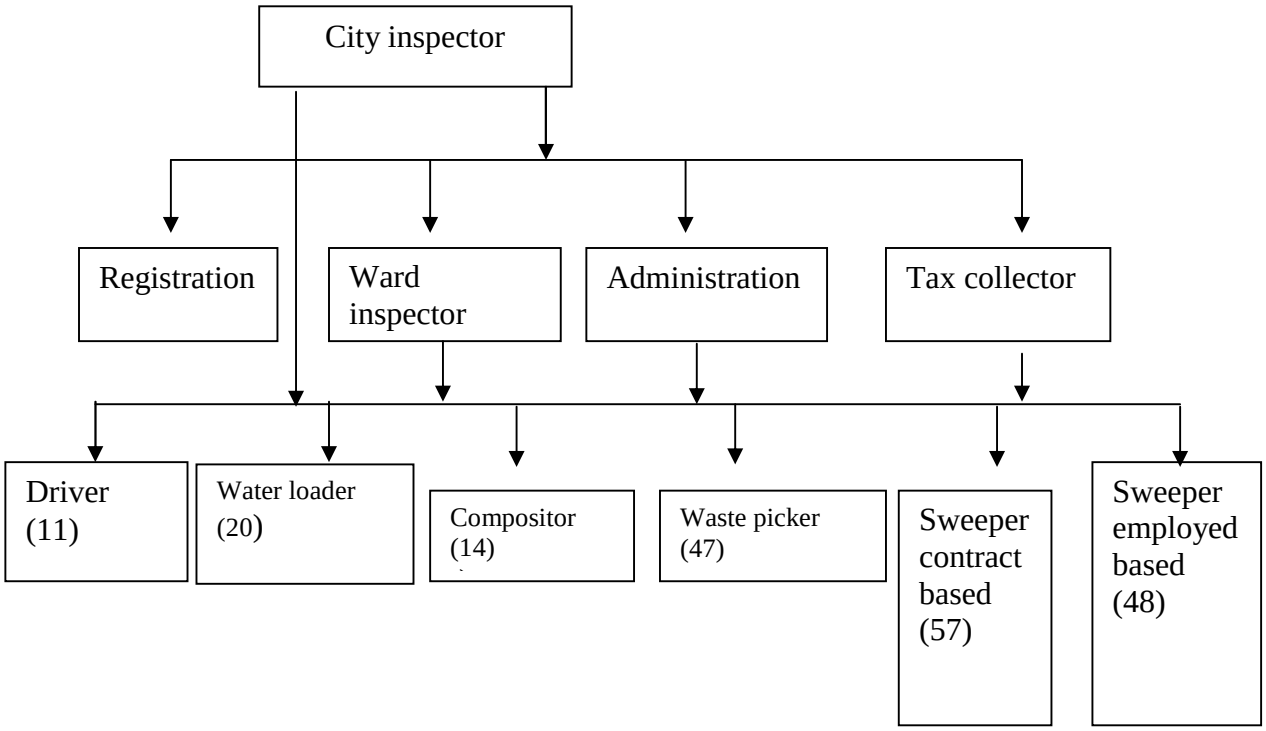
Bhaktapur municipality – a historical town – spreads over an area of nearly 7 km2, situated at an altitude of 4600 ft. above the sea level. It is a popular tourist destination, located only 30 minutes' drive from the capital Kathmandu. It is divided into 17 administrative wards and 75 per cent of the area is used for agriculture. The projected population of this Municipality for the year 2008 is 85,000, the urban population growth rate being 1.7 % and the population density 11,058.38 per km2 (CBS, 2001).

### 4.3: Study Population

The Study population consisted of the municipal solid waste workers (sanitary workers) who had been employed in their current job for at least one year to twenty seven years.

In the sanitation section of Bhaktapur municipality, there are altogether 197 municipal solid waste workers (sanitary workers) of different categories; they are drivers, waste pickers, waste loaders, waste compositor and sweepers. Among which most of them are employed staffs of municipality as municipal solid waste workers. And rest of which are local community groups which provide waste management services under an annual contract to the municipality in 12 of the 17 wards. However, the municipality still has overall responsibility for waste management in the five remaining wards. The community

contractors range in size from three to seven employees, and are allocated to the wards according to population of each ward. Each group is responsible for one ward in order to facilitate effective waste management.




**4.4: Study design**

- A descriptive cross-sectional study.

**4.5: Sampling Method**

A simple random sampling method was used.

**4.6: Instrumentation**

***4.6.1: Questionnaire***

One of our survey instruments for measurement of occupational health hazards was adapted from the Standardized Nordic Questionnaire and translated in to Nepali language. All our study participants (60 individuals) were asked to complete a questionnaire collecting information on work history, health behaviours, individual characteristics, precaution practices and knowledge related to their occupation. Almost Questionnaires were filled up by interviewing the sanitary workers as most of them were illiterate and had not enough skill for reading or writing.

### *4.6.2: Health check up*

Health camp was organized especially for the sanitary workers of Bhaktapur Municipality. It was launched with the help Bhaktapur Municipality at Public Health Centre or Janaswastha Kendra of ward no.1, Chyamasingh which was launched by the Bhaktapur Municipality itself.

During the health camp, 140 individuals participated but the reports were collected only from 76 individuals in which 60 respondents from the questionnaire were also included. Health check up was done in four sections; they were general, Dental, Gynaecology and Eye check up. Altogether 6 doctors and more than 10 health workers were involved in the camp.

Blood pressures of all sanitary workers were also taken by using Sphygmomanometers with the help of nurses of Khwopa Polytechnic Nursing College which was launched by the Bhaktapur Municipality itself in the same Building.

Prescribed medicines were also distributed to the sanitary workers after the check up at the same time. It was distributed with the help of District Health Department.

All the reports were collected to note the prescriptions by the doctors.

### *4.6.3: Stool examination*

A total 60 stool samples (single sample from each) were collected and examined microscopically. After collecting stool samples, they were examination routinely with the help of compound microscope in the laboratory of Public Health Post (Janaswasthya Kendra), running by the Bhaktapur Municipality at Chyamasingh-1.

#### *4.6.3.1: Direct Smear Technique:*

The normal saline (0.9%) and lugol's iodine soln(1%) were used for routine examination of the stools samples to determine helminth ova, protozoan trophozoites, oocysts and cysts.

#### *4.6.3.2: Concentration Technique:*

Formal ether concentration technique was used to get large no. of helminth ova, protozoan trophozoites, cysts and oocysts.

## 4.7: Data Analysis

The data were analyzed using the (Statistical Package of Social Science) SPSS Version 11.5.

### 4.8: Limitation of this study

- The study was limited only among the sanitary workers of Bhaktapur Municipality.
- Health check up was done only in four sections; General, Dental, Gynaecology Eye check up.
- The study period was in the winter season.
- Laboratory diagnosis except stool examination was not done for further disease identification.

### 4.9: Validity and Reliability

- Consultation was done with the supervisor/guide/subject experts.
- Concerned persons were requested to read the questionnaire and give some necessary feedback.
- Field work and lab work was carried out by the researcher herself and necessary help was taken from the experts.
- All the reagent, equipments and laboratory methods were standardized.
- Necessary help and support was taken from the expert and the supervisor.

# V

# RESULTS

The study was carried out among the sanitary workers of Bhaktapur Municipality. The information regarding the participants was collected with questionnaire survey, health camp and stool examination.

### 5.1: Characteristics of respondents

The table below shows the characteristics of respondents. Out of 60 respondents 50(83.3%) were males whereas females were only 10(16.3%). Most of them were illiterate i.e. 40(66.7%), all the literate respondents were also under SLC and only one was SLC passed.

The sanitary workers are categorised into five groups according to their work: driver, waste loader, waste picker, compositor and sweeper. They have been working from one year to 27 years. The higher no. of respondents was from the job duration 10-15 yrs. Most of the respondent i.e.83% had not taken the vaccine against the Hepatitis B and only 17% were vaccinated.

Table 1: Characteristics of respondents

| **Characteristics of respondents** | | **Frequency n=60** | **Percentage** |
|---|---|---|---|
| Sex | Male | 50 | 83.3 |
| | Female | 10 | 16.3 |
| Educational status | Literate | 20 | 33.3 |
| | Illiterate | 40 | 66.7 |
| Category of work | Driver | 6 | 10.0 |
| | Waste loader | 16 | 26.7 |
| | Waste picker | 13 | 21.7 |
| | Composting | 7 | 11.7 |
| | Sweeper | 18 | 30.0 |
| Duration of job | 0-5 | 7 | 11.7 |
| | 5-10 | 10 | 16.7 |
| | 10-15 | 25 | 41.7 |
| | 15-20 | 12 | 20.0 |
| | >20 | 6 | 10.0 |
| Vaccination against Hep B | Yes | 10 | 16.7 |
| | No | 50 | 83.3 |

## 5.2: Health behaviours and knowledge regarding health hazards

### *5.2.1: Bathing habit and practice of nail cutting*

Table 2 shows the bathing habits and practice of nail cutting of the respondents. Only one respondent had habit of daily bathing, the higher number of the respondents i.e. 38 (63.3%) bath once a week. It was also found that 5 respondents bath once a month. Maximum number i.e. 35(58.3%) of respondents had habit of cutting nails once a week and only one respondent cut nails twice in a month.

Table 2: Bathing habit and practice of nail cutting

| **Duration** | **Bathing habit** | | **Practice of nail cutting** | |
|---|---|---|---|---|
| | **Frequency n=60** | **Percentage** | **Frequency n=60** | **Percentage** |
| Daily | 1 | 1.7 | NA | |
| Once a week | 38 | 63.3 | 35 | 58.3 |
| Twice a week | 16 | 26.7 | 8 | 13.3 |
| Once a month | 5 | 8.3 | 16 | 26.7 |
| Twice a month | NA | | 1 | 1.7 |

### *5.2.2: Knowledge about health hazards*

Table 3 shows the knowledge about health hazards among the respondents. The maximum number .i.e. 31(51.7%) of them had no idea about it.

Table 3: Knowledge about health hazards

| **Knowledge about Health Hazard of solid waste** | **Frequency n=60** | **Percentage** |
|---|---|---|
| No | 31 | 51.7 |
| Yes | 29 | 48.3 |

### *5.2.3: Practice for the safety/precaution*

Table 4 shows the tools which were used by sanitary workers for precaution during work. It shows that only 2 respondents i.e. 3.3% used apron, mask, gloves and boots. Most of the respondents 12(20%) used apron, masks and boots and 4 respondents i.e. 6.7% used nothing for precaution or safety.

Table 4: Practice for the safety/precaution

| **Practice for the safety/precaution** | **Frequency n = 60** | **Percentage** |
|---|---|---|
| ‘’Apron only’’ | 11 | 18.3 |
| ‘’Mask only’’ | 8 | 13.3 |
| "Apron+mask" | 11 | 18.3 |
| "Apron+mask+boots" | 12 | 20.0 |
| "Apron+mask+boots+gloves" | 2 | 03.3 |
| "Apron+boots" | 10 | 16.7 |
| "Mask+boot" | 2 | 03.3 |
| ‘’None’’ | 4 | 06.7 |

### *5.2.4: Health discomfort while working*

Table 5 shows types of health discomfort while working. It shows that out of 60, 48 respondents i.e. 80% were having some health discomforts while working and most of them i.e. 31(64%) had headache.

Table 5: Health discomfort while working

| **Types of health discomfort** | **Feeling health discomfort while working** | |
|---|---|---|
| | **Yes n = 48** | **Percentage** |
| Headache | 31 | 64.6 |
| Hesitation(faltering) | 3 | 6.3 |
| Allergy | 3 | 6.3 |
| Problem in respiration | 1 | 2.1 |
| Headache + hesitation | 3 | 6.3 |
| Headache + allergy | 2 | 4.2 |
| Headache + weakness | 5 | 10.4 |

### *5.2.5: Diseases and health complications before and after municipality job*

Table 6 shows the diseases and health complications of respondents before being engaged in the municipality job. Out of 60 respondents, 49(81.7%) were healthy before being engaged in the municipality job and only 11 i.e. 18.3% were found having some health problems. Out of 11, most of them i.e. 5 respondents (45.5%) were suffering from gastrointestinal disorders.

Table 6: Diseases and health complications before municipality job

| **Type of diseases and health Complications** | **Frequency n = 11** | **Percentage** |
|---|---|---|
| Skin Disorders | 3 | 27.3 |
| Eye problem | 1 | 9.1 |
| Gastrointestinal disorders | 5 | 45.5 |
| TB | 1 | 9.1 |
| MSD | 1 | 9.1 |

Table 7 shows the health complications or diseases reported in the respondents after entering in the job. Out of 60 respondents, 56(93.3%) had health problems and ten health complications were reported, of which musculoskeletal disorder (MSD), gastrointestinal disorder, respiratory problem and chest pain/infection were major health complications.

The most common health complication was musculoskeletal disorder (MSD) found in 41 respondents i.e. 73.2%. The 2$^{nd}$ and 3$^{rd}$ common health complications were gastrointestinal disorder found in 24 respondents i.e. 42.9% and respiratory problem found in 20 respondents i.e. 35.7% respectively. The least common health complication was cancer found in only one respondent i.e. 1.8%.

Table 7: Diseases and health complications after municipality job

| **Types of diseases and health complications** | **Frequency n=56** | **Percentage** |
|---|---|---|
| Skin disorder | 13 | 23.2 |
| Hypertension | 3 | 5.4 |
| Eye problem | 6 | 10.7 |
| MSD | 41 | 73.2 |
| Respiratory problem | 20 | 35.7 |
| Gastrointestinal disorder | 24 | 42.9 |
| Chest pain/infection | 19 | 33.9 |
| NSD | 2 | 3.6 |
| TB | 2 | 3.6 |
| Cancer | 1 | 1.8 |

### *5.2.6: Health problems in relation to characteristics of respondents*

Table 8 shows the health problems in relation to characteristics of respondents. It shows that 100% of female were having health problems. Out of 40 illiterate, 39(97.5%) of them were suffering from any one kind of health problem and out of 20 literate, 17(85%) had health problems. In relation to the work division, 100% of drivers, compositors and sweepers were having major health problems or complications such as MSD, respiratory problems, gastrointestinal disorder and so on. The respondents having no knowledge of health hazards were found having more health problems.

Table 8: Health problems in relation to characteristics of respondents

| **Characteristics of respondents** | | **Health complications/diseases** | | | |
|---|---|---|---|---|---|
| | | **No** | | **Yes** | |
| | | **Frequency n=60** | **Percentage** | **Frequency n=60** | **Percentage** |
| Sex | Female | 0 | 0 | 10 | 100.0 |
| | Male | 4 | 8.0 | 46 | 92.0 |
| Category of work | Driver | 0 | 0 | 6 | 100.0 |
| | Waste Loader | 3 | 18.8 | 13 | 81.3 |
| | Composting | 0 | 0 | 7 | 100.0 |
| | Waste Picker | 1 | 7.7 | 12 | 92.3 |
| | Sweeper | 0 | 0 | 18 | 100.0 |
| Educational status | Illiterate | 1 | 2.5 | 39 | 97.5 |
| | Literate | 3 | 15.0 | 17 | 85.0 |
| Knowledge about health hazards of solid waste | No | 1 | 3.2 | 30 | 96.8 |
| | Yes | 3 | 10.3 | 26 | 89.7 |

### *5.2.7: Health problems in relation to job duration*

Table 9 shows the health problems in relation to job duration of respondents. It shows that the respondents who had passed their time more than 10 years were seem to be having more health complications/diseases.

Table 9: Health problems in relation to job duration

| Job duration | Health complications/diseases | | | |
|---|---|---|---|---|
| | No | | Yes | |
| | Frequency n=60 | Percentage | Frequency n=60 | Percentage |
| 0-5yrs(n=7) | 1 | 14.3 | 6 | 85.7 |
| 5-10yrs(n=10) | 2 | 20.0 | 8 | 80.0 |
| 10-15yrs(n=25) | 1 | 4.0 | 24 | 96.0 |
| 15-20yrs(n=12) | 0 | 0 | 12 | 100.0 |
| >20yrs(n=6) | 0 | 0 | 6 | 100.0 |
| Total | 4 | 6.7 | 56 | 93.3 |

Statistically, there is significant difference of infection/health problems with job duration. (P=0.05, d.f.=4, Chi square=9.488)

### *5.2.8: Health problems in relation to practice for safety/precaution*

Table 10 shows the health problems in relation to practice for safety/precaution. Statistically, there is no significant risk of infection/health problems to safety practitioners. (P=0.05, d.f.=6, Chi square =11.81).

Table 10: Health problems in relation to practice for safety/precaution

| Practice for the Safety/Precaution | Respondents having health problems n=56 |
|---|---|
| "Apron only" | 10 |
| "Mask only" | 8 |
| "Apron+mask" | 11 |
| "Apron+mask+boots" | 10 |
| "Apron+mask+boots+gloves" | 2 |
| "Apron+boots" | 9 |
| "Mask+boot" | 2 |
| ‘’None’’ | 4 |

### *5.2.9: Occupation wise health complications/diseases*

Table 11 shows the health complications/diseases in relation with the categories of work of the respondents. It shows that MSD was most prevalent in compositors, waste pickers and sweepers. Out of 7 compositors, all of them (100%) were suffering from MSD. Out

of 12 waste pickers, 10 of them (83.3%) were suffering, and out of 18 sweepers, 15 of them (83.3%) were suffering. The least population suffering from MSD was drivers.

Gastrointestinal disorder was most prevalent in waste pickers (75%) and waste loaders (61%). Respiratory problem was mostly reported in sweepers (50%) and waste pickers (41.7%). Higher number of waste pickers (58.3%) and compositor (42.9) were suffering from chest pain. Skin diseases were mostly reported in waste pickers (33.3%) and drivers (33.3%). Eye problems were found excess in sweepers (27.8%). Hypertension was reported highly in waste picker (8.3%) and waste loaders (7.7%). Neurological disorder (NSD) was only reported in 2 waste pickers out of 18 waste pickers i.e. 16.7%. Tuberculosis was only found in compositors and sweepers. Lastly cancer was found only in one waste picker.

Table 11: Occupation wise health complications/diseases

| **Type of health complications/disease** | **Category of work** | | | | | **Total Percentage n =56** |
|---|---|---|---|---|---|---|
| | **Driver** **Percentage n = 6** | **Waste Loader** **Percentage n = 13** | **Composting** **Percentage n = 7** | **Waste Picker** **Percentage n = 12** | **Sweeper** **Percentage n = 18** | |
| *Skin Disorder | 2(33.3) | 2(15.4) | | 4(33.3) | 5(27.8) | 13(23.2) |
| Hypertension | | 1(7.7) | | 1(8.3) | 1(5.6) | 3(5.4) |
| Eye problem | | | | 1(8.3) | 5(27.8) | 6(10.7) |
| *MSD | 1(16.7) | 8(61.5) | 7(100.0) | 10(83.3) | 15(83.3) | 41(73.2) |
| *Respiratory Problem | 2(33.3) | 2(15.4) | 2(28.6) | 5(41.7) | 9(50.0) | 20(35.7) |
| *Gastrointestinal disorder | 3(50.0) | 8(61.5) | 2(28.6) | 9(75.0) | 2(11.1) | 24(42.9) |
| *Chest pain/infection | 1(16.7) | 2(15.4) | 3(42.9) | 7(58.3) | 6(33.3) | 19(33.9) |
| NSD | | | | 2(16.7) | | 2(3.6) |
| TB | | | 1(14.3) | | 1(5.6) | 2(3.6) |
| Cancer(skin) | | | | 1(8.3) | | 1(1.8) |

(* = statistically tested)

There is significant difference in infection/health problems due to professions. (Oneway ANOVA, P=0.05, d.f.=4,20, F=3.74)

### *5.2.10: Relation between knowledge about health hazards of solid waste and the educational status*

Table 12 shows the relation between knowledge about health hazards of solid waste and the educational status. It shows that out of 60 respondents, 40 (66.66%) of them were illiterate and 67.5% of illiterate respondents had no knowledge about health hazards of solid waste where as 20.0% of respondents had no idea about health hazard of solid waste even they are literate.

Table 12: Relation between knowledge about health hazards of solid waste and the educational status

| **Knowledge about health hazard of solid waste** | **Educational Status** | | | |
|---|---|---|---|---|
| | **Illiterate** | | **Literate** | |
| | **Frequency n = 40** | **percentage** | **Frequency n = 20** | **percentage** |
| No | 27 | 67.5 | 4 | 20.0 |
| Yes | 13 | 32.5 | 16 | 80.0 |

## 5.3: Findings of Stool Examination

### *5.3.1: Types of intestinal parasites*

Table 13 shows types of intestinal parasites found in respondents. Out of 60 stool samples, 28(46.66%) were positive for intestinal parasites. It shows that four types of helminthes (*Ascaris lumbricoides, Ancylostoma duodenale, Strongyloides stercoralis, Trichuris trichiura*) and two types of protozoans (*Entamoeba histolytica, Giardia lamblia*) were found in stool samples. Among them the most common intestinal parasite was found to be *Ascaris lumbricoides* 18(30.0%) and the least common intestinal parasite was *Strongyloides stercoralis* i.e. 2(3.33%).

Table 13: Types of intestinal parasites

| **Types of intestinal parasites** | **Frequency n=60** | **Percentage** |
|---|---|---|
| *Giardia lamblia* | 3 | 5.0 |
| *Entamoeba histolytica* | 3 | 5.0 |
| *Ascaris lumbricoides* | 18 | 30.0 |
| *Ancylostoma duodenale* | 4 | 6.66 |
| *Strongyloides stercoralis* | 2 | 3.33 |
| *Trichuris trichiura* | 5 | 8.33 |

### *5.3.2: Co-infection of intestinal parasites*

Table 14 shows the prevalence of co-infection of intestinal parasites. Out of 60 sanitary workers only 7(11.66%) were infected with more than one type of intestinal parasites. Only double infections were found.

Table 14: Co-infection of intestinal parasites

| **Types of intestinal parasites** | **Frequency n=60** | **Percentage** |
|---|---|---|
| *Ascaris+Entamoeba* | 3 | 5.0 |
| *Ascaris+Trichuris* | 1 | 1.6 |
| *Ascaris+Giardia* | 1 | 1.6 |
| *Ancylostoma+Trichuris* | 2 | 3.3 |

### *5.3.3: Occurrence of intestinal parasitic infection in relation to the characteristics of the respondents*

Table 15 shows the occurrence of intestinal parasitic infection in relation to the characteristics of the respondents. It shows that higher numbers of male were infected than the female. Out of 40 illiterate respondents, 19(47.5%) of them were infected. In relation to the categories of work, most of the waste picker and waste loaders were found to be more infected. Out of 13 waste pickers, 9(69.2%) and out of 16 waste loaders, 8(50%) were infected with any one of the intestinal parasite.

Table 15: Parasitic infection in relation to the characteristics of the respondents

| **Characteristics of respondents** | | **Intestinal parasitic infection** | | | |
|---|---|---|---|---|---|
| | | **Present** | | **Absent** | |
| | | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| Sex | Female | 4 | 40.0 | 6 | 60.0 |
| | Male | 24 | 48.0 | 26 | 52.0 |
| Educational Status | Illiterate | 19 | 47.5 | 21 | 52.5 |
| | Literate | 9 | 45.0 | 11 | 55.0 |
| Category of work | Driver | 2 | 33.3 | 4 | 66.7 |
| | Waste Loader | 8 | 50.0 | 8 | 50.0 |
| | Composting | 0 | 0 | 7 | 100.0 |
| | Waste Picker | 9 | 69.2 | 4 | 30.8 |
| | Sweeper | 9 | 50.0 | 9 | 50.0 |

### *5.3.4: Occurrence of intestinal parasitic infection in relation to the health behaviour and knowledge about health hazards*

Table 16 shows the occurrence of intestinal parasitic infection in relation to the health behaviour and knowledge about health hazards. Intestinal parasitic infections were found higher in those respondents who had no habit of washing hand and do not use soap for washing hands before taking food. Out of 60 respondents, 6 of them had no habit of washing hands before taking food, all of them i.e. 100% were infected. Out of 60 respondents, 36 of them use soap for washing hands and only 9(25%) out of 36 were found to be infected.

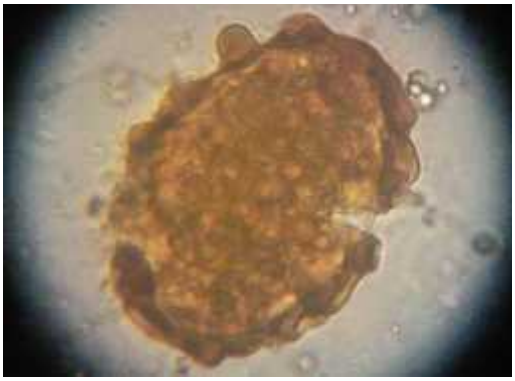
Statistically, incidence of intestinal parasitic infection was significant with the hand washing before taking food (P=<0.05, d.f.=1, Chi square=7.619). Incidence of intestinal parasitic infection was statistically significant with the use of soap for hand washing (p<0.001) and intestinal parasitic infection was 11.40 times more likely to those workers having no habit of soap for hand washing before taking food.

Similarly, incidence of intestinal parasitic infection was significant with the practice for safety/precaution (P=<0.05, d.f.=1, Chi square=4.898). Incidence of intestinal parasitic infection was not statistically significant with the knowledge of health hazards.

Table 16: Parasitic infection in relation to the health behaviour and knowledge about health hazards

| **Health behaviour and knowledge** | | **Intestinal parasitic infection** | | **OR (95%CI)** | **P value** |
|---|---|---|---|---|---|
| | | **Present Percentage n=60** | **Absent Percentage n=60** | | |
| Habit of hand wash before taking food | No | 6(100) | 0 | Na | |
| | Yes | 22(40.7) | 32(59.3) | | |
| Use soap for hand wash | No | 19(79.2) | 5(20.8) | 11.40 (3.296-39.425) | <0.001 |
| | Yes | 9(25.0) | 27(75.0) | | |
| Practice for safety/precaution | No | 4(100) | 0 | Na | |
| | yes | 24(40.0) | 32(53.33) | | |
| Knowledge about health hazard of solid waste | No | 16(51.6) | 3(48.4) | 1.51 (0.544-4.194) | >0.05 |
| | Yes | 12(41.4) | 17(58.6) | | |

## OVA AND LARVA OF HELMINTHS



*Ascaris lumbricoides* (Fertilized Egg)

*Ascaris lumbricoides* (Unfertilized Egg)

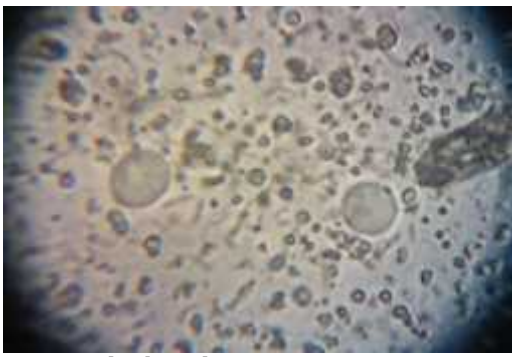
*Ascaris lumbricoides*
(Semidecorticated fertilized Egg)

*Strongyloides stercoralis(*larva)

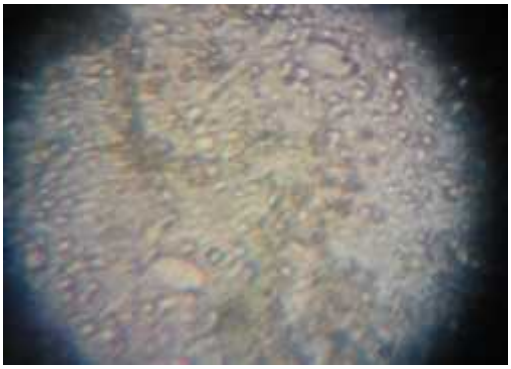
*Ancylostoma duodenale*

*Trichuris trichiura*

## CYSTS OF PROTOZOANS



*Entamoeba histolytica*



*Giardia lamblia*

# V

# DISCUSSION AND CONCLUSION

## 6.1: Discussion

The present study reveals the most common health complication was musculoskeletal disorder which was reported 73.2%. The 2nd and 3rd common health complications were gastrointestinal disorder (42.9%) and respiratory problem (35.7%) respectively. The least common health complication was cancer (1.8%). Mehrdad et al. (2008), obtained similar result among municipal solid waste workers. He reported that 65% of them have musculoskeletal disorder. Similar result was obtained in research concluded by Dorevitch & Marder (2001), that the most common non-fatal injuries were mainly musculoskeletal. Other common injuries are fractures, ocular trauma, and bites, and diseases include skin and gastrointestinal disorders. These results obtained may be due the continuous standing, heavy lifting and performing task that required repetitive motion.

Similarly, Kalahasthi et al. (2010) found that the morbidity conditions such as respiratory (34%), musculoskeletal (24.5%), past illnesses (12.7%), dermatological (11.8%), gastrointestinal (9.8%), injuries due to contact with sharp objects & heavy equipments (7.8%) and nose and eye (4.9%) problems were observed in hazardous waste workers.

Giri (2010), found that eye problems were most predominant, seen in 70.6% workers followed by musculoskeletal problems (68.0%), while 58.0% workers presented with gastrointestinal and 52.6% with respiratory ailment, with obstructive pattern observed in 38 (48.1%) subjects being the major finding. 52% workers had skin problems and injuries were observed in 39 (26.0%) workers including minor injuries such as cuts, abrasions and lacerations. The large proportion of workers suffered from work related symptomatic morbidities mainly of eye, respiratory, musculoskeletal system, gastrointestinal and skin.

MSD was most prevalent in compositors (100%), waste pickers (83.3%) and sweepers (83.3%). Huren et al. (1999) found waste collectors had a higher risk of injury than other workers in the MSW industry. The least suffering group from MSD was driver. This indicates that the drivers do not have to do heavy physical work than those of other groups. The findings also show that there is significant difference in infection/health problems due to professions (Oneway ANOVA, P=0.05, d.f.=4,20, F=3.74).

In the present study, gastrointestinal disorder was most prevalent in waste pickers (75%) and waste loaders (61%). Respiratory problem was mostly reported in sweepers (50%)

and waste pickers (41.7%). Bhattacharyya (2011), also observed the respiratory problem has been to a large extent among waste collector staff and waste pickers. High number of waste pickers (58.3%) and compositor (42.9) were suffering from chest infection. Skin diseases were mostly reported in waste pickers (33.3%) and drivers (33.3%).Eye problems were found excess in sweepers (27.8%). Hypertension was reported higher in waste picker (8.3%) and waste loaders (7.7%). Neurological disorder was only reported in 2 waste pickers out of 18 waste pickers i.e. 16.7%. Tuberculosis was only found in compositors and sweepers. Lastly cancer was found only in one waste picker.

The higher number of health complications and diseases were reported in the respondents whose job duration was within 10-15yrs and 100% of respondents had health problems whose job duration was more than 15 years. There is significant difference of health problems with job duration (P=0.05, d.f.=4, Chi square=9.488). Out of 60 respondents, 49 (81.7%) were healthy before being engaged in the job and only 11 (18.3%) were found having some health problem or past illness.

Most of the sanitary workers had bad habit of smoking and drinking. The smell of alcohol, tobacco, cigarettes etc was felt and was found uneasy during questionnaire filling. This habit may also affect the health of solid waste workers. Bhattacharyya (2011) also found many staffs were addicted to bad habits like drinking and chewing tobacco.

Out of 60 stool samples, 28 (46.66%) was positive for intestinal parasites. The most common intestinal parasite was *Ascaris lumbricoides* 18(30.0%). Other parasites detected include *Trichuris trichiura* 5(8.88%), *Ancylostoma duodenale* 4(6.66%), *Entamoeba histolytica* 3(5.0%), *Giardia lamblia* 3(5.0%) and *Strongyloides stercoralis* 2(3.33%). Similar type of result was obtained by Karaman et al. (2006), who found 39% positive cases with intestinal parasites and found the most common parasite was *Entamoeba coli*.

*Ascaris lumbricoides* was most common parasite found in stool examination. Incidence of intestinal parasites was statistically significant with hand washing practice before taking food (P=<0.05, d.f.=1, Chi square=7.619) and using soap (p<0.001) and intestinal parasitic infection was 11.40 times more likely to those workers having no habit of soap for hands washing before taking food. Waste pickers (69.2%) and waste loader (50.0%) were found to be most infected group with intestinal parasites among sanitary workers.

The Municipality has provided some tools like apron, masks, gloves and boots to the sanitary workers for the safety and precaution. The findings show that only two respondents i.e. 3.3% used apron, mask, gloves and boots. Most of the respondents (12) i.e. 20% used apron, mask, gloves and 4 respondents i.e. 6.7% used nothing for

precaution and safety. The study shows the relation between the practice of precaution and the health complications. It shows that the respondents who used all the tools (apron, mask, gloves and boots) were having least health complications/diseases and who used nothing for precaution were suffering from maximum health problems.

Most of them were illiterate i.e. 66.7%. The higher numbers (27) of the respondents visited the public health centre and only 2 respondents visited private clinic for the treatment. They have no practice of regular health check up and 83% of them had not taken the vaccine against the Hepatitis B and only 17% were vaccinated. But all of the solid waste workers must have to vaccinate against the Hepatitis B as the solid waste may also include the waste from the hospital contaminated with hepatitis B virus which can be easily transmitted to the human body.

### 6.2: Conclusion

The findings indicate that musculoskeletal disorder, respiratory problems, gastrointestinal disorder, chest pain, and skin diseases are the major health complications and diseases among the sanitary workers of Bhaktapur Municipality. Maximum health complications were found in the waste pickers and the least affected group was driver. *Ascaris lumbricoides* was the most common intestinal parasite where as *Strongyloides stercoralis* was least common parasite. The higher numbers of sanitary workers were illiterate and most of them have no knowledge about the health hazards of solid waste and transmission route of various diseases. Only a few of them use the tools for safety or precaution seriously, those who do not use the tools for precautions were highly victimized.

# VI

## RECOMMENDATIONS

The study provides some recommendations for the future researches, which are as follows:

- Most of the sanitary workers have no knowledge about the health hazard of solid waste and the transmission routes of various diseases. Thus awareness programmes should be organised by the Municipality office itself.
- Trainings for safety handling waste should be given to the sanitary workers.
- Sanitary workers should be made conscious of using the tools like apron, masks, gloves, boots etc for the protection.
- Regular health check up and laboratory diagnosis should be carried out for the sanitary workers by the Municipality.
- The sanitary workers should be encouraged to leave the bad habits of drinking and smoking.
- There must be the facilities of bathing after returning from the field work in the Municipality and in the wards.
- The changing of dress must be made compulsory to return home for all sanitary workers.

# REFERENCES


- An H., Englehardt J., Fleming L., Bean J., 1999. Occupational health and safety among the municipal solid waste workers in Florida. Waste Management and Research, 17(5): 369-377.
- Athanasiou M., Makrynos G., Dounias G., 2010. Respiratory health of municipal solid waste workers, Department of Occupational and Industrial Hygiene, National School of Public Health, Occup Med (Lond).
- Bhandari T.R. and Adhikari R.K., 2006. Occupational health hazards and care provision of employees in Nepal Telecom, Kathmandu District of Nepal, Journal of Nepal Health Research Council;4(2).
- Bhattacharyya J.K., 2011. Occupational health hazards in municipal solid waste management, National Environmental Engineering Research Institute. Presented on health Indo German workshop, 2010 March 22.
- Chaudhry M.A., Hyat A., Qureshi S.M., Najmi S.A.A., 2004. Health hazard of hospital waste to sanitary workers at combined military hospital, Rawalpindi. Pakistan Armed Forces Medical Journal, 54(2):253-258.
- CREOD, Geneva., 2011, Global workshop on Occupational skin diseases.
- Dearwent S.M., Mumtaz M.M., Godfrey G., Sinks T., Falk H., 2006. Health effects of hazardous waste. Agency for Toxic Substances and Disease Registry;1076:439-448.
- Dimri A., 2008. Death of a sanitary worker. Published: August 6 2008 in 'Social Ostracism Reviews & Summaries'. http://www.shvoong.com/social-sciences/sociology/1831680-death-sanitary-worker.
- District profile analysis, 2059,B.S. District Development committee, Bhaktapur.
- Donoghue A.M., 2004.Occupational health hazards in mining. Occupational Medicine; 54:283-289.
- Dorevitch S., Marder D., 2001. Occupational hazards of municipal solid waste workers. Occup. Med.16(1):125-133.
- Dounias G., Rachiotis G., 2006. Prevalence of hepatitis A virus infection among municipal solid-waste workers. Department of Occupational and Industrial Hygiene. International journal of clinical practice;60(11):1432-1436
- Environment Agency. Waste Statistics for England and Wales 1998–99

- Franco S., Erminio C., Giovanni B.B., Claudio F., Mariella C., Prof. Angelo G. L., 1987. Sister chromatid exchanges and DNA repair capability in sanitary workers exposed to ethylene oxide: Evaluation of the dose-effect relationship. Digital Object Identifier (DOI).
- Frisvold, George, Mines, Richard, Perloff, Jeffrey M., 1987. The effects of job site sanitation and living conditions on the health and welfare of agricultural workers. Department of Agricultural and Resource Economics, UCB, UC Berkeley
- Ghimere S., 2008. To access the knowledge and practice regarding occupational health hazard and safety measures among the workers working in Birat Jute Mill, Biratnagar. Koshi Health and Science Campus, PU.
- Gillett J.W., 1992. Issues in risk assessment of compost from municipal solid waste: occupational health and safety, public health, and environmental concerns. Institute for Comparative and Environmental Toxicology, Biomass and Bioenergy, Aerobic Composting and Compost Utilization. 3:145-162.
- Giri Purushottam., 2010. Study on morbidity profile of sewage workers in Mumbai City. International Journal of Collaborative Research on Internal Medicine & Public Health.
- Guo H.R., Chang Y.C., Yeh W.Y., Chen C.W. and Guo Y.L., 2004. Prevalence of Musculoskeletal Disorder among Workers in Taiwan: A Nationwide Study. Journal of Occupational Health, 46:26-36.
- Gurung H., 2005. Social Demography of Nepal, Census 2001. Himal Books 2:5.
- Hansen J., Ivens U.I., Breum N.O., Nielsen M., Wurtz H., Poulsen O.M., Ebbehoj N., 1997. Respiratory symptoms among Danish waste collectors. Presented at the International Meeting: “Waste Collection and Recycling - Bioaerosol Exposure and Health Problems”, 13-14 September 1996. Ann Agric Environ Med; 4:69-74.
- Harrad S.J., Harrison R.M., 1996. The Health Effects of the Products of Waste Combustion. Institute of Public and Environmental Health, University of Birmingham.
- Hernando R. P., Arthur L. F., Neil J. Z., 2006. Health effects associated with organic dust exposure during the handling of municipal solid waste. Indoor and Built Environment, 15(3):207-212.
- IEH, 1997.Health Effects of Waste Combustion Products. Leicester: Institute for Environment and Health

- ILO/WHO, 1950, Occupational health.
- Jamaluddin J., 2010. Sanitary workers lifting garbage with bare hands. Published: January 19, 2010 in Pakistan Daily Newspaper, 'The Nation'
- Kalahasthi R., Pradyuonna A., Narendran P., Hirehal R., Rao R., 2010. Evaluation of the Relationship between Pro-inflammatory Cytokines and Health Hazards in Workers Involved in Hazardous Waste Sites at Karnataka, India.Karaman U., Atambay M., Aycan O., Yoloğlu S., Daldal N., 2006. Incidence of intestinal parasites in municipal sanitary workers in Malatya. Turkiye Parazitol Derg.,30(3):181-183.
- Khruakhorn S., Sritipsukho P., Siripakarn Y., Vachalathiti R., 2010. Prevalence and risk factors of low back pain among the university staff. J Med Assoc Thai. ; 93 Suppl 7:142-148.
- Kiviranta H., Tuomainen A., Reiman M., Laitinen S., Nevalainen A., Liesivuori J., 1999. Exposure to airborne microorganisms and volatile organic compounds in different types of waste handling. Ann Agric Environ Med; 6:39–44.
- Kuijer P.P.F., van der Beek A. J., van Dieen J. H., Visser B. and Frings-Dresen M.H., 2005. Effect of job rotation on need for recovery, musculoskeletal complaints, and sick leave due to musculoskeletal complaints: A prospective study among refuse collectors. American Journal of Industrial Medicine; 47: 394–402.
- Levy R.I., 1992. Mesocosm. Motilal Banarsidass Publisher Pvt. Ltd., Nepal.
- Maharjan B., 2008. Occupational health hazards related to pesticide use in agriculture: A study among vegetable grower's of Lalitpur District. Research paper submitted to the Department of Public Health, Asian college for advance studies (Saddobato, Lalitpur) in partial fulfillment of the courses in Bachelor of Public health.
- Maskay P.L., 1962.Guide to Bhaktapur, Publisher-P.L. Maskay, Kathmandu, Nepal
- Mehrdad R., Majlessi-Nasr M., Aminian O., Sharifian S.A. and Malekahmadi F., 2008. Musculoskeletal disorders among municipal solid waste workers. Acta Medica Iranica; 46(3): 233-238.
- Ministry of Local Development, Solid Waste Management and Resource Mobilisation Centre (SWMRMC)., 2004. Solid Waste Management in Nepalese Municipalities.

- Mulloy K.B., 2001. Sewage workers: toxic hazards and health effects. Occup Med.;16(1):23-38.
- Oyelola O. T., Babatunde A.I. and Odunlade A. K., 2009. Health implications of solid waste disposal: Case Study of Olusosun Dumpsite, Lagos, Nigeria. Int. Jor. P. App. Scs.; 3(2):1-8.
- Pandey R., 2011. Solid waste management practice and health implication: A Case of Kathmandu Metropolitan City, Nepal, The Himalayan review 35-36 (2004-2005) 33-47, (-Published: 14 march 2011).
- Perez-Padron M., Bernabé E., Gomez-Santos G., Tsakos G., Lozano de Luacess V., 2010. Healthy mind and body in a healthy work environment. Int Dent J.;60(6):395-398.
- Pokhrel D. and Viraraghavan T., 2005. Municipal solid waste management in Nepal: practices and challenges. Faculty of Engineering, University of Regina, Regina, SK, Canada.
- Pokhrel D. and Viraraghavan T., 2005. Municipal solid waste management in Nepal*:* Practices and challenges, Waste Management 25; 555-562. www.wateraid.org/documents/../solid_waste_management_in_nepal.pd
- Poudel K., Acharya A., Pokharel S., 2005. Follow up study on adoption of national health care waste management guideline at Health Care Institution at Kathmandu. NHRC, Ramshah Path, Kathmandu.
- Poulsen O.M., Breum N.O., Ebbehoj N., Hansen A.M., Ivens U.I., van Lelieveld D. et al.,1994. Collection of domestic waste. Review of occupational health problems and their possible causes. Sci Total Environ; 170: 1–19.
- Poulsen O.M., Breum N.O., Ebbehoj N., Hansen A.M., Ivens U.I., van Lelieveld D. et al., 1995. Sorting and recycling of domestic waste. Review of occupational health problems and their possible causes. Sci Total Environ*;* 168: 33–56.
- Practical Action Nepal., 2008. Best practice on solid waste management of Nepalese cities. 1st Ed. Pandol Marga, Lazimpat, Kathmandu, Nepal.
- Ray M.R., Roychoudhury S., Mukherjee G., Roy S., Lahiri T., 2005. Respiratory and general health impairments of workers employed in a municipal solid waste disposal at an open landfill site in Delhi. Int J Hyg Environ Health; 208(4):255-262.

- Regional Occupational Healthcentre (Southern), Nirmal Bhavan Complex, Indian Council of Medical Research,Poojanhalli, Kannamangala (Post), Bangalore-562110,India.10(1):7-14.
- Rogers B., 2001. Municipal healthcare workers: work-related health hazards. Occup Med; (1):143-61.
- Roy S., Dasgupta A., 2008. A study on health status of women engaged in a home-based "Papad-making" industry in a slum area of Kolkata. Indian J Occup Environ Med; 12: 33-36.
- Rushton L., 2003. Health hazards and waste management. British Medical Bulletin,68(1):183-197.
- Sigsgaard T., 1999. Health hazards to waste management workers in Denmark. Schriftenr Ver Wasser Boden Lufthyg, 104: 563-568
- Statistical Year Book of Nepal (CBS)., 2001.
- Thorn J., and Kerekes E., 2001. Health effects among employees in sewage treatment plants: A literature survey. American Journal of Industrial Medicine; 40: 170–179.
- Tiwari R.R., 2008. Occupational health hazards in sewage and sanitary workers. Indian J Occup Environ Med; 12(3): 112–115.
- Tooher R., Griffin T., Shute E., Maddern G., 2005. Vaccinations for waste-handling workers. Waste Management & Research, 23(1):79-86
- UNEP., 1996. Health impacts of solid waste: Occupational health hazards associated with waste handling
- WHO 2011, Occupational health
- WHO European Centre for Environment and Health., 2000. Methods of Assessing Risk to Health from Exposure to Hazards Released from Waste Landfills
- WHO, 2006. Constitution of the World Health Organization - Basic Documents, Forty-fifth edition, Supplement, October 2006
- WHO, Geneva. 1997. Occupational health: the workplace
- WHO, Geneva., 1995. Global Strategy on Occupational Health for All
- Www.wisegreek.com, What are the most common occupational health hazards?
- Yang C.Y., Chang W.T., Chuang H.Y., Tsai S.S., Wu T.N., Sung F.C., 2001. Adverse health effects among household waste collectors in Taiwan. Environ Res, 85(3):195-199

Yu G.P., Hsieh C.C., Peng J., 1998. Risk factors associated with the prevalence of pulmonary tuberculosis among sanitary workers in Shanghai. Department of Epidemiology, School of Public Health, Shanghai Medical University, China. 69(2):105-112

## PHOTOGRAPHS RELATED TO THE STUDY

A. Waste loaders loading the solid waste

B.Sweeper & waste picker cleaning the road

C. Booklets distributing to the sanitary workers during health camp


D. Health camp at Public Health Centre running by the Bhaktapur Municipality

E. Sanitary workers waiting for health check up.

F. Nurse taking BP of sanitary workers

G. General health check up

H. General health check up

I. Eye check up

J. Putting the Narplant on arm of female sanitary workers

K. Questionnaire filling interviewing the Sanitary worker

L. Stool examination in the Laboratory.

## APPENDICES I: QUESTIONNAIRE

(For Sanitary Workers of Bhaktapur Municipality)

1. Name: _____ Age: ____ Sex: _____

Address (Locality): _____ Ward: _____ Caste: _____

Category of work: Driver ( ) Waste Loader ( ) Compositing ( ) Waste Picker ( ) Sweeper ( )

2. Family type: Nuclear ( ) Joint ( ), Number of family members ____

House type: Old ( ) New ( ), Environment of House: Open ( ) Congested ( )

3. Education*:* Literate ( ) Illiterate ( ) Under SLC ( )SLC passed ( )Intermediate ( )

4. Economic Condition of family

Poor ( ) Medium ( ) Good ( )

5. How long have you been in this job?

From <1year ( ) From 1 year ( ) More than year ( )

6. What is your working hour per day: _____

7. While workings do you feel something discomfort to your health?

Yes ( ) No ( )

If yes what kinds of uncomfortable do you feel?

Headache ( ) Irritation ( ) Hesitation ( ) Allergy ( )

8. Before starting the job, did you have any kind of disease?

Yes ( ) No ( )

If yes what type of disease?

Skin disease ( ) Caught ENT disorders ( . ) Gastrointestinal disorders ( )

Respiratory disease ( ) Hepatitis ( ) Other ( )

If yes did you made treatment of that disease?

Yes ( ) No ( )

9. Recently, are you suffering from any kind of disease?

Yes ( ) No ( )

If yes what type of disease?

Skin disease ( ) Caught ENT disorders ( ) Gastrointestinal disorders ( )

Respiratory disease ( ) Hepatitis ( ) Other ( )

10. Where do you prefer for your treatment?

Private Clinic ( ) Health Centre ( ) Hospital ( ) Private medical centre( )

11. How often do you visit the health centers & hospital for general medical checkup?

Once a month ( ) Twice a Month ( ) Only when suffering from disease ( )

12. Are you vaccinated against hepatitis B?

Yes ( ) No ( )

13. Have you even checked your stool before? Yes ( ) No ( )

If yes did you take any medicine? Yes ( ) No ( )

If yes what type of parasite was found? Amoebisis ( ) tape worm ( )

Ascaris ( ) Hookworm ( ) Pin worm ( ) Don't know( )

14. You people are provided the facility of free check up in the health post running from the municipality, are you satisfied with that facility?

Yes ( ) No ( )

15. Do you have practice of using the things for precaution?

Apron ( ) Mask ( ) Gloves ( ) Boots ( )

16. By returning from the field work, do you change the dress? Yes ( ) No ( )

17. By returning from the field work, what would you do?

Take a bath ( ) Wash hands, face & feet ( ) Only wash the hand ( ) Nothing ( )

18. Do you wash your hands before taking food? Yes ( ) No ( )

19. Do you use the soap for washing hands? Yes ( ) No ( )

20. How often do you cut your nail?

One a week ( ) twice a week ( ) Once a month ( )

21. What type of water you drink?

Tab water ( ) Tube well ( ) Well ( ) River ( )Other ( )

22. How often do you take a bath?

Daily ( ) Once a week ( ) Twice a week ( ) Once a month ( )

23. How often do you cut your nail?

One a week ( ) twice a week ( ) Once a month ( )

24. Do you have knowledge about the Health Hazard of solid waste?

Yes ( ) No ( )

25. Did you get any awareness program from the municipality?

Yes/what_____ No ( )

26. Did you get any training for the handling of solid waste?

Yes/what_____ No ( )

Thank You