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The Impact of Medical Wastes Incineration at Governmental Hospitals on the Households in the Surrounding Areas

Submitted by

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The Impact of Medical Wastes Incineration at Governmental Hospitals on the Households in the Surrounding Areas

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قال رسول الله صلى الله عليه و سلم:

"لا ضرر و لا ضرار" حديث حسن.

صدق رسول الله صلى الله عليه و سلم

Dedication

I dedicate this study to the soul of martyrs, who sacrificed their lives for Al-Aqusa Mosque and Palestine.

To the soul of my brother martyr Abdulraheem Hamdona. And to the soul of my uncle Hammed who has been a love, compassion and resort.

To the Palestinian people who are unwavering and patient on the beloved land of Palestine.

To my parents, my brothers and sisters for their endless patience and unwavering support that they have shown to me during this long, arduous study. They have been my largest source of inspiration, empower my career of education and wait my success.

To my wife Faten, my sons Mohammed and Abdulraheem and my daughter Malak, for their endless patience and support that they have shown to me during this process.

Thank you all. From the deepest of my heart, I express to you all my sincere love and appreciations

Abdallah Omer Hamdouna.

Date: November 2010

Declaration

I certify that this thesis submitted for the degree of master is the result of my own research, except where otherwise acknowledged, and that this thesis or any of its parts has not been submitted for higher degree to any other university or institution.

Signed

Abdallah Omer Hamdouna

Date: / /2011

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List of Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
BAN	Basel Action Network
CDDs	Chlorinated dibenzo-p-dioxins
CDFs	Chlorinated dibenzofurans
CO	Carbon Monoxide
CO2	Carbon Dioxide
COMEAP	The Committee On the Medical Effects of Air Pollutants
EPA	Environmental Protection Agency
EQA	Environment Quality Authority
Fe3+	Ferric
GS	Gaza Strip
HCL	Hydrogen Chloride
HCWH	Health Care Without Harm
IARC	International Agency of Research on Cancer
IPCP	Infection Prevention and Control Protocol
Kg	Kilogram
Km	Kilometer
Km^2	Square Kilometer
MOH	Palestinian Ministry of Health
MW	Medical Waste
NGO's	Non Governmental Organizations
NOx	Nitrogen Oxides
PAHs	Polycyclic Aromatic Hydrocarbons

PCBS	Palestinian Central Bureau of Statistics
PCBs	Poly Chlorinated Biphenyls
PCDD	Poly Chlorinated Dibenzo-p-Dioxin
PCDF	Poly Chlorinated Dibenzo-p-Furan
ppm	Parts-per-million
PVC	Polyvinyl Chloride
SO2	Sulfur Dioxide
SPSS	Statistical Package for Social Sciences
SWHS	Seveso Women's Health Status
TCDD	Tetrachlorodibenzo-p-dioxin
UNRWA	United Nations Relief and Working Agency
US	United State of America
USEPA	United States Environment Protection Agency
WHO	World Health Organization

Abstract

This study titled "The Impact of Medical Wastes Incineration at Governmental Hospitals on the Households in the Surrounding Areas" was conducted in the year 2010 in the Gaza Strip. The study aimed at assessing the adverse health impacts on the health status of the population on targeted areas due to the exposure to gases and emissions from medical wastes incinerators.

A descriptive analytic cross sectional study design was used. A self-administered questionnaire was proportionally distributed according to the population density in the study areas to a total sample of 176 subjects. The response rate was 71.5% (126 subjects of 176). About two thirds (80 subjects) of the sample were living around Al-Shifa Hospital area, and one third (46 subjects) near Nasser Hospital area. The SPSS Statistical Package was used to analyze the collected data, in which frequency distribution, Chi square test, medium and stander deviation were used for analyses.

The results revealed that the percentage of fetuses' deaths just before delivery in the targeted areas was 10.3%. Infants' deaths after delivery without knowing the reason in the targeted areas represented 16.7%. The prevalence of chronic diseases represents about 52.4%. The prevalence of congenital anomalies had reached 4.8%. In about 83.3% of the reported congenital anomalies, the conditions were visible, while in 16.7% it was invisible. Chronic diseases presented as follows; Diabetes mellitus '25.2%' of the surveyed population, hypertension '31.7%', heart diseases '15.4%', and the other chronic diseases '27.7%'. Respiratory diseases were reported by 76.2% of the surveyed population as follows; bronchial asthma accounts for 8.6%, chronic bronchitis 10% and allergy accounts for 81.4% of the respiratory diseases cases. Eye diseases reported by 77.8% of all the study population. From all cases affected with eye diseases, 15.8% suffered from redness, 73% suffered from sensitivity and irritation, 11.2% suffered from increase eye secretion.

Skin diseases were reported by 30% of the study population. Kidney diseases were reported by 13.5% of study population while liver diseases were reported by 7.1%. In addition, problems in immune system were reported by 6.3%. Smelling unpleasant odors in their place of residence were reported by 88.9% of the subjects. Around 70% of all participants claimed that there is no specific time for emissions and odors and they reported smelling it continuously. Almost all respondents reported experiencing exaggeration of their diseases with the exposure to the smells and emissions that arise from the incinerators. Also, 89.7% of all study population claimed that there are flying ash and dust around their houses.

The study concluded that the current incinerators produce negative impacts on the health of the people living nearby the hospitals. There is a great need to monitor the health status among those population and to replace the current incinerators with more advanced ones that are environmentally friendly and/or to move them to other areas away from densely populated places.

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Chapter 1

Introduction

Chapter 1 :Introduction

1.1 Background

The environment is an essential element of human life and his activities, the quality of which plays a vital role in human health (Bency, 2003).The human health is very closely associated with the environmental quality, as the etiology of most of the human diseases being related to the status of the living environment of man, and according to statistics, 25% of all preventable illnesses are caused by detrimental environmental factors, in which in Africa, the environmental entrance on disease incidence is even higher, being about 35% (Gopalan, 2003). Environmental pollution is a contamination of air, water or food in such a manner as to cause real or potential harm to human health or well being or to damage or harm non – human nature without justification (Peirce, et al., 1998).

Solid waste including hazardous and medical wastes are considered major sources of environmental pollutants. Medical wastes are considered as dangerous and hazardous material that causes severe threats to human health and environment. The hazardous medical wastes contain several types of pollutants such as radioactive, chemical substances and poisonous materials. They include many types of microorganisms such as viruses and bacteria that can be spread rapidly.

Medical wastes are the second most hazardous wastes after radioactive waste, the improper management of medical wastes (MW) causes serious environmental problems in terms of air, water and land pollution which directly affect all living of life in which the nature of pollutants can be classified to three main components: chemical, biological and radioactive. Accordingly, the main problems face environment can arise from the mere generation of MW and from the process of handling, treatment and disposal (Manyele, 2004). Inappropriate disposal of medical waste including uncontrolled burning of wastes increases the risk of spreading infections and of exposure to toxic emissions from incomplete combustion.

Johnson in 1999 stated that the adverse health effects connected with medical wastes incineration are of great concern as large population groups and workers may be exposed to

derived toxic substances. He added that many of these chemicals are known to be persistent, bio-accumulative, carcinogenic or endocrine disruptors (Johnson, 1999).

Kelly in 1995 claimed that the environmental exposure is associated with many pollutants, so the possible impacts of hazardous waste incineration on human health and the environment should be dealt with scientifically and carefully. Making a scientifically valid connection between the exposures to emissions, from the incinerators and possible resulting disease within a population in the surrounding area, requires the collective efforts of toxicologists, epidemiologists, environmental chemists, physicians, and other disciplines. He added that concerns regarding the potential impacts of incineration need to be addressed and communicated, both accurately and effectively, if the actual risks of incineration are to become widely understood (Kelly, 1995).

The toxics that arise from medical waste incinerators contain organic emissions such as polychlorinated di-benzo-dioxin/furans (PCDD/Fs) and polycyclic aromatic hydrocarbons (PAHs), inorganic emissions and ashes containing toxic metals such as lead, mercury and arsenic. Attempts made by various investigators to reduce emissions have also been included (Singh and Prakash, 2007).

Harris in 2005 explained that arsenic, lead, cadmium, sulfur dioxide, ammonia and benzene, are just some of the many other hazardous pollutants from medical waste incinerators. He added that the heavy metals, cadmium and lead, are common poly vinyl chloride (PVC) additives, and like mercury are neurotoxic, especially to fetuses, infants and young children.

Many studies conducted in the Gaza Strip show that air, soil and water are affected by pollution. The main concern of this study is the air pollution caused by medical wastes incineration and its health impact on the population who are living in the surrounding areas. So the current study aims at evaluating the incineration units that work at governmental hospital and investigating the hazardous effects of the medical waste incineration and its health impacts on the population health of the surrounding areas.

1.2 Problem Statement

Almost all health facilities in Gaza Strip dispose of its medical wastes by incineration. There are two working incineration units located at two governmental hospitals: Al-Shifa in Gaza city and Nasser hospital in Khan Younis city. The two hospitals are located within densely populated areas, which may lead to a direct impact on the human health from the burning of medical wastes and emissions of many gases into the ambient air. In addition to that, parts of the existing incinerators may be not working efficiently.

The main problem emerges as a result of increasing amount of medical wastes from governmental hospital departments, centers, clinics, and diagnostic laboratories. The major hazardous problem is related to the process of medical wastes disposal by incinerating these materials in the two main governmental hospitals and its possible impact on the atmosphere which directly affects the surrounding area of hospitals.

Possible incomplete combustion of medical waste in these units could lead to spread, increase or aggravate some diseases or lead to adverse health effects on the surrounding population besides arising of hazardous emissions from stacks that may affect the population and may put their lives at risk. Based on my fined survey and observations it is noticed that the populations in the surrounding areas of Al-Shifa and Nasser hospitals complain recently from the awful smell and bad odor. Also the dark plumes that arise from the stack with particles settle on building's floors and over the washed clothes.

1.3 Justification of the study

This research aims to study the impact of medical waste incineration on the health of population in the surrounding areas of incineration units. The importance of this study arises from overloading the capacity of the two incinerators at Al-Shifa and Nasser hospitals in Gaza Strip, which are located within densely populated areas and very close to households. These units deal with all medical wastes produced from all governmental health institutions in Gaza strip. Accordingly, studying such cases may lead to improve environmental-health aspects among population and may be used to avoid spreading/increasing some diseases in the area.

1.4 Aim of the study

The aim of the study is to assess the environmental health impacts of medical wastes incineration at governmental hospitals on the households in the surrounding area.

1.5 Specific objectives

- To assess the impacts of incinerator emissions on health of the population in the surrounding area.
- To determine the level of awareness of the environmental health risks of individuals in the surrounding areas to Al-Shifa and Nasser hospitals who might exposed to emissions from medical wastes incinerators at governmental hospitals and its impact on their health.
- To develop recommendations and present them to officials and decision-makers of how the incinerators work in the governmental hospitals and the associated risks.

1.6 Research questions

- To what extent the incineration of medical wastes in the governmental hospitals affect the population health?
- What are the effects of burning medical wastes by incineration on peoples' health?
- Do the emissions that arise from the incinerators increase the complaints of people who suffer from specific diseases such as bronchial asthma?
- To what extent the populations of the surrounding areas are aware of health consequences of medical wastes incineration?
- Does the population around the incinerators have enough knowledge about the hazards that may arise from the burning of medical wastes?
- How the populations living around the incinerators perceive its presence close to their homes?

1.7 Context of the study

The context of this study contains background information about the study area and the variables that influence this topic. The context involves also socio-economic, demographic variables, and health care system which is related to medical waste incineration at governmental hospitals and its impact on the household in the surrounding area.

1.7.1. Demographic context:

Palestine is located in the heart of the Arab countries, even though it is relatively a small country. The total surface area of historical Palestine is about 27.000 Km^2. Palestine is occupied in 1948 by Israel. Since that time most of the Palestinians are living in two separated geographical areas: West Bank and Gaza Strip after the war of 1967. The total area of Gaza Strip is about 378 km^2 and the West Bank is about 5879 Km^2 with total population living in is about 3,762,005 individuals with 6257 Km^2 per capita (MOH, 2006).

Gaza strip is considered as a very narrow piece of land along with the Mediterranean Sea, with a narrow section about 378 Km^2 (UNEP, 2003). Just 40 km long and 10 km wide. Gaza strip is divided into five governorates: the North, Gaza, Deir El Balah, Khan Younis and Rafah governorate. It is considered as one of the most populated areas in the world (4054 person/Km^2) with an estimated population of about 1.5 million according to February 2007 estimates of PCBS (Palestine Central Bureau of Statistic, 2007).

Gaza Strip is one of the highest population densities in the world that increases the overload on hospitals and health care centers which stress and increase the demand for health services, and resulted in an increase in the amount of medical wastes. The increase of medical wastes will increase the demands for disposal by incineration. Therefore it is necessary to manage medical wastes properly in accordance with international standards of safety and security of the population neighboring the incinerators in governmental hospitals.

1.7.2. Socio-economic and political context:

Gaza strip is under hard situation due to different constraints, including political and economical closure after the Palestinian elections in 2006. The Israeli closure to Gaza Strip, which have had an intensely negative impact on public health and access to basic health care services. The last Israeli aggression against Gaza in 2009 in December 2008-January 2009 resulted in hundreds of fatalities and thousands of injuries; and further badly affect the already weakened state at all health sectors in the Gaza Strip. Medical supplies were in very short supply and health facilities were often not able to treat the sick during the crisis, also severe scarcity in all medical devices replacement (World Bank, 2008). For this reason there are two incinerators only that are working in governmental hospitals.

After the war on Gaza, due to unorganized flow of medical assistance, huge amount of such medical supplies and disposables were incinerated by MOH at Gaza Strip because of its invalidity or expiry date. This led to an increase in the amount of medical waste that need incineration process, and in turn, led to a waste gases emitted into the air and to the atmosphere that could adversely affect the life and health of the surrounding inhabitants.

In Palestine, the concern about medical waste is recent and its disposal and treatment are still very weak and not efficient enough as it should be. This may be attributed to political, social and economic reasons (Abu-Awwad, 2008).

1.7.3. Health Care Context:

Health care system in Palestine is considered as a complex work with multi providers interacting with each other (MOH, 2006). Governmental hospitals in Gaza strip are considered as the main health institutions that provide health care services for patients, where the main duty of hospitals and healthcare centers is providing care of public health. Health care service in Palestine is divided into five types of health care providers: two public providers, the Ministry of Health and the Ministry of Interior (Military medical service), multiple private providers (hospital, clinics and centers) and various NGO providers (the United Nations Relief and Works Agency and other non-profit institutions). UNRWA takes its place and operates an extensive network of outpatient services for the

registered refugee population following 1948 (World Bank, 2008). The MOH provides a complete package of primary, secondary, and tertiary health care services.

1.8 Al-Shifa and Nasser Hospitals

1.8.1. Al-Shifa hospital:

Al-Shifa hospital is considered as the largest hospital in Gaza Strip, which contains different departments and units. It is the first hospital to receive patients and critical cases, especially during emergency situations. It was established on 1946 on an area of 45,000 square meters, the hospital contains 503 hospitalization beds (MOH, 2005) distributed in different sections, such as burn unit, intensive care unit, internal medicine, neonatal department, and obstetric/gynecology and surgical department (MOH, 2009). The bed occupancy rate has reached 77.4% and the average duration of stay was 2.8 days in general (PCBS, 2007).

1.8.2. Nasser hospital:

Nasser Governmental Hospital is located in Khan Younis city, south of Gaza Strip. It is the second largest hospital in Gaza Strip governorates. And it provides health services to the southern Gaza Strip population. The hospital contains 277 hospitalization beds distributed in different sections (MOH, 2005). The most important services provided by this hospital are offered through the main units such as: delivery, laboratory, radiology, physiotherapy, outpatient, emergency, department of dialysis, x-ray and internal department. It also contains the pediatric hospital (Mubarak hospital) which is a specialized hospital mainly for children, and contains 151 hospitalization beds (MOH, 2005).

Chapter 2

Literature review

Chapter 2: Literature review

2.1 Definitions

2.1.1. Environment:

The vital surrounding with all forms of life including air, water, land, the facilities and the reactions among them (Palestinian Environmental law, 1999). The all elements, factors and conditions in the surroundings which may have an impact or interaction among each other on the development, deed or survival of an organism or group of organisms (www.medterms.com). It is an environment that includes the interaction between all living species and contains all living and non-living things that are occurring naturally on earth or some region thereof. (Johnson, et al., 1997).

2.1.2. Environmental pollution:

Any direct or indirect changes in the characteristics of the environment, that may cause harm to any of its components or disrupts its natural balance (Palestinian Environmental law, 1999). Environmental pollution is considered as the contamination of air, water or food that may cause real or potential harm or threats to human health or well-being, damage or harm non human nature without justification (Peirce, et al., 1998).

2.1.3. Medical waste:

WHO defines medical or healthcare wastes as the total waste that disposed from healthcare establishments, research facilities, laboratories, and emergency relief donations. In addition, it includes the waste originating from minor or scattered sources such as that produced in the home such as dialysis, insulin injections, etc. (WHO, 1999). Medical waste is defined as the waste generated from health-care establishments, such as hospitals, primary healthcare centers, private clinics, research facilities , laboratories used in diagnosis, monitoring, and prevention activities (curative or palliative) drugs in the field of human and veterinary medicine including infectious hazardous materials and human body parts (Massrouje, 2001 and Silva, et al., 2002). Very broadly medical waste is defined as any solid or liquid waste

that is generated in the diagnosis, treatment or immunization of human beings or animals (BAN and HCWH, 1999).

2.1.4. Medical wastes incinerators:

Medical wastes incinerators are waste treatment technology that involves the burning of organic materials and/or substances. In addition to that incineration and other high temperature waste treatment systems are illustrated as "thermal treatment"(Knox, 2005). The incinerator is considered as a machine that use high-temperature dry oxidation process to reduces organic and flammable waste into inorganic, incombustible matter that lead to significant reduction of waste volume and weight (www.chmics.org).

2.1.5. Incineration process:

Incineration process is considered as the procedure that convert solid and liquid toxic waste into gaseous emissions and particulate matters in which the acid gases (e.g. hydrogen chloride, nitrogen oxides and sulphur dioxides), can cause acute effects such as eyes and respiratory irritation, can contribute to acid rain, and may enhance the toxic effects to heavy metals, while the particulate matter can cause chronic health effects; even burning of chlorine made material e.g. PVC, creates dioxin that is considered as a human carcinogen (Pruss, et al., 1999).

Incineration process change the medical waste materials inside the incinerator to: bottom ash, flue gases, particulates, and heat, which can in turn be used to generate electric power (Knox, 2005). Incinerators convert some of the waste into emissions and ashes, some of these ashes may contain high concentrations of toxic substances such as heavy metals, creating a major pollution problem for future generations (Thompson, and Anthony, 2008). This process is usually preferred to treat wastes that can not be recycled, reused or disposed of in the landfill site due to its hazardous issue; this process produces gaseous emissions and toxic substances that should be treated to avoid adverse health effects on human and environment (www.chmics.org).

2.1.6. Health:

Health was defined by MOH as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (WHO, 1948).

2.1.7. Hazardous waste:

Waste generated by the various activities and operations or the ash thereof, which preserve the characteristics of hazardous substance which have no uses, such as atomic waste, medical waste, or refuse emanating from manufacturing of pharmacological products, medicines, organic solvents, dyes, painting, pesticides or any other similar substance (Palestinian Environmental law, 1999). Hazardous waste can be defined as a waste that may, by special state of use, quantity, concentration or inherent physical, chemical or infectious characteristics, cause ill health, disease or increase morbidity and mortality in humans, or adversely affect the environment directly or indirectly when improperly treated, stored, transported or disposed (Godfrey, 2003).

2.2 Medical waste

In the recent years, the production of medical waste in Palestine, as many other nations in the world, has become a serious problem that is considered as a dangerous issue which had a bad impact on population health and the environment (Miyazaki, et al., 2005). And also in Palestine, concern about medical waste is recently considered and still not enough as it should be, which may be attributed to political, social and economical reasons (Abu-Awwad, 2008).

Large quantity of medical wastes is generated from all health sectors that produce health services in Gaza Strip every day. The improper disposal of medical wastes creates an increasing problem that needs to be addressed. Because of the increase of medical wastes and improper treatment, management and disposal of these hazardous materials directly leads to environmental pollution and hazards may take place to the environmental components which lead to bad health to all living kinds.

Slight attention has been directed to the proper management and disposal of this hazardous and harmful waste. Therefore, medical waste is considered as one of the major hazards that affect consequently the environment and the health of human beings who may deal or be exposed to these wastes. The improper management of this waste may create health hazards through transmission of diseases or contamination of soil and groundwater in addition to poisonous emissions from improper burning of medical waste (Ja'al, 2003). However, in developing countries, medical wastes have not received sufficient and adequate attention, in which many countries are still handle and dispose of the hazardous and medical wastes together with domestic wastes, thus creating a great health risk to municipal workers, the public and the environment (Silva, et al., 2002).

Health-care waste consists of all waste generated by health-care establishments, research facilities, and laboratories (Pruss, et al., 1999). Inappropriate management of medical wastes may cause health hazards through spread of diseases, not only to health workers and their families, but also to the patients and their relatives, moreover to the population who are living in the surrounding area of hospitals, especially children whose play activity and mouthing behavior increases their contact with medical waste, thus exposing them to injuries and infections (Johnson, 1999).

Wastes from radioactive isotopes and gene-toxic treatment may cause health risks and severe injury to human health (Pruss, et al., 1999). In addition to health hazards that affect the human kind, environmental hazards have to be considered and may be affected, such as the contamination of soil and groundwater and poisonous emissions from improper burning of medical wastes (Halbwachs, 1994). In the long term, medical wastes can not only damage the quality of life of the community, but can also affect the welfare of the entire population and the national economy (Massrouje, 2001 and Silva, et al., 2002).

Medical wastes are classified as a one source of contamination and pollution to both humans and the natural environment, in which they are potentially capable of causing diseases and illnesses in man, either through direct contact or indirectly by contamination of soil, groundwater, surface water and air, furthermore wind blown dusts and particulate matter from these incinerators also have the potential to carry pathogens and hazardous emissions. Therefore medical wastes pose a risk to individuals, communities, and the environment if not carefully handled (Akter, et al., 1998).

2.3 Classification of medical waste

Classification of medical waste may be sorted into different classes according to their source, type and risk factors associated with their handling, storage and ultimate disposal.

2.3.1. WHO classification:

According to WHO in 1999, medical or healthcare waste was classified into the following:

- **Pathological waste:** consists of tissue, organ, body part, human fetuses, blood and body fluid. It is hazardous waste.

- **Infectious waste:** the wastes that contain pathogens (bacteria, viruses, parasites, or fungi) in adequate concentration or quantity that could cause diseases. It is hazardous e.g. culture and stocks of infectious agents from laboratories, waste from surgery, waste originating from infectious patients.

- **Sharps:** are waste materials which could cause cut or injury to the person handling it, e.g. needles, broken glass, saws, nail, blades, and scalpels. Whether or not they are infected, such items are usually considered as highly hazardous healthcare waste.

- **Pharmaceutical waste:** this includes pharmaceutical products, drugs, and chemicals that have been returned from wards, have been spilled, outdated, expired or contaminated.

- **Genotoxic wastes:** are highly hazardous wastes and may have mutagenic, teratogenic, or carcinogenic properties. Genotoxic waste may include certain cytostatic drugs, vomit, urine, or feces from patients treated with cytostatic drugs, chemicals, and radioactive material.

- **Chemical waste:** this comprises discarded solid, liquid and gaseous chemicals e.g. cleaning, house keeping, and disinfecting products.

- **Radioactive waste:** it includes solid, liquid, and gaseous waste that is contaminated with radio-nuclides generated from in-vitro analysis of body tissues and fluid, in-vivo body organ imaging and tumor localization and therapeutic procedures.

- **General and non-hazardous waste:** it consists of chemicals with none of the above properties, such as sugars, amino acids, and certain organic and inorganic salts. Largely composed of domestic or house hold type waste. For example these wastes arise after eating. It is non-hazardous to human beings, e.g. kitchen waste, packaging material, paper, wrappers, and plastics.

2.3.2. Eigenheer and Zanon classification:

Other classifications were done for hospitals waste by Eigenheer, E. and Zanon, U. (1991), in which they classified medical waste according to their liquid and solid state. The European Union has been making a special effort to standardize waste classification through the establishment of the Waste European Catalogue (Alvim-Ferraz, M., Afonso, S. 2005).

2.3.3. Portuguese legislation classification:

Furthermore, other classification for medical wastes was done: classified according to their type, source and risks factors associated with their handling, storage, collection and final disposal. Portuguese legislation classifies the waste stream produced through medical activities into four groups: (Alvim-Ferraz, and Afonso, 2003)

- Group I: like municipal wastes (MW).
- Group II: non-hazardous medical waste that does not require specific treatment and can be considered as group I.
- Group III: medical waste with biological risks that must be pre-treated before elimination as MW.
- Group IV: specific medical wastes which need essential incineration.

The researcher conclude that, all of these classifications are focus on the type, source and risks factors associated handling, storage, collection and final disposal of medical waste.

2.4 Quantity of medical waste

The total quantities the medical wastes generated vary from hospital to hospital and depend on the type of health care facility and local economic condition. High income countries can generate up to 6 kg of hazardous medical wastes per person per year. The majority of low income countries health care wastes are usually not separated into hazardous or non hazardous waste. In these countries the total health care waste per person per year is anywhere from 0.5 to 3 kg (WHO, 2007a). For example, China produces around 650,000 tons of medical waste per year. This is growing from 19% to 25% per year, in which the amount of medical waste per capita in China is at present about 8 to 10 times lower than that in western countries (Run-dong, et al., 2006).

Palestinian health care centers produce about 426 tons of solid waste per month, including 288 tons in the West Bank and 138 tons in Gaza Strip. The total estimated quantity produced by the secondary health care centers in Palestine is about 121 tons (PCBS, 2006). According to the WHO report in 2005, the amount of waste generated from hospitals in Palestine was estimated at:

- For small hospitals 1 kg/bed/day.
- For general hospitals 2 kg/bed/day.
- For educational hospitals 4 kg/bed/day.

2.5 Medical waste management

Medical waste management is a process that ensures proper hygiene in the health institution and safety of healthcare workers and communities (Sanitation Connection, 2002). The proper management of medical waste can minimize the risk that arises from medical wastes within and outside healthcare facilities (Johannessen, et al., 2000).

In the West Bank and Gaza Strip, open burning is considered the common disposal process of medical wastes, by using incinerators. The residents around incinerators are exposed to health and environmental risks because of improper disposal of medical wastes and steps are needed to improve the situation through the establishment and enforcement of laws, provision of the necessary infrastructure for proper waste management and training of healthcare workers and cleaners (Al Khateeb, 2007).

2.6 Medical waste treatment and disposal protocols in Palestine

In 2004, the Palestinian Ministry of Health (MOH) has developed a number of protocols that help to promote and strengthen the system of primary care and health in Palestine, it is known as: Infection Prevention and Control Protocols (IPCP).

According to IPCP, 2004, the proper waste disposal is summarized in:

- Limiting the spread and transmission of infection and disease among health care providers and workers who deal with waste in addition to the local community.
- Providing the necessary protection for those who deal with medical waste from unintentional injury, such as scavengers.
- Providing healthy and safe environment.

2.7 Medical wastes treatment and disposal methods

The most common treatment and disposal methods used in the management of healthcare wastes in developing countries are: autoclaves and retorts; microwave disinfection systems; chemical disinfections; combustion or incineration with low, medium, and high technology; and disposal on land such as dump site, controlled landfill, pits and sanitary landfill (Diaz, et al., 2005). These are briefly discussed as in the following subsection:

2.7.1. Autoclaves:

Generally this method is used to treat some of medical materials, such as: sharps, cultures, items contaminated with blood, residues from surgery, bandages, gauze, linen, gowns,

other similar materials and non-chemical laboratory wastes. In some special circumstances, it is technically possible to sterilize body parts. In which, in case of items with a large mass, care must be taken to achieve the necessary time-temperature relationships. In addition to that, any time that body parts are treated in autoclave, cultural, ethical, legal, and other factors must be taken into consideration (Abor, 2007).

2.7.2. Microwave disinfection systems:

This is another method of medical wastes disposal that application of exposing the wastes of a high energy of electromagnetic field that provokes the liquid contained within the waste, as well as the liquid cell material of microorganisms, to oscillate at high frequency, heat up rapidly and eventually cause the destruction of all infectious components of the waste (Johannessen, et al., 2000).

2.7.3. Chemical disinfection:

Chemical disinfectants generally are used to treat medical materials as describe in autoclave method. Healthcare facilities also produce a variety of chemical and hazardous substances that should not be treated with chemical compounds. These types of wastes include: wastes from chemotherapy treatment, mercury, volatile and semi-volatile organic compounds, radioactive wastes, and other hazardous chemical wastes. Generally, it is not advisable to treat large some of these hazardous material, because of their mass and other characteristics that make it difficult or costly for the entire material to be properly treated (Abor, 2007).

2.7.4. Land disposal:

Land filling or dumping of medical waste is carried out in the same method as municipal solid waste. Generally, land disposal of medical solid wastes can be divided into three methods: open dumps, controlled landfills, and sanitary landfills. Landfill is the site where the wastes are deposed of in a specially designated area, which in modem sites consists of a pre-constructed 'cell' lined with a resistant layer (natural or man-made) and provided with controls to minimize emissions (Diaz, et al., 2003).

2.7.5. Incineration process

This method of medical wastes disposal is our concern in this study.

2.8 Medical wastes incinerators

The first incinerators for waste disposal were built in Nottingham in England by Manlove Alliott in 1874 according to a design patented by Albert Fryer. They were originally known as destructors (Herbert and Lewis, 2007).

The burning process is a complex technology that is used to burn waste. The problem of medical waste is one of many problems facing governments in most countries; it is increasing with increased use of disposables in medicine. The most important of medical waste, is burning plastics and like substances, especially in the unregulated burning plants where it will lead to negative effects for all sorts of life, particularly due to the odor they emit. Medical waste incineration is a process of converting a biological problem to a chemical problem.

Medical wastes incinerators create ash that is potentially hazardous. In the United State (US.) medical waste incinerators have become less common; however the technology is still being exported (Gonzaga, 2006) . Incinerators are designed especially for treatment of health-care waste and should be operated at temperatures between 900 and 1200° C (Pruss, et al., 1999). Akter (2000) claimed that incineration has a particular health concern since it is not only destroys the pathogen but also the material on which the pathogen live in. Thus, those materials go under a process of transformation and dematerialization (Akter, 2000).

Thompson and Anthony (2008), explain that incinerators produce pollution to the environment by releasing many pollutants into the atmosphere. So, there are concentrations of the major chemicals emitted from the incinerators, which is only a branch of the problem. They added that many of these chemicals are both toxic and bio-accumulative, building up over time in the body in a dangerous mode with the risk of chronic effects at much lower exposures. The incinerators of medical wastes must be controlled and validated by permanent monitoring of operating parameters that include physiochemical ones through

measurement of pollutant concentrations in effluent gases in addition to biological tests (Blenkhnn, 2005).

2.9 Medical wastes incinerators in Gaza Strip

According to the researcher filed survey there are five incinerators located in governmental hospitals in Gaza Strip: two at Al-Shifa hospital, one of them is working and the other is not, one incinerator at Nasser hospital, one at Gaza European hospital which does not work efficiently, and the last one at Specialized Pediatric Hospital which is turned off. Accordingly this study will focus on the two operating incinerators located at Al-Shifa and Nasser hospitals in Gaza Strip.

All incinerators in the governmental hospitals in Gaza Strip are of the same type and named as (Kalfrisa), they were donated by the Spanish Government to 12 governorates in 1996. Only three were installed, in Shifa hospital, and Nasser hospital in Gaza as well as a third in Jericho, and started to work in 1996. The others were not installed because of a lack of coordination between Spanish Government with MOH. They were observed to work at temperature 600-850°C and they never reach 1200°C. The height of the stack is 8 meters from the ground, the incinerators were supplied without pollution control equipment (World Bank, 2004).

2.10 Advantages and disadvantages of incinerators

The major advantages of medical waste incineration are considerable as a reduction in the volume of material, and destruction of pathogen and hazardous organics, in addition to that, optional and easy process and heat recovery is possible. The main disadvantages are that incineration may emit trace amounts of unwanted pollutants such as polychlorinated dibenzo-p-dioxin (PCDD) and polychlorinated dibenzo-p-furans (PCDF), in addition to acidic gases and heavy metals, and it generates an ashe residue that needs safe handling and land filling (Johannessen, et al., 2000).

2.11 Impacts of medical wastes incineration on health and environment

The hazardous issues of medical waste incineration and its emission could affect the environment and health status of population at the surrounding area to governmental hospital especially those who are living within the hazardous zone which is estimated to be a distance of less than 500 meters.

In South Africa, for example, medical wastes are seen as a mounting of problems. Recently, in this condition negative health effects affected the poor population of society and the incineration of medical waste has also caused much concerns. For instance, about 45% of healthcare waste generated in the region of KwaZulu-Natal alone cannot be accounted and indicating that it is being illegally dumped, buried or burnt in unknown locations, thus affecting the health of the people and the environment (Leonard, L. 2004). Some studies have pointed out that medical waste incinerators have been associated with a wide variety of health problems in South Africa, such as disrupting the bodies' hormonal, immune and reproductive systems, and even caused cancers (Groundwork, 2002).

Incineration of plastic, paper, metals and another materials leads to generate large amounts of particulate matter, emissions and heavy metals, as well as dioxins and furans. In addition, the final process residues in the bottom fly ashes containing high levels of heavy metals and dioxins also constitute a serious health and environmental problem and take its impact on air, water and soil (Peirce et al., 1998).

The primary hazard with medical wastes incineration is the toxic chemicals in the emissions from stack, and according to the EPA, medical waste is the third leading source of dioxin emissions in the US and the fourth leading source of mercury emissions (USEPA, 1998). Heavy metals and dioxin may be dispersed over a wide area, settling on the food we eat and the water we drink (USEPA, 1997). The hospitals in Pakistan are creating a large quantity of medical waste which is mainly managed by burning it in incinerators and burning of medical waste pollutes the environment by fly ash and toxic metals (Sabiha, et al., 2008).

Harris in 2005 stated that the reality of incinerators doesn't eliminate toxic substances, but they concentrate them. He added that, the toxics in lead to toxics out, in which the heavy metals, mercury, lead and cadmium, don’t just disappear; they are basic elements not

destroyed by burning and they are still present after incineration, only concentrated in the ash and released to the air from the stack. In addition to that, all the trash that enters the incinerator, 30% remains as ash at the end of the process, so that's a great deal of very toxic ash exists in the incinerator (Harris, 2005).

Many researches were conducted to identify the effects of medical wastes incineration on the health of population who are living in the surrounding area; a majority of such researches had proven the relationship between the incineration process and the negative health consequences due to the dangers of such emissions from the incinerator after combustion of medical wastes. Furthermore, all of them identified that the main particles, emissions or gases emitted to the atmosphere include dioxins, furans, CO2, hydrocarbons, SO2, HCl, CO and NOx, beside heavy metals, such as lead, cadmium, arsenic, chromium, nickel and so on, which are compounds that are present for example in plastics.

2.12 Pollutants from burning of medical waste

It is documented that the most important emissions and pollutants that usually produced from medical waste burning are: particles, heavy metals, mercury, carbon monoxide, dioxins, sulfur oxides, nitrogen oxides, hydrogen chloride, (mainly small particles), and volatile organic compounds (Chen, et al., 2001; Ficarella, and Laforgia, 2000).
The researcher discusses the following pollutants:

2.12.1. Particulate matter:

Particle is the common term used for dust particles in the air. And these particulates or molecules consist of materials and organic compounds containing sulfur, nitrogen and metals, in which emitting these particles in the air irritate the respiratory tract when inhaled and result in increased exposure for long periods to cases of chronic respiratory diseases (www.se.gov.sk.ca). In addition to that, exposure for long period of time to these components affect human health and may cause many diseases, particularly heart disease, blood vessels, lung cancer and may lead to death (COMEAP, 2009, COMEAP, 2006, Krewski, et al., 2000).

Exposure to short or long term periods of such particles could expose humans to the serious health damage (WHO, 2006). Accumulation of many heavy metals after the burning process in the bottom of incinerator are associated with fly ash, in which control of these particles and emissions after the burning process in high-income countries is limited and therefore works in a limited way to reduce the components that create air pollution that leads to cancer risk. And the same is not true in developing countries where many of the incinerators, which are built with short chimneys that do not control volatile particulates, workers and people living in the direction of the wind out of the incinerator are exposed to increased health risk from respiratory diseases, as well as increase in the risk of cancer (www.se.gov.sk.ca and Rahkonen, 1992).

Short-term exposures to pollutants including particulates are linked to and with strong relationship between negative health effect and the increase of the concentration of these substances. That may cause the increase in deaths from heart attacks and respiratory diseases in addition to increased frequency and hospitalization due to the irritation of some diseases and special cases of respiratory chronic conditions such as crisis and weakening of the efficiency and function of the lungs (Goldberg, et al., 2002).

2.12.2. Heavy metals:

The main metals that emitted from the incinerator plants include: cadmium, thallium, lead, arsenic, antimony, chromium, cobalt, copper, manganese, nickel and mercury. Exposure to these metals is associated with a range of adverse health effects that affect all body systems, particularly metals that have been reported to be associated with kidney disease, respiratory diseases, cardiovascular damage, blood effects, and neurotoxicity (Johnson, 1999)

As mentioned earlier the population less than 15 years old in Gaza Strip represents about 49% of total population (MOH, 2006). This group of population is not only considered the largest percentage of the population in Gaza Strip but also the most venerable for bad health effects due to exposure to medical wastes incineration emissions. The heavy metals, cadmium and lead, are common PVC additives, and like mercury are neurotoxic, especially to fetuses, infants and young children (Harris, 2005).

2.12.3. Mercury:

Mercury is considered as a heavy, silvery-white metal, and when compared to other metals, it is a poor conductor of heat, but a fair conductor of electricity (Hammond, 2000). In addition to that, Senese in 2007 claimed that it is one of six chemical elements that are liquid at or near room temperature and normal atmospheric pressure (Senese, 2007). Exposure to mercury or any of its compounds, leads to a state of intoxication. It has multiple forms and all of them poisonous and dangerous and may lead to adverse health effect, even with low doses. Mercury exists in several cases, including vapor, solid or liquid in which its toxicity effects include damage to the brain, kidneys and lungs (Clifton, 2007). According to the EPA in 2006, there are three chemical forms that exist for mercury, and each of them has its specific effects on human health where these forms are: Methyl mercury, elemental mercury and other mercury compounds (inorganic and organic) (EPA, 2006).

Mercury poisoning can result in several diseases, including acrodynia (pink disease), Hunter-Russell syndrome, and Minamata disease (Davidson, et al., 2004). Mercury is found in various thermometers, blood pressure cuffs, and esophageal dilators, measurement devices in medical laboratories, fluorescent lighting, and batteries. In addition, thermometers used in homes account for 10 percent of the mercury in the municipal waste stream. Mercury is a potent neurotoxin, especially for the newborns, infants, and children. More than 15% of women of childbearing age are exposed to mercury levels high enough to put their newborns at risk of irreversible neurological and developmental damage. Fetal exposure to mercury can cause mental retardation, learning disabilities, concentration deficit, disturbances of gait and impairments of language and memory (Harris, 2005).

2.12.4. Carbon Monoxide (CO):

Carbon monoxide (CO) has the following physical and chemical characteristics: colorless, odorless, tasteless and considered as highly toxic gas, which may be released from the incomplete combustion of wastes. The molecule of (CO) consists of one oxygen atom and one carbon atom attached to each other by a covalent double bond and a dative covalent bond. In addition to that the main starting place for poisoning occurs after the inhalation,

where it is very difficult for people to detect it because it is non-irritating, and exposures at 100 ppm may lead to life threatening (Ernst, and Zibrak, 1998). Carbon monoxide is combining with hemoglobin in the blood to form carboxyhemoglobin and hence decreases or prevents binding with oxygen, so anoxemia gradually occurs (Buckley, et al., 2005).

Blumenthal identified that the most common symptoms due to exposure to CO poisoning as: flu-like symptoms, which include headache, nausea and vomiting, dizziness, lethargy and a feeling of weakness. In addition, infants may be irritable and feed poorly. Moreover neurological signs include confusion, disorientation, visual disturbance, syncope and seizures (Blumenthal, 2001). Many countries in the world complain of fatal poisoning due to exposure to carbon monoxide poisoning (Omaye, 2002).

Carbon Monoxide is formed naturally in the human body as a result of normal metabolism process, breakdown of heme occur (a part of the hemoglobin molecule) by the enzyme hemeoxygenase to CO, biliverdin and a Fe3+ action. Producing CO may have important physiological roles in the body, such as a neurotransmitter or a blood vessels relaxant. It provides many effects on the body systems such as cardiac protection in the circulatory system. It also has roles in the immune, respiratory, reproductive, and gastrointestinal systems, as well as in the kidneys and liver. Because of its expansive role, abnormalities in CO metabolism have been linked to a variety of disease processes, including neurodegenerations, hypertension, heart failure, and inflammation (Wu, and Wang, 2005).

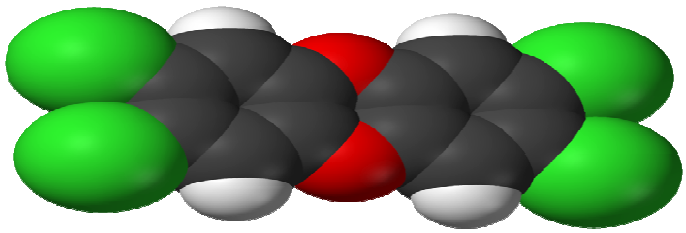
2.12.5. Dioxin and furans:

Dioxins are the most serious environmental pollutants, and a source of great concern to being highly toxic, and when it enters the human body remains for a long time. Because of their chemical stability to be absorbed by the adipose tissue where it is stored (WHO, 2007b). Some pollutants are classified as biodegradable and non-biodegradable. Dioxins are considered as non-biodegradable pollutants that persist for long period in the environment (Peirce, et al., 1998). The U.S. Environmental Protection Agency estimated that the incineration of medical waste is the third largest source of dioxin air emissions (USEPA, 1998).

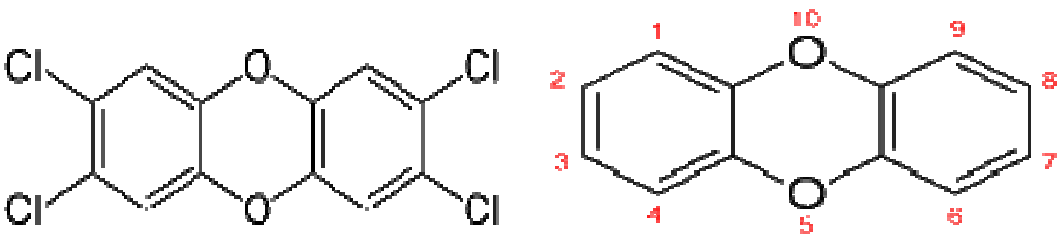
Chemically the term dioxins, refers to polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzo-p-furans (PCDFs) and other related chemical compounds like polychlorinated biphenyls (PCBs). Chlorine atoms can attach to 8 different sites of the molecule, the toxicity of the dioxins depends on the number and the position of chlorine atoms (Green facts, 2000). In addition, it is a group of chemicals that have the structures of compounds which are characterized by the attributes of some substances in terms of chemical and biological properties, which includes 75 different chlorinated dibenzo-P-dioxins (CDDs), 135 chlorinated dibenzofurans (CDF) and some polychlorinated biphenyls (PCBs). The most toxic one which was and studied widely refers to 2,3,7,8 - tetrachlorodibenzo-dioxin, simply 2, 3, 7, 8- TCDD, or TCDD dioxin (Halden, 2004).

Chemical structure and space filling model DIOXINS and 2, 3, 7, 8-TCDD

Space-filling Model 2, 3, 7, 8-TCDD



Dioxins Skeleton



Source: http://en.wikipedia.org/wiki/Dioxins

Figure 2.1: Chemical structure and space filling model dioxins and 2, 3, 7, 8-TCDD

Many studies have shown that there are clear correlations between dioxin formation and chloride content and indicate that PVC is a significant contributor to the formation of both dioxin and PCB in incinerators (Katami and Takeo, et al., 2002; Wagner, and Green, 1993).

Chlorine atoms can join to 8 different sites of the molecule, so dioxins depend on the position and number of chlorine atoms to play a vital role of its toxicity. The more chlorine atoms added to 2, 3, 7, 8-TCDD structure are the more toxic, but to a lesser amount of dioxins that are water insoluble but have great affinity to fat. Also they tend to associate with organic matters such as soil, ash and plant leaves (Green facts, 2000).

2.13 Dioxin as a main pollutant

Dioxin is considered as one of the most organic compounds, which act on the contamination of the environment, and sometimes referred to one of the most toxic substances. It has dubious distinction of belonging to the dirty dozen a group of persistent organic pollutants (included in Stockholm convention on persistent organic pollutants).

2.13.1. Sources of Dioxins:

Dioxin has existed in the nature prior to industrialization in low concentrations due to natural combustion such as forest fire and geological processes as volcanoes. The first accidentally produced dioxin was in the year 1848 onwards as Leblanc process plants started operating in Germany (Weber, et al., 2008). The first intentional synthesis of chlorinated dibenzodioxin was in 1872. Today, concentrations of dioxins are found in all humans, with higher levels commonly found in persons living in more industrialized countries. The most toxic dioxin, (TCDD), became well known as a contaminant of Agent Orange, an herbicide used in the Vietnam War (Schecter, et al., 2006).

Man-made dioxins are produced during the manufacturing of organic chlorides, and during the incineration of chlorine containing materials e.g. polyvinyl chloride (PVC) and in lightening of paper. The natural sources of TCDD include forest fire and volcanoes (Milton, 1987).

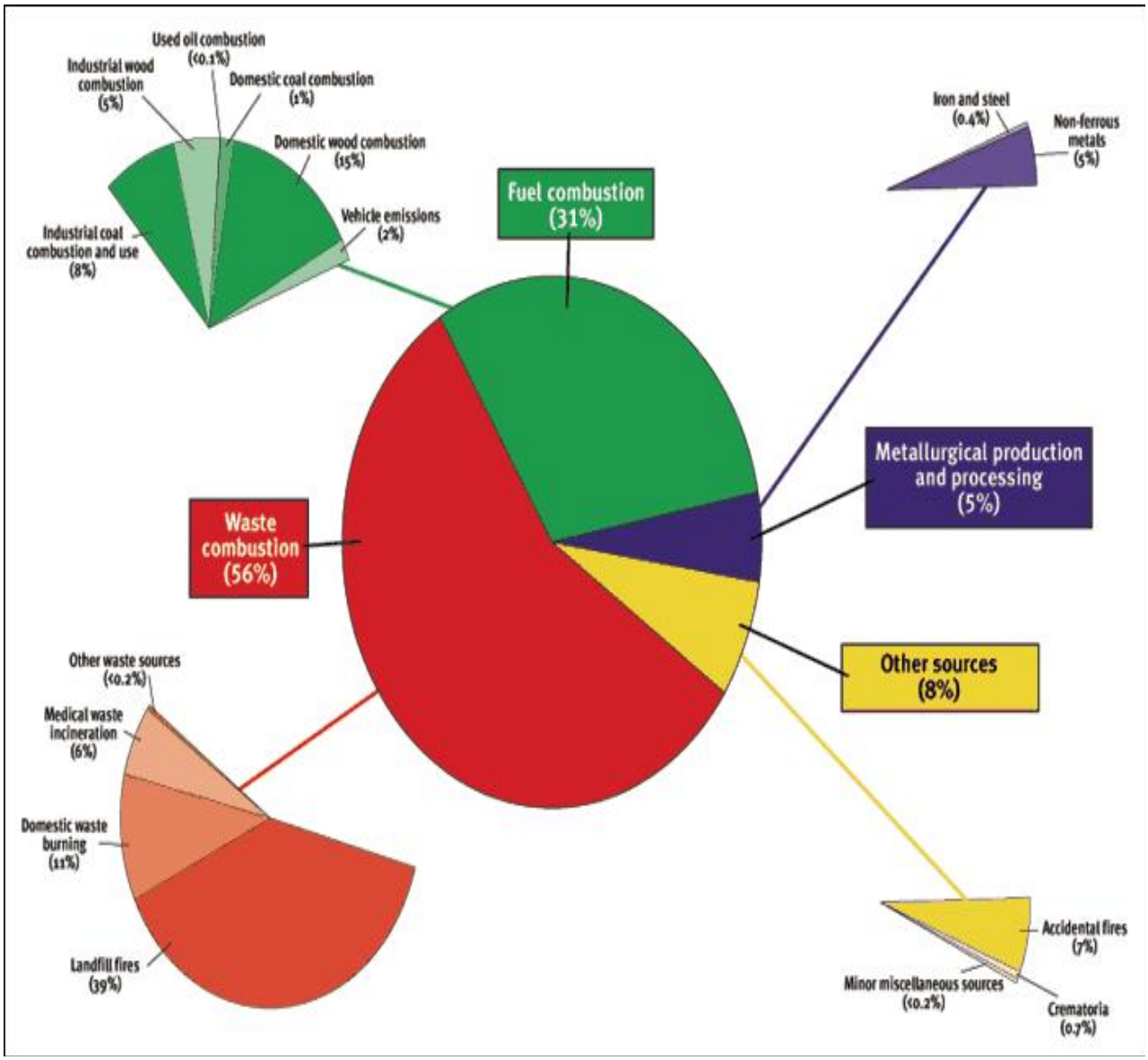


Figure 2.2: Sources and Relative Sizes of Dioxin Discharges to Air in New Zealand

Source: Ministry of Environment. New Zealand Web site 2009. As cited in (Ramadan, 2009).

Dioxins are unintentionally produced but can not be avoidable, that produced during the manufacture of materials containing chlorine, PVC and other chlorinated plastic feedstock (Carroll, et al., 2001). There are other sources for the production of dioxins emitted into the air and polluting the environment, as example the waste incinerators (such as solid waste and hospital waste), and are often the worst offenders, due to incomplete burning (WHO, 2010).

2.13.2. Factors affecting the severity of dioxins toxicity according to (ATSDR, 2006):

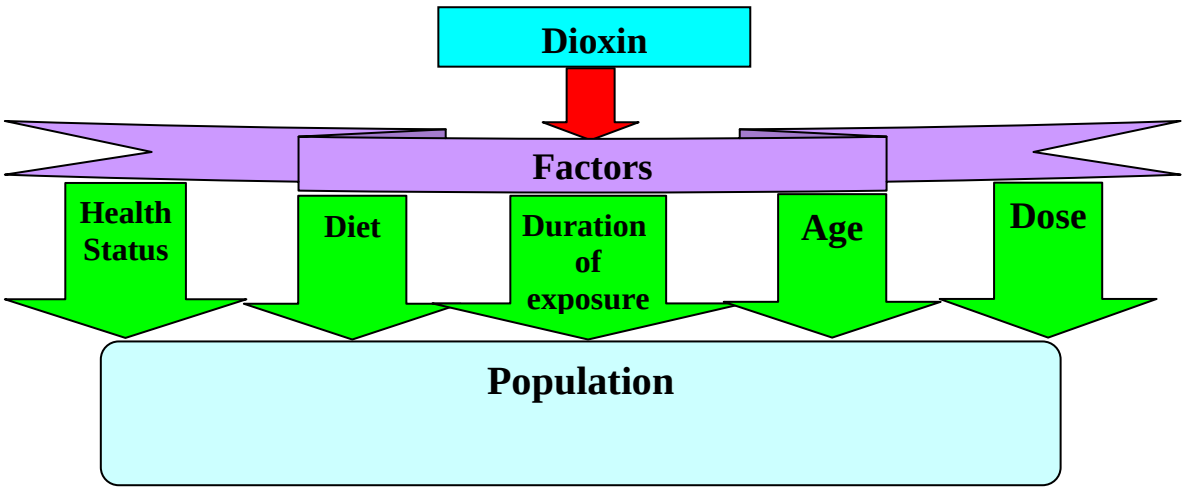


Figure (2.3), factors that may affect the population who may exposed to dioxins. (Developed by the researcher).

- Dose.
- Age of person exposed (children and fetuses are the most susceptible).
- Duration of exposure.
- Health status of the person exposed.
- Diet, consumption of meat, full fatty dairy products and fatty fish are more Susceptible.

2.13.3. Effects on human:

According to the WHO the short-term exposure of humans to high levels of dioxins may result in many problems may affect their skin and cause skin lesions such as darkening of the skin. and altered liver function. The long-term exposure is associated with impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions. Chronic exposure of animals to dioxins has resulted in several types of cancer (WHO, 2010).

The International Agency for Research on Cancer (IARC) -part of the World Health Organization- in 1997, has evaluated the TCDD in which it based on animal data and on

human epidemiology data. It was classified by IARC as a known human carcinogen. However, TCDD does not affect genetic material and there is a level of exposure below which cancer risk would be insignificant (IARC, 1997).

Acute effects of TCDD on humans health is due to combinations between pure TCCD and other associated chemicals that may contribute to the human dioxin toxicity. Acute levels produce eye irritation, headaches, nausea and vomiting, severe muscle pain, gross enlargement of the liver, pancreatitis, neurobehavioral effects, persistently elevated blood lipids and a possible increased risk of death from heart attack or coronary artery disease, suppression of the immune system, withering of the thymus gland (ATSDR, 1998).

2.13.4. Environmental effect:

Dioxin has been discovered in many places such as soil, surface water, sediments, plants and animal tissues. The most important sources of dioxins formation during the burning of fuel and wastes are released into the air. Soil near the burn areas also may be contaminated with dioxin. Surface water can become contaminated when rainwater carrying dust containing dioxin in surface water and when some industries discharge their wastes contaminated with dioxin directly to surface waters. And due to the property of dioxins that it does not dissolve easily in water, they settle in the bottom, and adhere to sediment. In addition, dioxins persist for a very long time in the environment before breaking. In surface water and sediment, dioxin can be transmitted to aquatic organisms and eventually find their way into the food chain. Furthermore dioxins are absorbed easily from animals and are stored in fatty tissue (Arnold, 2009).

2.13.5. Human carcinogenicity:

Dioxin carcinogenicity is well established in animals. While in humans, the World Health Organization and the United States Environment Protection Agency conclude that dioxins increase the risk of all cancers including soft tissue malignancy sarcomas, respiratory tract cancers, lymphatic tissue cancer, as well as Non Hodgkin's lymphoma and Hodgkin's disease, malignant enlargement of lymph nodes, spleen and liver (ASTDR, 2006).

TCDD was categorized as a group one carcinogen to human by IARC (IARC, 1997). It is also considered as carcinogen to humans by USEPA. After many studies concludes that, (as a result of cohort occupational studies), exposure to dioxin increases mortality from cancer anywhere in human body, lung cancer and may be other specific sites. Three of cohort studies provide quantitative dose-response estimates linking serum dioxin to cancer mortality (Steenland, et al., 2001). Several studies with laboratory animals have found that long-term exposure to dioxin may lead to various types of cancer (WHO, 1999).

As mentioned above that this compound 2, 3, 7, 8-Tetrachlorodibenzo-p-dioxin (TCDD or dioxin), is considered as a widespread environmental contaminant with it's sever toxicity, and has been shown to disrupt multiple endocrine pathways. A study was conducted by using data from the Seveso Women's Health Study (SWHS), in which it examined the association between individual serum TCDD levels and breast cancer risk in women residing around Seveso, Italy. In 1976, at the time of an industrial explosion the population in surrounding area was exposed to TCDD. The SWHS cohort comprises 981 women who were infants to 40 years old, resident in the most contaminated areas at the time of the explosion, measuring of serum TCDD exposure for each woman. Cancer cases were identified during interview and confirmed by medical record. At interview, many cases between these samples had been diagnosed with breast cancer. Individual serum TCDD is significantly related with breast cancer incidence among women in the SWHS cohort (Warner, 2002).

2.14 Cancer incidence rate in Palestine

In Palestine, in 2005 cancer mortality rate was of 27.8 per 100,000 of the population, while it was 27.4 per 100,000 of the population in the year 2000. The most common types of cancer such as: Trachea, bronchus and lung cancer. Among Palestinian males, trachea, bronchus and lung cancer was the first leading cause of cancer deaths (22.8%) with a mortality rate of 7.1 per 100,000 males. Among Palestinian females, breast cancer was the first leading cause of cancer deaths (21.1%) with a mortality rate of 5.2 per 100,000 females (MOH, 2005).

2.15 Conceptual framework

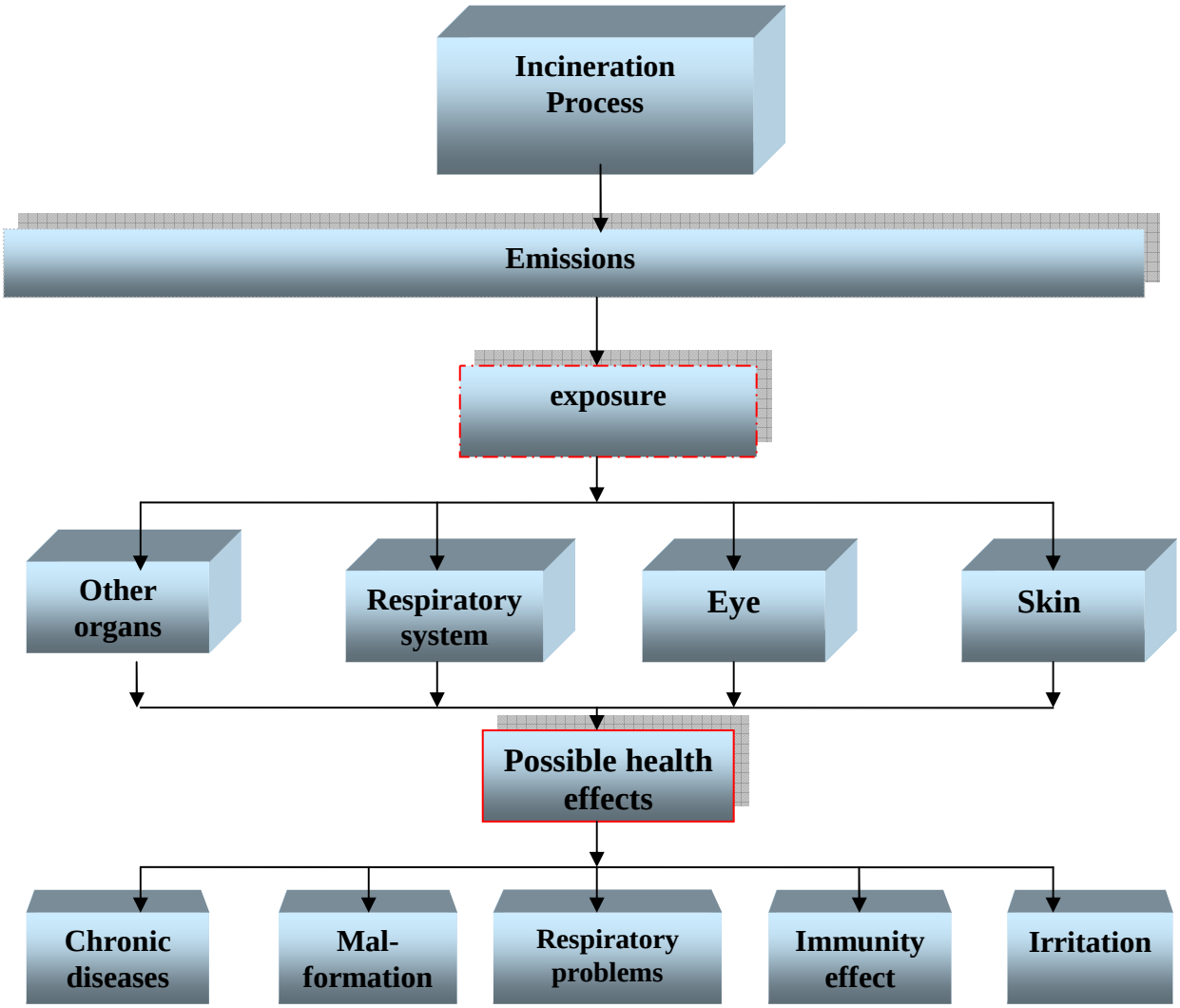


Figure 2.4: Conceptual framework of the research study. (Developed by the researcher).

Figure (2.4) illustrates the conceptual framework that the study considered to identify the impact of medical wastes incineration on the population who are living in the surrounding area to these incinerators which located in the governmental hospitals in Gaza Strip. According to Jordan MOH, the hazardous area is located at less than 500 meters from all directions around the incinerator units (Jordan MOH, 2001). Medical wastes are collected from many sectors that provide health service to the population at Gaza Strip. Al-Shifa and Nasser hospitals receive most of these medical wastes and disposed by incineration. Burning take place to many types of medical wastes.

As a result of incineration process many types of hazardous emissions such as dioxin, CO, CO2 and other toxic material are release. These emissions may affect the population who are living around Al-Shifa and Nasser hospitals. Exposure to these hazardous emissions that arise from the incineration units may affect the population health such as respiratory, eye and skin irritation, congenital anomalies, chronic diseases and other health problems.

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Chapter 3

Methodology

Chapter 3: Methodology

3.1 Overview

The objectives of this research were achieved by implementing the following steps (figure 3.1):

- Identification the problem of the research and define the objectives.
- Reviewing the literature on the medical waste incineration and its impacts, health status in the study area, and related previous studies.
- Collection and analysis of the data needed.
- Establishing and preparation of appropriate statistical model for identifying correlations and significances.
- Evaluation of the health status within the study area according to the statistical analyses of collected data.
- Writing the thesis which summarizes and reports the achieved results.

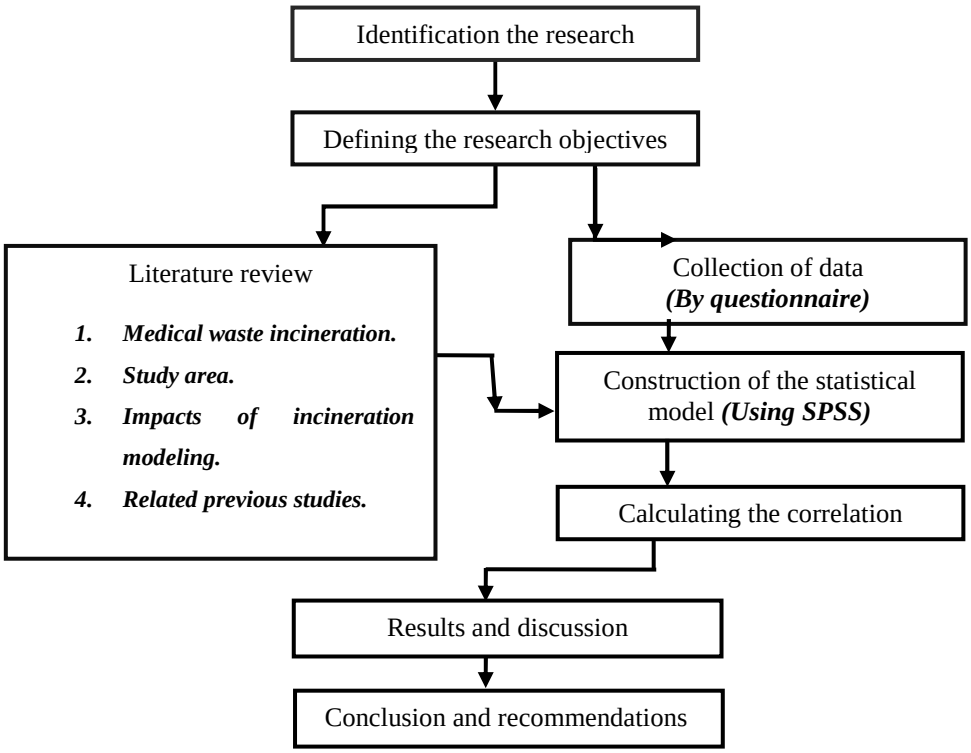

Figure 3.1: Schematic diagram of study methodology

3.2 Study design

A descriptive, analytic, and cross sectional study design has been used to implement the research. This is useful for the descriptive purposes to explore the impact of medical wastes incineration at governmental hospitals on the population in the surrounding area.

3.3 Period of study

The study started immediately after the approval from Alquds University, and completed in the mid of November 2010. It took one month for data collection and entry. Two months for data analysis and discussion, while the rest of the period had been allocated for thesis writing.

3.4 Place of study

Two areas have been chosen. The first area was the whole households around Al-Shifa hospital in Gaza governorate, west of Gaza city, which has been exposed to smoke and emissions arise from medical wastes incinerator that has been operating for a long period of time. The other chosen area was the whole households around Nasser hospital in Khan-Yonis governorate, southern area of Gaza Strip, which has been exposed to smoke and emissions that arise from medical wastes incinerator.

3.5 Study population

The targeted population of this study has been chosen from the people, who are living near the incinerators in the governmental hospitals (Al-Shifa and Nasser), at a distance that dose not exceed more than 500 meters from the incinerator unit from all directions.

3.6 Study sample

The researcher has used census study, all the population who are living near Al-Shifa and Nasser hospital has been subject to the study, 111 households has been involved in the study around Al Shifa hospital. At Khan Yoni's city around Nasser hospital, this area consists of 65 households chosen from the north, west, east, south, and southeast. So the total participants in this study were 167. While the respondents from all households around Al Shifa and Nasser hospitals was 126. About two third (80 subjects) of the sample has been living around Al-Shifa hospital area, and one third (46 subjects) from Nasser hospital area. The chosen process has been done according to the distance from the site of incinerator units at both hospitals taking into account the direction of the wind.

3.7 Sampling method and procedure

A questionnaire was prepared and used to collect the data on all sample subjects chosen for the study sample. Full effort was exerted to collect data, in which the questionnaire was distributed and collected by the researcher him self.

3.8 Eligibility

3.8.1 Inclusion criteria:

- All households which are located within the hazardous zone (500 meters) at the surrounding area to the incinerator unit at Al-Shifa and Nasser hospitals. And mainly the houses that are located directly opposite of the hospitals from all directions were eligible for the study.
- All the families that inhabited the place for more than one year were included.

3.8.2 Exclusion criteria:

- Any household which is located at a distance of more than 500 m from the incinerator unit was excluded.

- All the families that inhabited the place for less than one year.

3.9 Ethical Consideration

The author obtained all the necessary ethical documents to conduct the study; an official letter of approval to conduct the research had been obtained from Helsinki Committee-Gaza strip (Annex 3). Furthermore, confidentiality was maintained at all levels during the study; a full explanation was given for all participants both verbally and written of the purposes and objectives of the study, to assure confidentiality and optional participation. Then consent forms have been distributed and signed at the time of data collection. The inclusion in the study was optional and confidential. Neither name nor personal data were disclosed.

3.10 Data collection

A closed ended questionnaire had been administrated for all sample individuals by the researcher. The data had been collected in the same area and near to the incinerators at Al-Shifa and Nasser hospitals for all houses located close to these hospitals. After selection of the subjects as mentioned earlier, the researcher explained the purpose and objectives of the study and affirmed to the all participants the confidentiality of the study. After the free acceptance, the subjects were asked to fill the proper questionnaire. The average time for filling the questionnaire was about 20-25 minutes.

3.11 Questionnaire

As the Arabic language is the only official language in Palestine, the questionnaire was designed in Arabic language (annex 1), and translated to English (annex 2); it was constructed by the researcher. The questionnaire was easy to read and contained questions covering the majority of clinical signs and factors related to the topic. The questionnaire had been sent to 10 experts to review it, 7 feedbacks were received and the comments were included in the final design. Generally the questionnaire was divided into:

- Personal data.
- Housing.
- Diet status to family.
- Health status of the family.
- Emissions and odors.
- Knowledge & awareness.

3.12 Data analysis

The collected data has been statistically analyzed by using SPSS program for data coding, entry and analysis, and getting the suitable information and constructing the needed tables to answer the research questions and to check the study hypotheses.

Data analysis was carried out as follows:

Over viewing the field questionnaire, coding of the questionnaire, choosing data entry mode, data entry, data cleaning, frequency table for all study variables, defining and recoding of certain variables.

Statistical treatment: Methods used in the statistical analysis of the following:

- Repetition "Frequencies" and percentages: Tool gives the frequency distribution for qualitative or quantitative variables, broken down into categories.
- Chi square test: Measures the relationship between two variables generic.
- Medium: It is the sum of the values on the number.
- Standard deviation: It is a deviation values for the arithmetic average.
- The relative weights.

These tests were used to identify the significance of the correlations, associations, and interactions among medical wastes incineration and its health impact on the population in the surrounding area.

3.13 Validity

3.13.1. Content validity:

The questionnaire was reviewed by 7 experts; their responses were helpful to reach the final design and enriching the content of the questionnaire.

3.14 Pilot study

The pilot study has been conducted by the researcher prior to data collection which is considered as a pre-test to point out weaknesses in wording, predict response rate, determine the real time needed to fill the questionnaire, identify areas of ambiguity and to test the validity and suitability of the questionnaire. In the light of the results of the pilot study some useful modifications were made, and the final form of the questionnaire was produced. All of the pilot participants were excluded from the main study.

3.15 Response rate

The response rate, was 71.5% which represents 126out 176 of surveyed people who answered and responded to the questionnaire properly.

3.16 Limitations of the study

The most important limitations of the present study are:

- Lack of some devices that measure the emissions from incinerators.
- Lack of some lab testes to measure lead and dioxin in the human blood.
- Lack of access to international publications.
- Limited local and regional literature
- Lack of data about quantity and management of medical waste generation in Gaza health sectors.

Chapter 4

Results and discussion

Chapter 4: Results and discussion

All the questionnaires that had been distributed among the selected study areas were 176. The number positively responded was 126 households, giving a response rate of 71.5% and 50 questionnaires had been rejected. Data analysis was a quantitative analysis using SPSS version18 to show frequencies, and the P value for result significance was 0.05.

4.1 Characteristics of study population

Table 4.1: Personal data

Variables		Frequency	Percent%
Age groups	13-28	39	31
	29-44	44	34.9
	45-60	36	28.6
	More than 61	7	5.6
Gender	Male	102	81
	Female	24	19
Marital status	Married	97	77
	Single	26	20.6
	Divorced	1	0.8
	Widow/er	2	1.6
Consanguinity	Near	50	50
	Far	50	50
Type of job	Without	44.0	34.9
	Agriculture	1.0	8.0
	Industry	6.0	4.8
	Trade	16.0	12.7
	Public job	38.0	30.2
	Technician	7.0	5.6
	Worker	14.0	11.1
Distribution of study population according to satisfaction with income	No	76	60.3
	Yes	50	39.7
Education	Primary	12	9.5
	Elementary	20	15.9
	Secondary	34	27.0
	University	60	47.6
Fetus deaths just before delivery	No	113	89.7
	Yes	13	10.3
Infant deaths after birth without knowing the reason	No	105	83.3
	Yes	21	16.7
children with congenital malformation	No	120	95.2
	Yes	6	4.8
malformation apparent and clearly manifested	No	1	16.7
	Yes	5	83.3
Distribution according to smoking	No	79	62.7
	Yes	47	37.3

Table 4.1 shows the personal data about the families who participated in the study with regard to sex, age marital status and other information shown in the table.

4.1.1. Distribution of the study population according to the age:

As shown in table (4.2) the age group was divided into four groups, first the age group 13-28 years, with frequency of 39 and (31%). The second was the age group 29-44, with a frequency 44 and 34.9%. Third group was the age group 45-60, with frequency 36 and 28.6%. The fourth group was the age group more than 61 years, with frequency 7 and 5.5%.

Table 4.2: The distribution of study population according to age group:

Age group	Frequency	Percent%
13-28	39	31
29-44	44	34.9
45-60	36	28.6
More than 61	7	5.5
Total	126	100

Age ranges between 13 and 90 years, with mean 38.2 years and standard deviation 15 years. The highest percentage of participants was the age group 29-44 with 34.9%. According to the annual report of the MOH in 2005 the percentage of population in Gaza Strip less than 15 years old is 49.1%, and the percentage of those who are 65 years and more is 2.5% (MOH, 2005). So the percentage of population in Gaza strip between ages 15-65 years old is 48.4%. This distribution reflects the fact that the Palestinian population is young population.

4.1.2. Distribution of the study population according to consanguinity:

The result of consanguinity distribution shows that the relative couples' percentage is 50 and the non-relatives is 50%. This reflects the extent of homogeneity and mixing in the Palestinian society.

4.1.3. Distribution of the study population according to the gender:

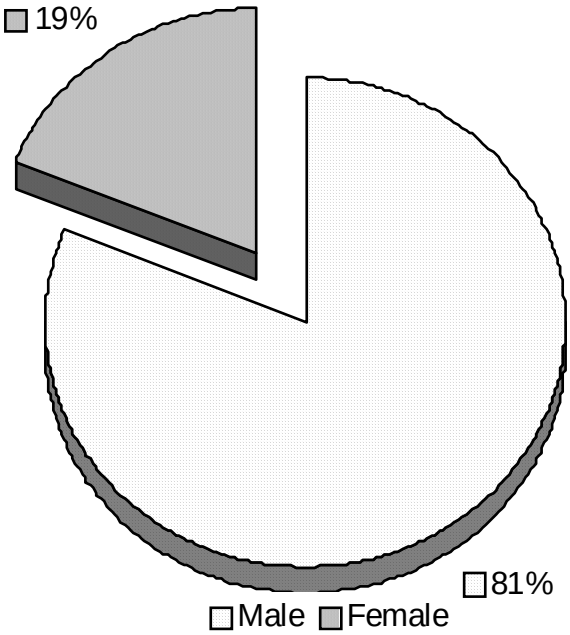

Figure 4.1: Distribution of the study population according to the gender

The result of gender distribution shows that the male percentage of the study sample is 81% whiles the female percentage is 19. According to the PCBS in 2007, sex ratio male to female in 2007 was 103.1- 100 (PCBS, 2007).

4.1.4. Distribution of the study population according to marital status:

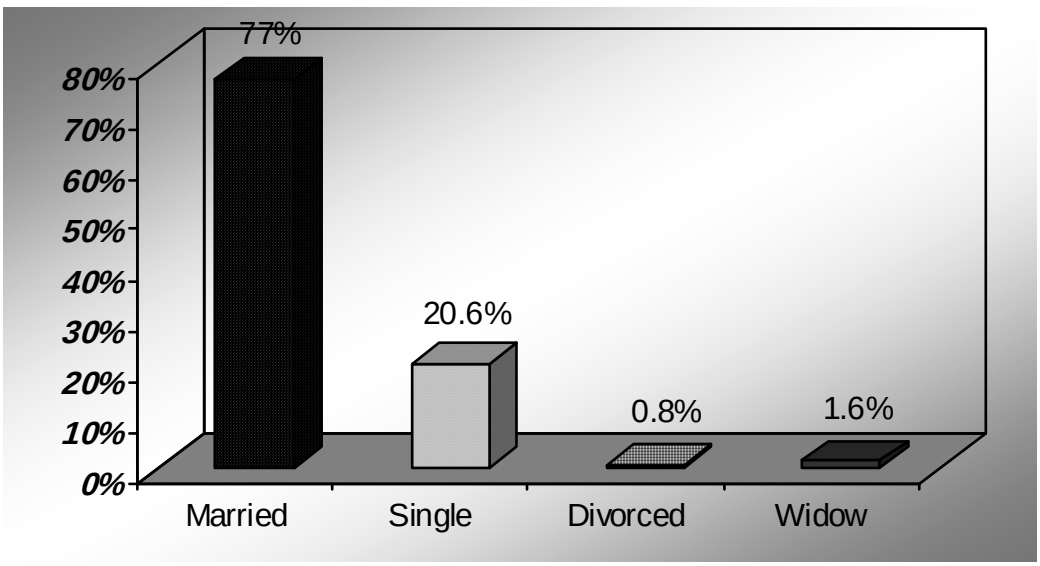

Figure 4.2: Distribution of the study population according to marital status

The frequency distribution shows that the majority of the study population is married with 77%. According to our Islam and Palestinian culture early marriage is the dominant feature of Palestinian society. And according to PCBS 2007, the first marriage for male with median age at about 24 years, while for female is about 19 years old (PCBS, 2007).

4.1.5. Distribution of the study population according to type of job:

Table 4.3 Distribution of study population according to job

Job	Frequency	Percent%
Without	44.0	34.9
Agriculture	1.0	0.8
Industry	6.0	4.8
Trade	16.0	12.7
Public job	38.0	30.2
Technician	7.0	5.6
Worker	14.0	11.1
Total	126	100

The job title was divided into seven groups: the first is without job which has reached the highest percentage of 34.9. This reason is attributed to the current political situation and the strict blockade, which have led to the destruction of the economic infrastructure and high unemployment in the Gaza Strip. The second one is agriculture with a percentage of 0.8. This is the lowest percentage among the jobs because the target areas for the study are urban areas not agricultural. The third is the Industry, with a percentage of 4.8. This is the second lowest percentage among the jobs, because the target areas for study are urban areas without presence of factories in this area. In addition to that people who live in the area of Al-Shifa hospital or what is called the northern Remal, the wealthy class of population that barely do work in factories. And on the contrary in the area of Nasser hospital the surrounding population is mostly of the middle class, and also the lack of factories in this region. The fourth is trade with a percentage of 12.7. The fifth was Public job with percentage 30.2. The sixth was Technician job with a percentage of 5.6.The last one was the workers which include all those who are not included in the previous groups with a percentage of 11.1.

4.1.6. Distribution of study population according to the income level:

The vast majority of the participants in the study did not answer the question of monthly income. And also the vast majority of them also said that the monthly income is not enough for requirement and needs with a percentage of 60.3. And this confirms the existence of high cost of living and rising prices.

4.1.7. Distribution of study population according to the education:

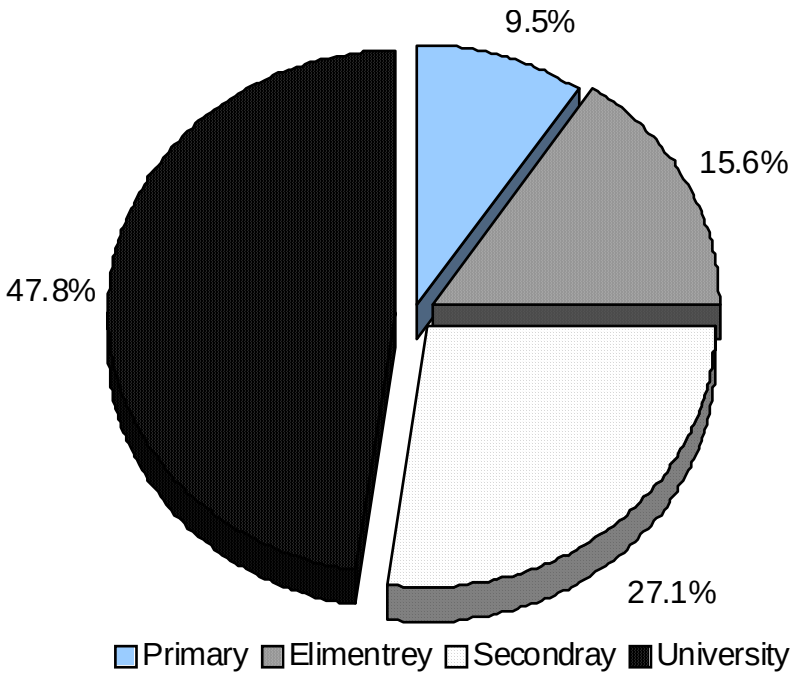

Figure 4.3: Distribution of study population according to the education

As shown in figure 4.3 the highest percentage of the study (47.8%) was for the participants who have a university degree. This reflects the prevailing status in Palestinian society as an educated society, and has university degrees in various disciplines.

4.1.8. Distribution of the study population according to the fetus deaths just before delivery:

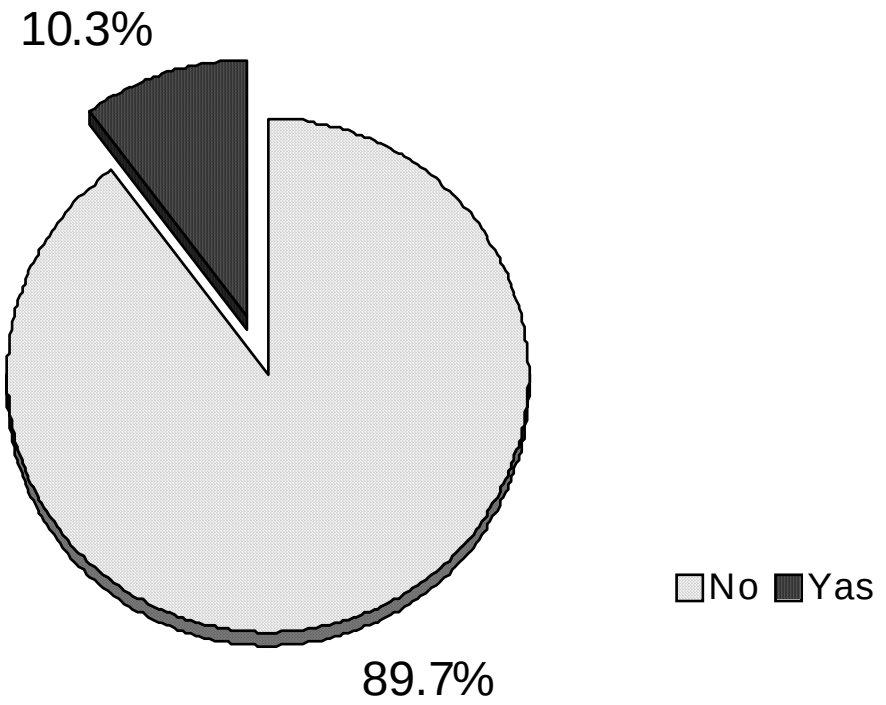

Figure 4.4: Distribution of the study population according to the fetus deaths just before delivery

In figure 4.4 it is clear that the fetus deaths just before delivery in the target area have a percentage of 10.3, while 89.7% of the total sample does not have this problem. According to WHO in 2005, the premature death rates were reported at 2.6/1000 in 1995 and 4.2/1000 in 2005 in Gaza Strip (WHO, 2005).

4.1.9. Distribution of study population according to infants' deaths after birth without knowing the reason:

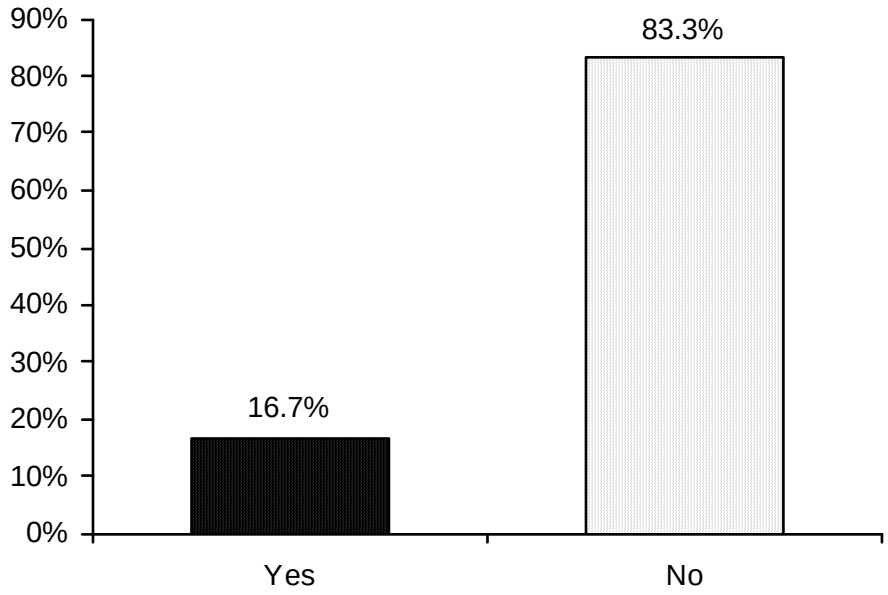

Figure (4.5): Distribution of study population according to infant deaths after birth without knowing the reason

From the figure (4.5) it is shown that the infant deaths after delivery without knowing the reason in the target area has a percentage of 16.7, while 83.3% of the total sample have not this problem. According to WHO in 2005, the proportion of infant deaths constituted 46% in early neonates, 20% in late neonate and 34% in post neonate from total infant deaths in Palestine. While in Gaza Strip 45% of infant deaths at early neonates, 23% in late neonate and 32% post neonate. Mortality at this age is primarily related to environmental causes such as infectious diseases and accidents, which may be preventable (MOH, 2005). The researcher fined that the percentage of infants who died after birth without knowing the reason in the sample accounts to 16.7% which is lower than the percentage of infant deaths according to the Palestinian MOH report in 2005.

4.1.10. Distribution of study population according to children with congenital malformation:

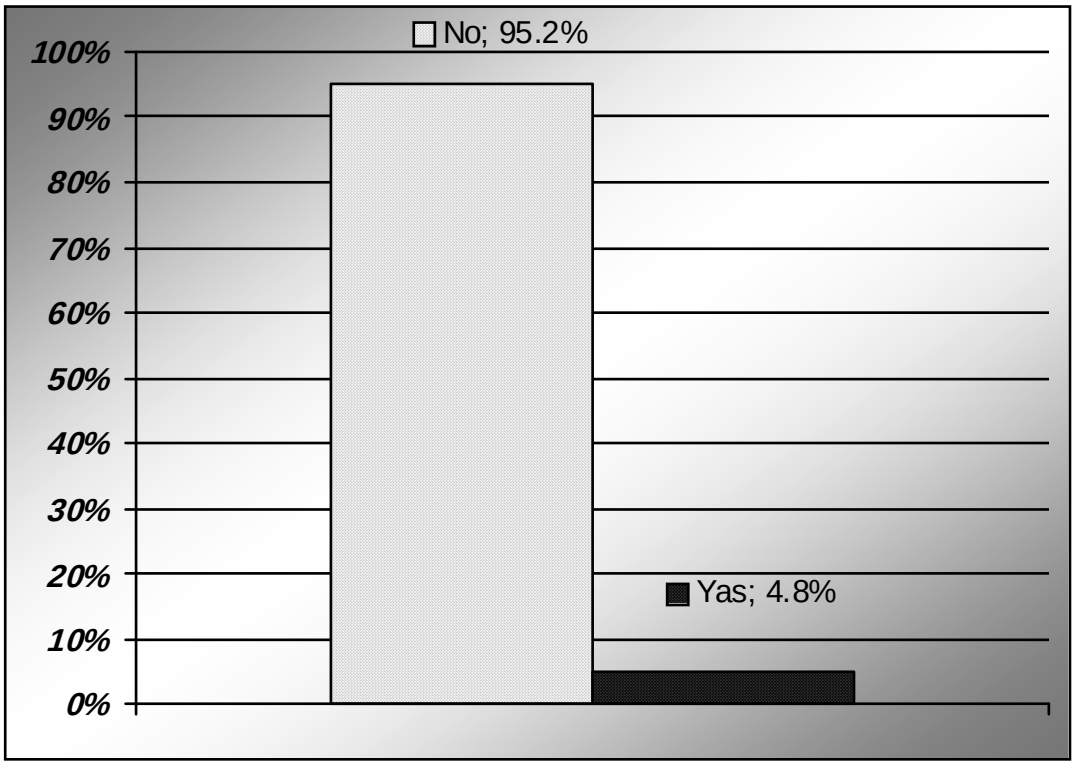

Figure 4.6: Distribution of study population according to children with congenital malformation

As shown in figure 4.6, the congenital malformation cases were six representing 4.8%. And from these cases five (83.3%) were with apparent malformation and clearly manifested, while one case has no apparent malformation. On the other hand 95.2% of the total sample does not have the problem. According to WHO in 2005, the congenital anomalies were reported at 2.5/1000 in 1995 and 3.6/1000 in 2005 (WHO, 2005).

4.1.11. Distribution of study population according to smoking:

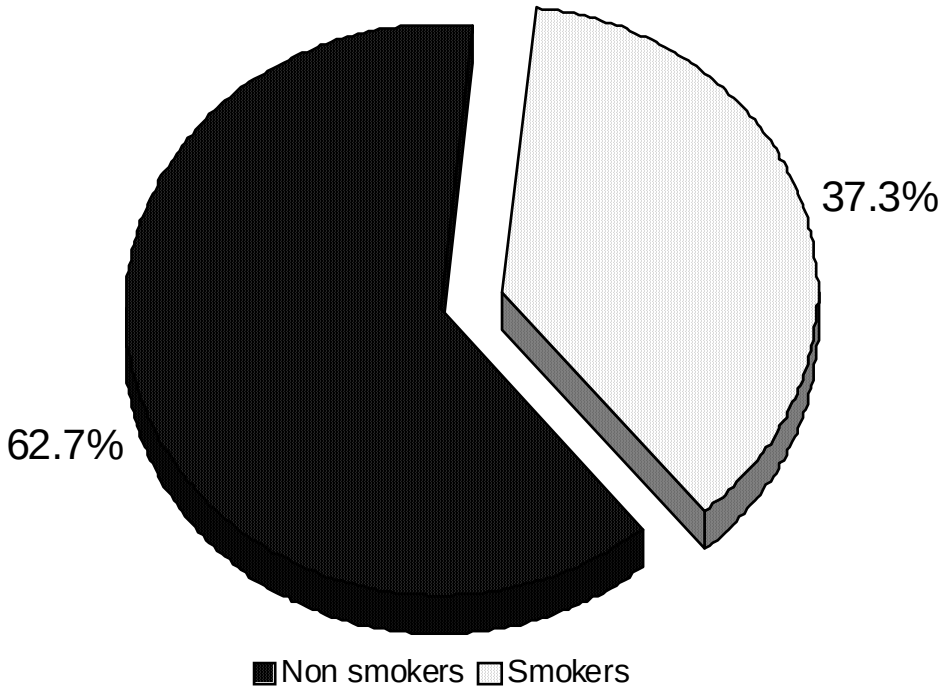

Figure 4.7: Distribution of study population according to smoking

As shown in figure 4.7, the number of smokers among the study population of both areas was 47 persons representing about 37.3%, and the nonsmokers were 79 persons (58.5%).

4.2 Housing conditions of study population

The following table (4.4) shows the housing conditions of the families who are living near medical waste incinerators, the permanent place of residence, geographical location of the house, and its direction from the medical waste incinerators and the quality of the family home.

Table 4.4: Housing conditions of study population

Variables	Frequency	Percent %
Place of residence		
Near Al-Shifa hospital	80	63.5
Near Nasser hospital	46	36.5
Housing site for medical waste incinerator		
East	27	21.4
West	15	11.9
North	30	23.8
South	31	24.6
Southeast	23	18.3
Type of house that the family live in		
Concrete	106	84.1
Asbestos	20	15.9
Degree of house ventilation		
High	52	41.3
Moderate	70	55.6
Low	4	3.2
The entrance of sun rays to the house		
High	54	42.9
Moderate	71	56.3
Low	1	0.8

4.2.1. Distribution of study population according to place of residence:

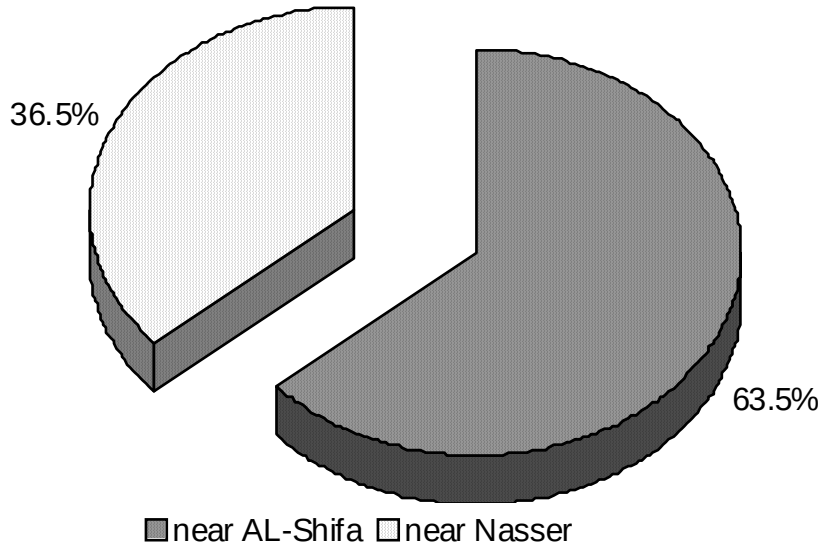

Figure 4.8: Place of residency

As shown in figure 4.8, about 63.5% of the sample lives around Al-Shifa hospital, and 36.5% around Nasser hospital.

4.2.2. Distribution of study population according to housing site from medical waste incinerator:

Table 4.5: Distribution of study population according to housing site from medical waste incinerator

location	Frequency	Percent%
East	27	21.4
West	15	11.9
North	30	23.8
South	31	24.6
Southeast	23	18.3
Total	126	100

Most of the population in the target study and in both areas are living in the southern region from the place of incineration unit with a percentage of 24.6, while the population

who are living in the north have the second percentage with 23.8, while in the southeast with percentage of 18.3. And the researcher note that the geographical location of the house has a great importance, because 95% of the direction of the wind in the Gaza Strip is Northwesterly, for this reason, the population living to the south or southeast are more vulnerable to pollutants and gases resulting from the incineration unit.

4.2.3. Distribution of study population according to type of house:

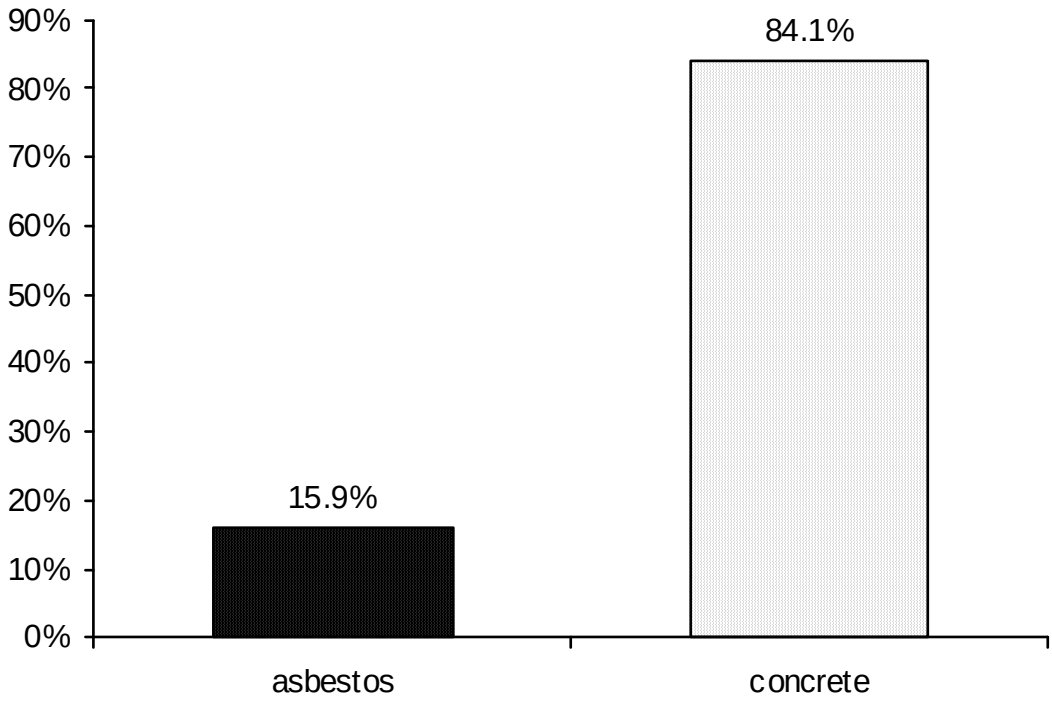

Figure 4.9: Distribution of study population according to the type of house

As shown in figure 4.9, about 84.1% of the total sample is live in concrete made houses and 15.9% in asbestos houses.

4.2.4. Distribution of study population according to the degree of house ventilation:

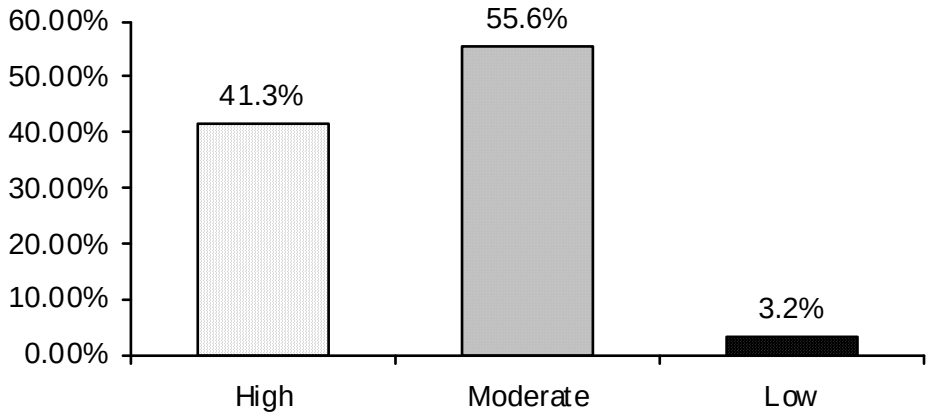

Figure 4.10: Distribution of study population according to the degree of house ventilation

As shown in figure 4.10, aboutn41.3% of the participants in the study claimed that there is a high degree of house ventilation in their homes. While moderate degree of house ventilation with a percentage of 55.6, and the last one of low degree of house ventilation is 3.2%.

4.2.5. Distribution of study population according to the entrance of sun inside the houses:

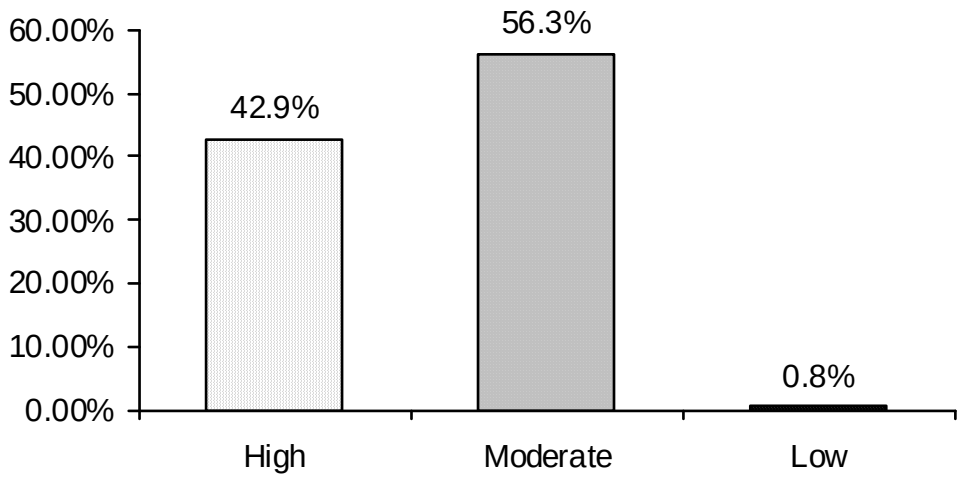

Figure 4.11: Distribution of study population according to the entrance of sun inside the houses

As shown in figure 4.11, about 42.9% of the participants in the study answered that the sun enters their homes highly, while moderate entrance was with a percentage of 56.3, and the lowest is 0.8%.

4.3 Nutritional status of the study families

Table 4.6 shows the nutritional status of the family in terms of the diversity among varieties, source and quality of the family food.

Table (4.6): Distribution of nutritional status of the study families

Variables	Frequency	Percent%
Classification of family food		
Vegetables	126	100
fruits	124	98.4
Meat	122	96.8
Fish	122	96.8
The family have its food (fruit - vegetables) from the house garden		
No	103	81.7
Yes	23	18.3
Type of family food		
Fresh food	60	47.6
Frozen food	44	34.9
Both	22	17.5

4.3.1. Distribution of participants according to classification of family food:

From table (4.6) above, it is shown that people eat all varieties of food such as vegetables, with a proportion of 100%, fruits 98.4%, meat 96.8% and fish 96.8%. This reflects the nature of dietary diversity which most of the population is doing in Gaza Strip.

4.3.2. Distribution of study population according to the eating from the house garden:

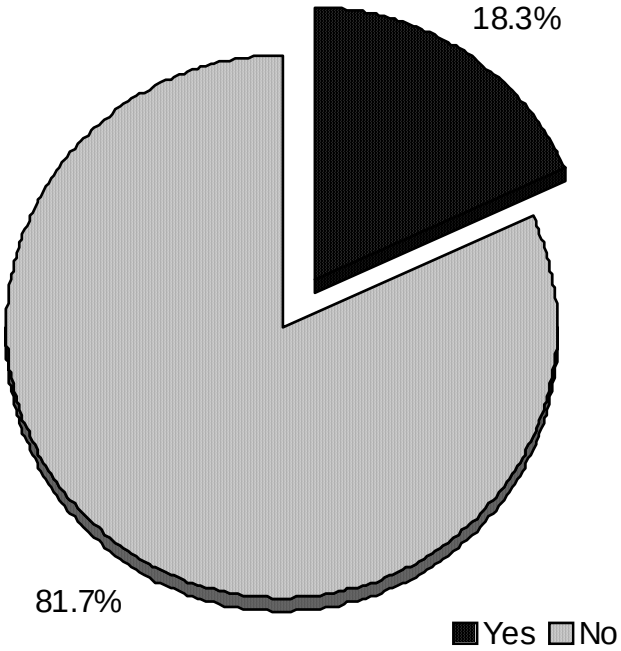

Figure 4.12: Distribution of study population according to the eating from the house garden

The above figure (4.12) shows that the vast majority of the respondents in both regions are not planting any kind in the garden of the house and therefore the proportion was 81.7%. While parts of the people in the study sample eat from the garden of the house which accounted for 18.3% and this indicates that the region is a residential area not agricultural.

4.3.3. Distribution of the type of family food:

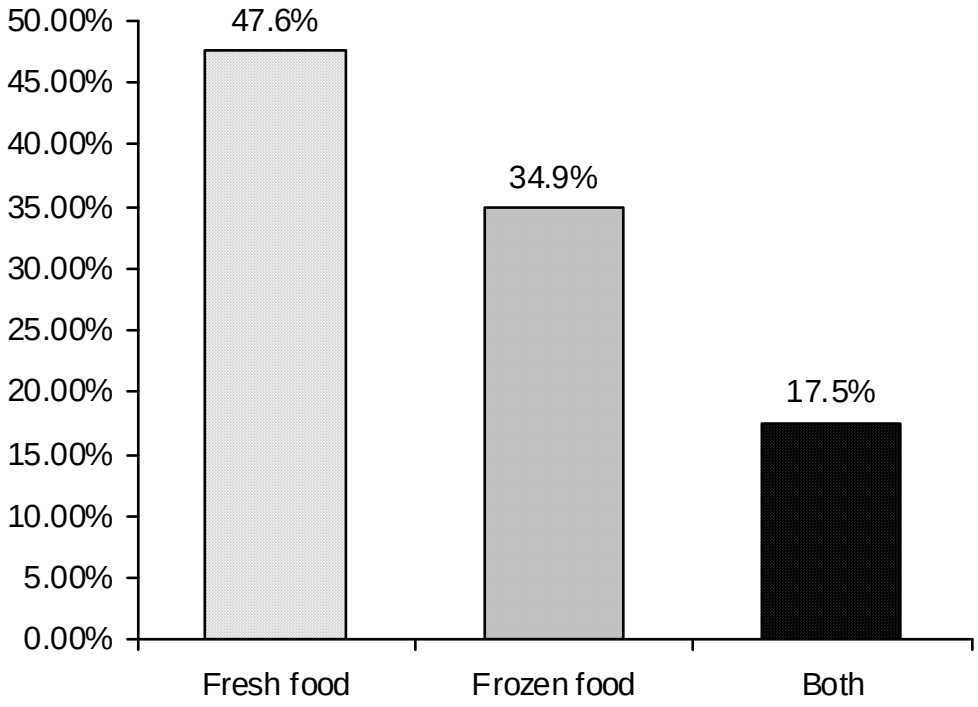

Figure 4.13: Distribution of the type of family food

Figure 4.13 above show that most of the respondents eat fresh food with a percentage of 47.6 and 34.9 of the sample depends on frozen food. About 17.5% eat fresh and frozen food together. These results show that most people in the sample eat fresh food because of its importance and usefulness to reduce health problems which may result from poor quality food.

4.4 Health status of the family

The following table (4.7) shows the health status experienced by the family and what are the diseases and health problems, including the immune system problems, chronic, respiratory, eye, skin, kidney, and liver diseases.

Table 4.7: Health status of the family

Variables		Frequency	Percent%
Does/did one of the family members suffer from any chronic illness?	No	60	47.6
	Yes	66	52.4
If yes, does it? (you Can choose more than one answer)	Diabetes mellitus	31	25.2
	Hypertension	39	31.7
	Heart disease	19	15.4
	Asthma	26	20.6
	Other chronic disease	8	6.5
Do you receive regular treatment for chronic diseases?	No	61	48.4
	Yes	65	51.6
In your opinion, how many times do the family members visit clinics for treatment monthly?	2-4	95	75.4
	4-6	28	22.2
	More than 6	3	2.4
Did you suffer from any of respiratory diseases?	No	30	23.8
	Yes	96	76.1
If the previous answer is yes, the disease is	Bronchial Asthma	6	8.6
	Chronic Bronchitis	7	10.0
	Allergy	57	81.4
Are any of the family members infected with eye diseases?	No	28	22.2
	Yes	98	77.8
If yes, the diseases are	Redness	20	15.8
	Sensitivity& irritation	92	73
	Increase secretion of tears	14	11.2
Are any of the family members infected with skin diseases?	No	88	70
	Yes	38	30
Are any of the family members infected with kidney disease?	No	109	86.5
	Yes	17	13.5
Are any of the family members infected with Liver disease?	No	117	92.9
	Yes	9	7.1
Are any of the family members infected with immune system?	No	118	93.7
	Yes	8	6.3

4.4.1. Family members suffering from any chronic illness (Question 28).

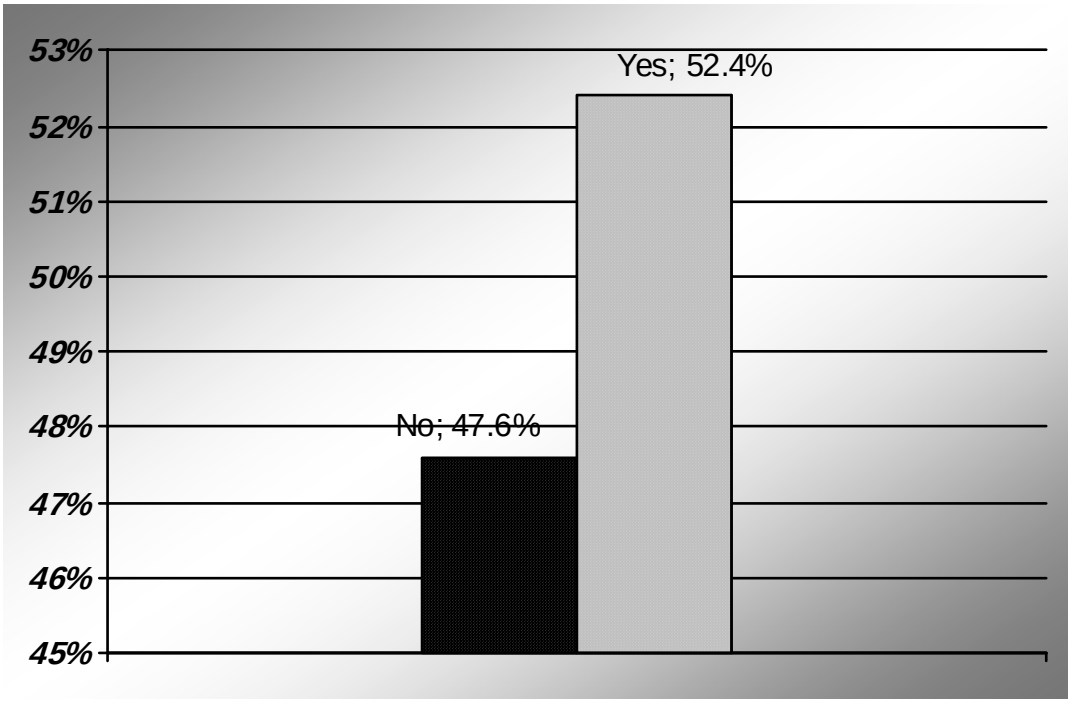

Figure 4.14: Distribution of the family members according to suffering from any chronic illness

The results in figure 4.14 show that 52.4% of the total sample have at least one family member suffering from chronic disease, while according to the WHO in 2009, about 10% of the population in the occupied Palestinian territory have at least one family member suffering from diagnosed chronic disease (WHO, 2009).The result of this study is very high, which indicate that there is a relationship between pollution emitted from medical waste incineration and chronic diseases in the population living in the target areas.

The result in table 4.7 depicted that 31 (25.2%) of the cases suffer from diabetes mellitus. This percentage (25.2%) of the population with diabetes is higher than that in the report of MOH, 2005 which gave a percentage of 9.0. The noticed increase of the diabetes cases in the current study is supported by many studies which concluded that there is a positive association between the exposure to pollutants and developing of diabetes mellitus (Uemura, et al., 2008, Remillard and Bunce, 2002, and Rylander, et al., 2005).

The result show that 39 (31.7%) of the cases suffer from hypertension which is the highest percentage in this study. In Palestine, no or weak national data are available on the overall

incidence and prevalence of hypertension diseases. In general mortality data is used to estimate the impacts of these diseases. According to MOH in the annual report 2005, hypertension disease is the eighth-leading cause of deaths in total population (4.8%), while it was the ninth leading deaths in males and females, 2.7% and 3.8% of males and female deaths respectively. So this result in the study indicates that there is a strong relationship between exposures to pollutants arises from medical incineration and hypertension.

The result depicted that (15.4%) 19 cases are suffering from heart disease. also no or weak national data are available on the overall incidence and prevalence of cardiovascular diseases (CVD). So mortality data is used to estimate the impacts of these diseases. In the annual report in 2005 the MOH indicated that, cardiovascular disease (CVDs), principally heart diseases is the first leading cause of death among population in Palestine in the year 2005 exactly as it is in the whole world. This involves males and females with a proportion of 18.7% and 19.9% respectively of the total number of death in Palestine. The result in this study shows that the percentage of patients suffering from heart disease is less than the percentage of mortality rate due to heart disease. This indicates that there is no relationship between exposure to pollutants that arise from medical incineration and heart disease.

The results indicate that 26 (21.2%) cases are suffering from asthma, and the other chronic diseases are 6.5%. The disease is rising owing to the effects of the political and socioeconomic situation, the rise in life expectancy, and unhealthy behaviors that include tobacco use, physical inactivity and unhealthy diet.

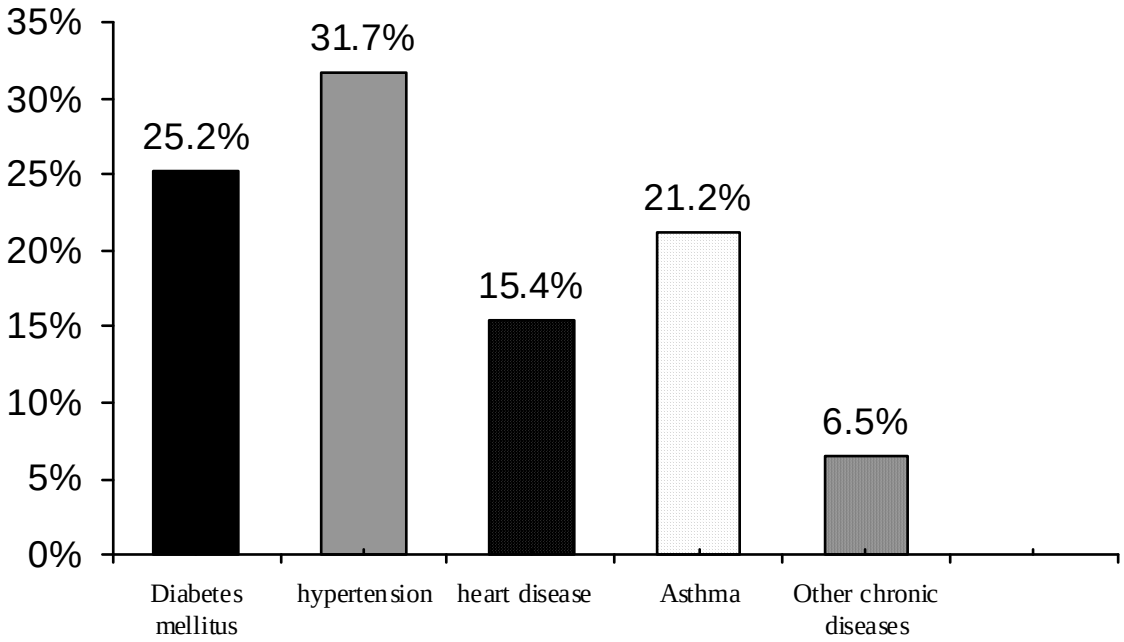

Figure 4.15: Distribution of chronic illness among the study population

4.4.2. The regular treatment for chronic diseases:

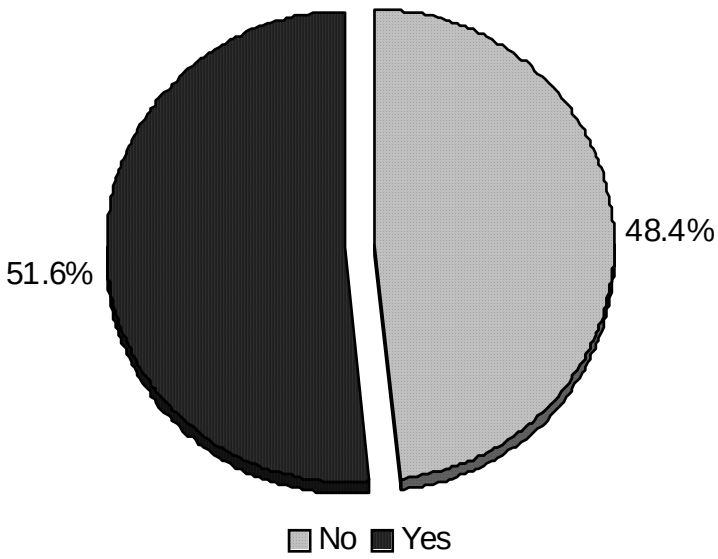

Figure 4.16: Distribution of regular treatment for chronic diseases

As in figure 4.16 the results show that 51.6% of the total sample has regular treatment for chronic diseases in the family, while 48.4% of the total sample has not a regular treatment for chronic diseases.

4.4.3. The family members who visit clinics for treatment per month:

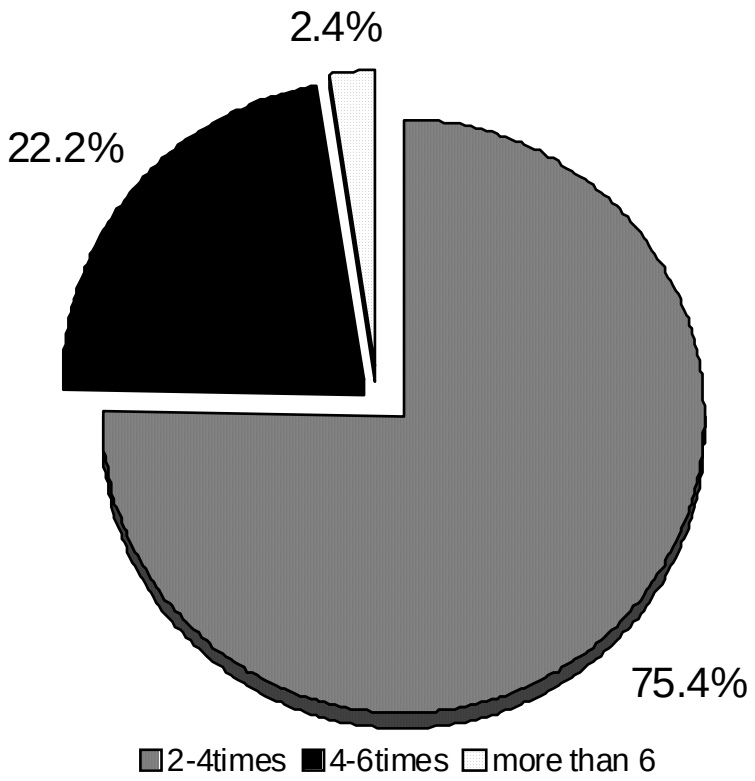

Figure 4.17: Distribution of the study population according to the family members who visit clinics for treatment per month

As depicted in figure 4.17 about 75.4% of the subjects visit clinics for treatment 2-4 times per month, while 22.2% visit the clinic 4-6 times. 2.4% of the total sample visits the clinics for treatment over 6 times. This result confirms the interest in those patients and people who are suffering from chronic diseases, where they visit the health care centers and receive the treatment regularly.

4.4.4. Suffering from any of respiratory diseases (Question 32):

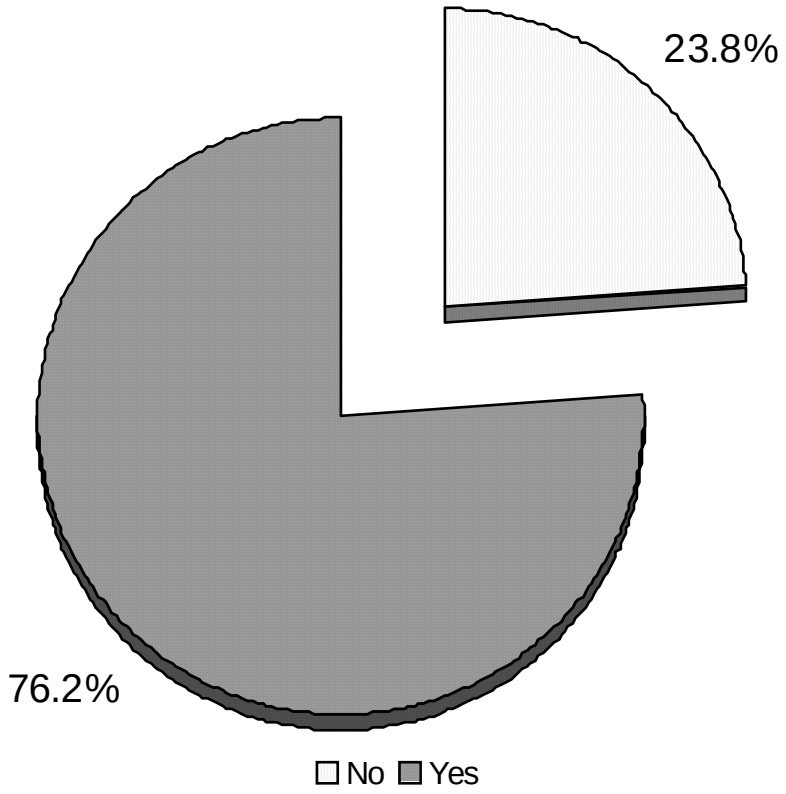

Figure 4.18: Distribution of the study population according to the family members who suffer from respiratory diseases

As depicted in figure 4.18 the current study shows that 96 (76.2%) of all study population have had respiratory diseases episodes and 30 (23.8%) did not have any respiratory diseases. Bronchial asthma accounts for 6 cases 8.6% of respiratory diseases cases, chronic bronchitis for 7 (10%) and allergy accounts for 57 (81.4%) of the respiratory diseases cases.

4.4.5. Family members infected with eye diseases (Question 34):

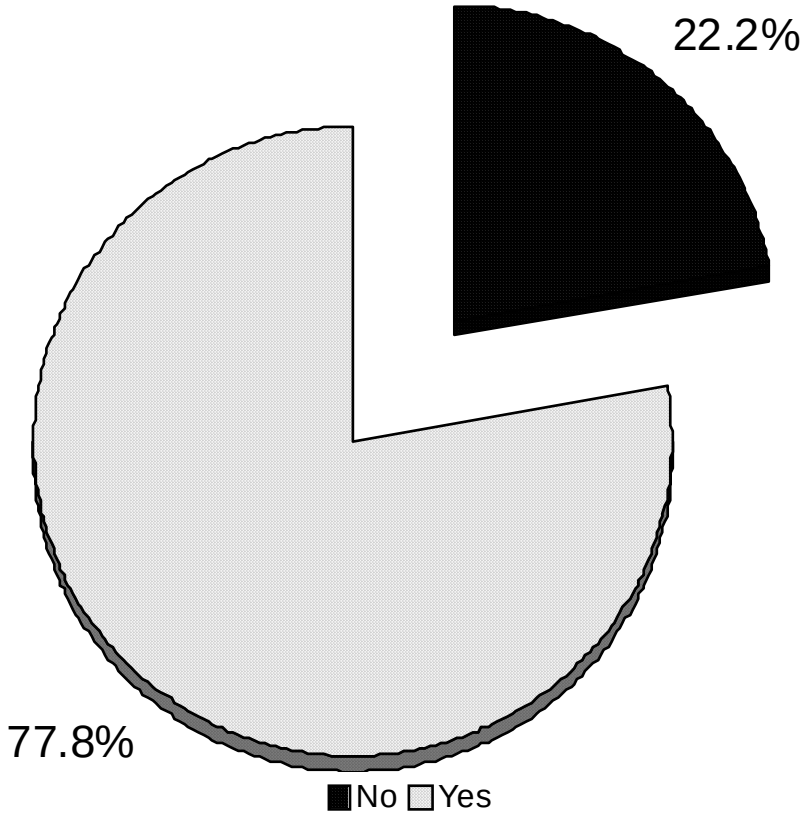

Figure 4.19: Distribution of the study sample according to the family members infected with eye diseases

As depicted in figure 4.19 the current study shows that 98 (77.8%) of all study population have had infection with eye diseases and 28 (22.2%) have not.

As shown in table 4.7 of all cases affected with eye diseases 20 cases (15.8%) suffered from redness, 92 cases (73%) suffered from sensitivity and irritation. And 14 cases (11.2%) suffered from increase eyes' secretion.

4.4.6. Family members infected with skin diseases (Question 36):

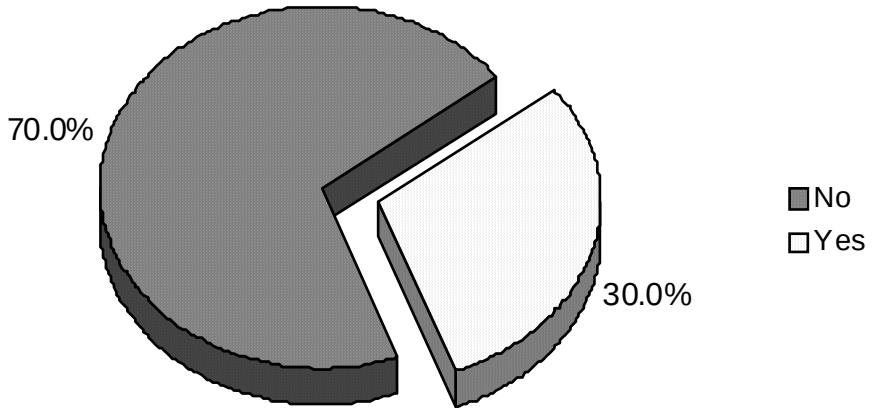

Figure 4.20: Distribution of the study sample according to the family members who infected with skin diseases

As depicted in figure, 4.20 the current study shows that 38 (30%) of all study population suffered from skin diseases and 88 (70%) did not.

4.4.7. Family members suffered from kidney diseases (Question 37):

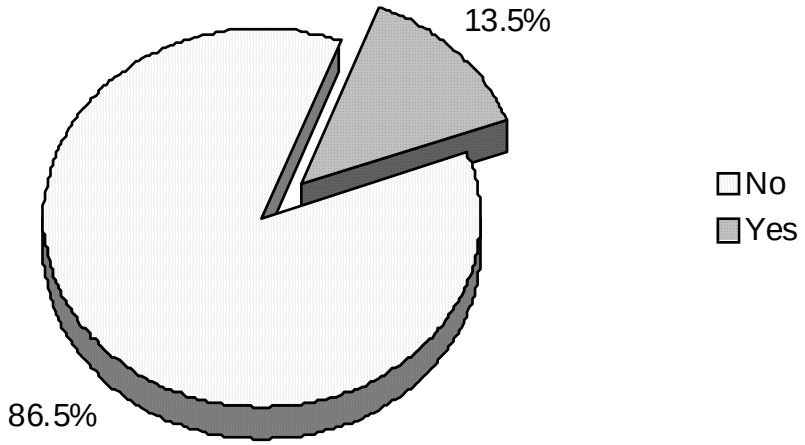

Figure 4.21: Distribution of the study sample according to the family members who suffered from kidney diseases

As depicted in figure 4.21 the current study shows that 17 (13.5%) of all study population are suffering from kidney diseases and 109 (86.5%) are not.

4.4.8. Family members suffered from liver diseases (Question 38):

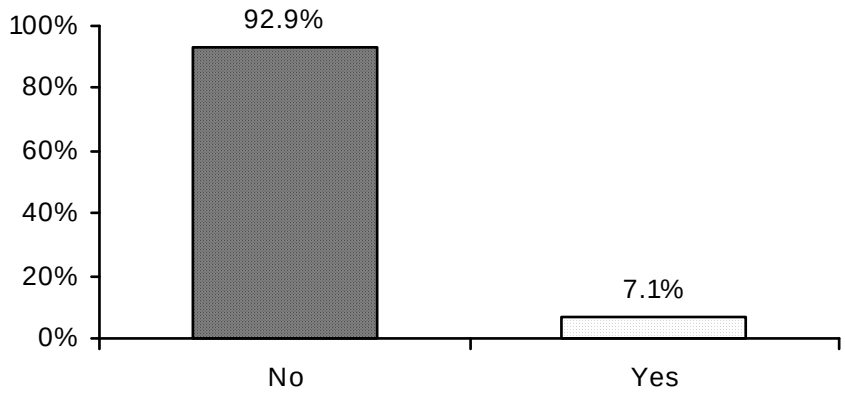

Figure 4.22: Distribution of the study sample according to the family members who suffered from liver diseases

As shown in figure, 4.22 the current study shows that 9 (7.1%) of all study population have suffered from liver diseases and 117 (92.9%) have not.

4.4.9. Family members infected with immune system (Question 38):

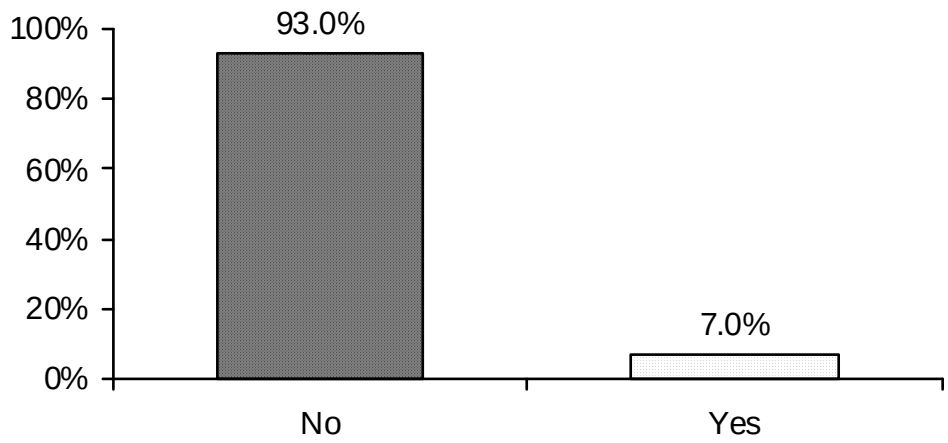

Figure 4.23: Distribution of the study sample according to the family members with infected immune system

As shown in figure 4.23 the current study shows that 8 (6.3%) of all study population have had infected immune system and 118 (93.7%) have not.

4.5 Emissions and odors

The following table (4.8) shows the general situation of the emissions and odors emitted from the medical waste incinerators, and its impact on the surrounding population when they inhale these emissions and odors.

Table 4.8: Emissions and odors from solid waste incinerators

Variables		Frequency	Percent%
Smell any unpleasant odors in the place of residence	No	14	11.1
	Yes	112	88.9
These smells are emitted from	Burning of solid waste	8	6.3
	Medical waste incineration	112	88.8
	Vehicle exhaust	4	3.1
	Other	2	1.5
Is there a specific time for emissions and odors?	No	89	70.7
	Yes	37	29.3
If yes, do you think the time is in the	Morning	10	7.9
	Afternoon	13	10.3
	Evening	10	7.9
	All times	90	71.4
	I do not know	3	2.3
In your opinion. Are these smells and emissions?	Nice	0	0
	Not nice	86	46.2
	Bad	100	53.8
	Doesn't have smell	0	0
Do you think these smells and emissions aggravate and increase disease?	No	8	7.1
	Yes	104	92.9
Do you watch the flying ash and dust around house	No	13	10.3
	Yes	113	89.7
If the answer is yes, what is the source in your opinion? Emission from	Burning of solid waste	29	16.8
	Medical waste incineration	107	61.8
	Vehicle exhaust	32	18.5
	Other	5	2.9
The most places where ash and dusts drop	Balconies	99	19.6
	Living rooms	107	21.1
	Kitchen	102	20.2
	Washed clothes	106	20.9
	House garden	92	18.2
Investigation by governmental or nongovernmental bodies of the problem	No	124	98.4
	Yes	2	1.6
The best solution is	Reducing the burning	0	0
	Burn in a specific times	1	0.8
	Removing burning spot	118	93.7
	Elevate the stack	0	0
	Filters	7	5.6

4.5.1. Smelling any unpleasant odors in the place of residence:

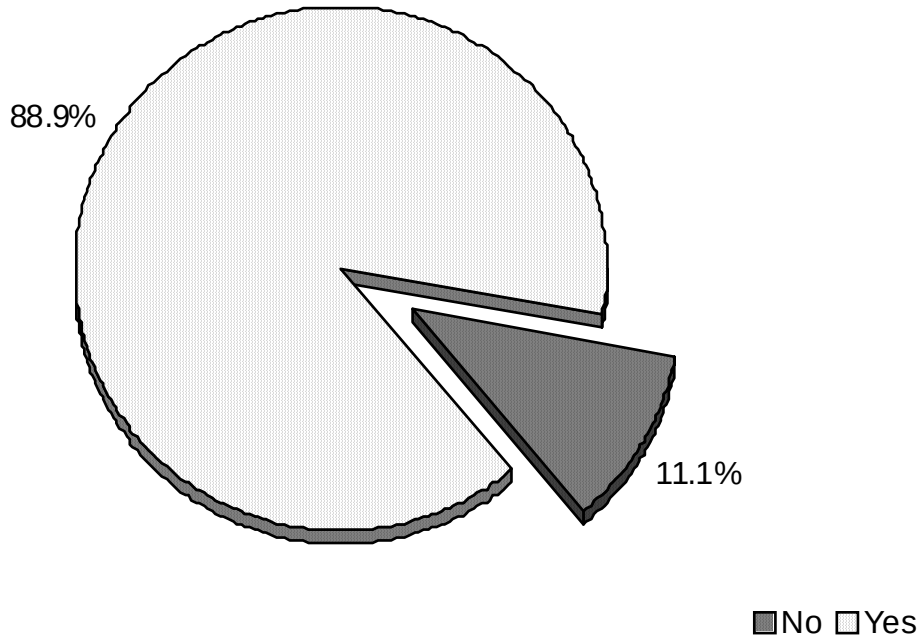

Figure 4.24: Distribution of the study population according to smelling any unpleasant odors in your place of residence

In figure 4.24 it is clear that 112 participants in this study with 88.9% smell unpleasant odors in their place of residence. While 14 participants in this study with 11.1 % are not smelling unpleasant odors in their place of residence. This percentage reflects the vulnerability of exposed people who are living around these incinerators, which emit a bad odors and hazardous emissions, and could affect the public health and also contaminate the surrounding environment.

4.5.2. Source of smelling any unpleasant odors or bad smells:

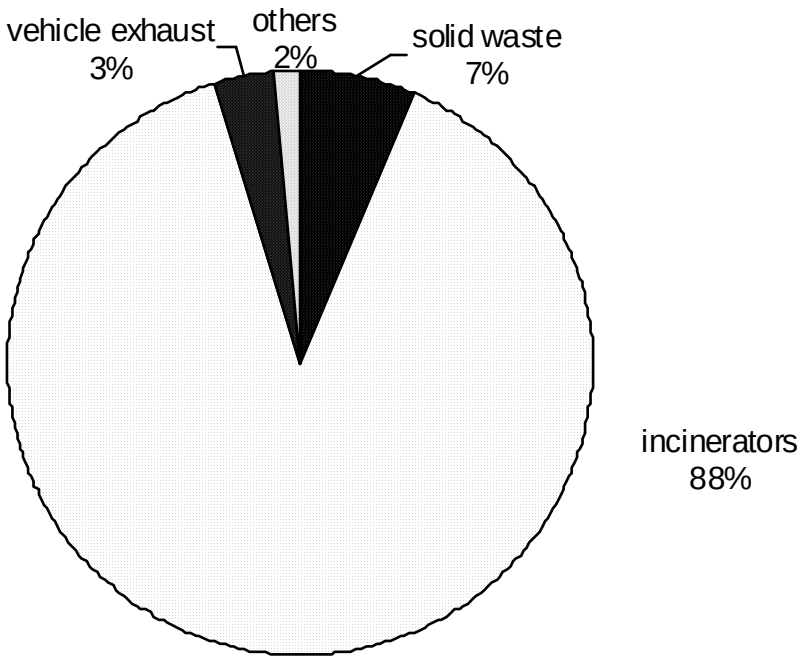

Figure 4.25: Distribution of the study population according to source of smelling any unpleasant odors or bad smells

In figure 4.25, it is clear that 8 participants in this study with 6.5 % recorded that the source of smelling any unpleasant odors or bad smells are from solid waste. While 112 participants in this study with 88.8 % recorded that these bad smells are from medical waste incineration. About 3.1% of the participants said that it is from vehicle exhaust. And 1.5% of the participants said that it is from other sources. This ratio reflects the people's ability to distinguish these bad smells, especially what arise from incinerators. It also gives clear indications as to the strength of these emissions, which is very bad and may be toxic odors.

4.5.3. Specific times for emissions and odors:

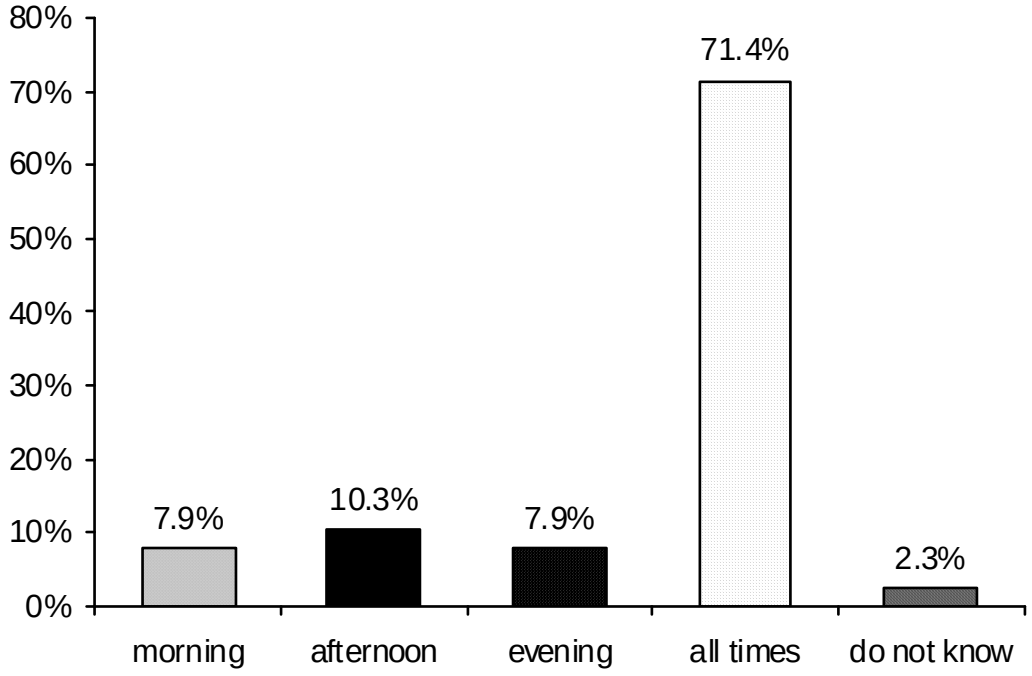

Figure (4.26): Distribution of the study sample according to specific time for emissions and odors

As shown in figure 4.26, the current study shows that 10 participants (6.3%) of the total sample recorded that the time of smelling these odors is in the morning. Also 13 participants (10.3%) of the current sample recorded that the time of smelling of these odors is in the afternoon. While 10 (7.9%) said that they smell the odor in the evening. The highest percentage with 71.4% of the participants claims that there is no specific time for emissions and odors and they smell it along the day. And finally 2.3% of the study population does not know when the odors emission time is. And these different ratios from the study population indicate that a lack of specific time in which the burning of medical waste is done.

4.5.4. Effect of smells and emissions on the diseases:

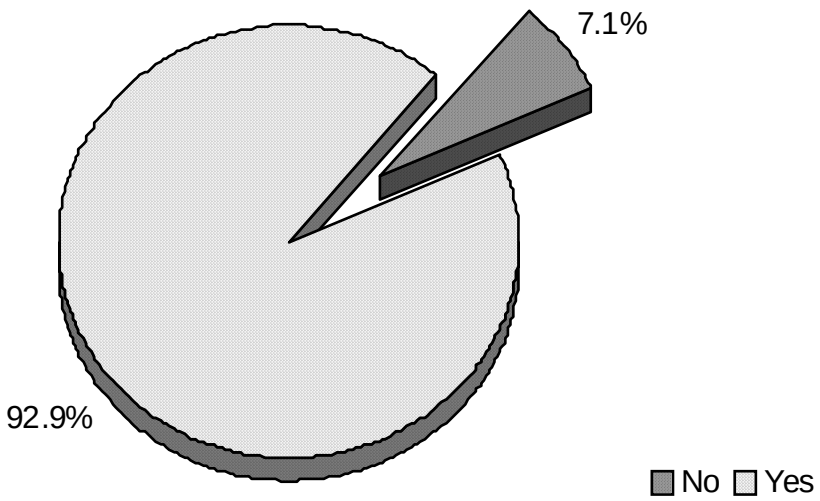

Figure 4.27: Distribution of the study sample according to the effect of smells and emissions on the diseases

As depicted in figure 4.27, the current study shows that 8 (7.1%) of all study population claimed that there is no effect of smells and emissions on the diseases , because they have no diseases that might be aggravated due to presence of emissions that arise from incinerators. While 104 of (92.9%) the participants are suffering from aggravation of the diseases they have due to they expose to the smells and emissions that arise from the incinerators.

4.5.5. Sitting of flying ash and dust around houses and its source:

As depicted in table 4.8), the current study shows that, 113 (89.7%) of all study population claimed that there are flying ash and dust around their houses, while 13 participants (10.3%) said that there is no flying ash and dust around their houses. The overwhelming proportion of the population, who noticed the presence of fly ash and dust around their homes, indicates that the incineration of medical waste is not a complete burning. In addition, the burning of large quantities of paper, leads to the escalation of carbon monoxide and carbon dioxide emissions.

Table 4.9 Distribution of study according to the source of flying ash and dust around house

Source	No.	Percentage%
Burning of solid waste	20	15.8
Medical waste incineration	90	71.5
Vehicle exhaust	15	11.9
Other	1	0.8
Total	126	100

Table 4.10 Distribution of study according to the most places where ashes and dusts accumulate

places	No.	Percentage%
Balconies	99	19.6
Living rooms	107	21.1
Kitchen	102	20.2
Washed clothes	106	20.9
House garden	92	18.2
All of the above	107	21.1

4.5.6. Investigation of the problem by any governmental or nongovernmental agencies (Question 49):

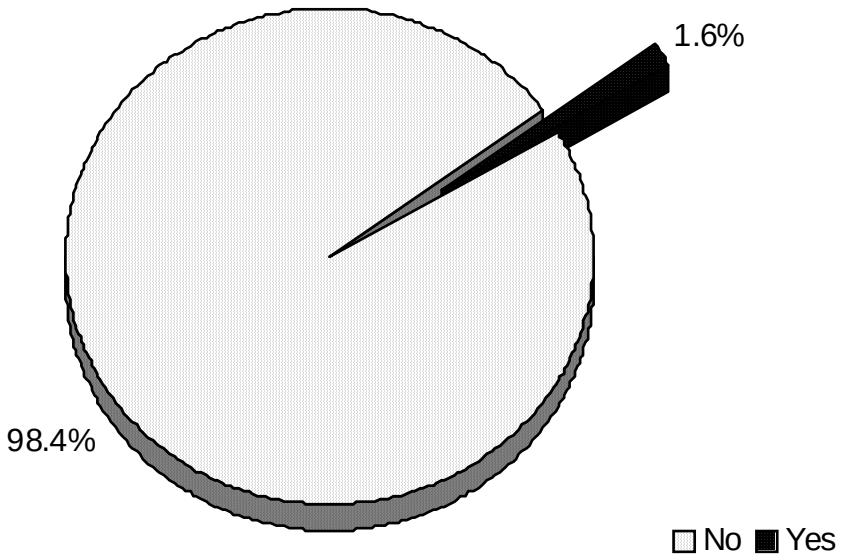

Figure 4.28: Distribution of the study sample according to the governmental or nongovernmental agencies visits to investigate the incineration problem

As shown in figure 4.28, about 98.4% of the total study population indicates no governmental or nongovernmental agencies have visited the place to investigate the incineration problem, or ask the population in the surrounding area close to the medical waste incinerator, and if they are exposed to its emissions. This reflects the reality of the medical waste incineration in governmental hospitals in Gaza Strip, where there is no any control or follow-up by any governmental or non-governmental agencies. Therefore health problems will be continuing increasing among the population in the surrounding area. In addition to that environmental pollution will intensity.

4.5.7. Participants opinion on the best solution to the problem of incineration emission (Question 50):

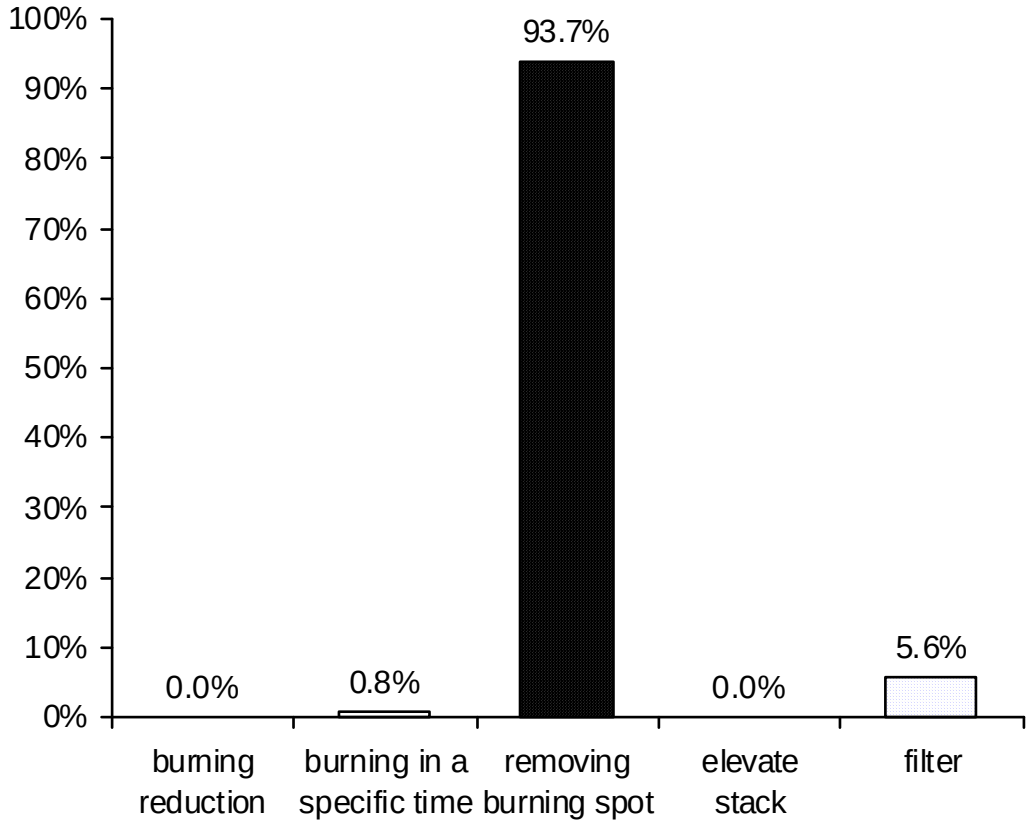

Figure 4.29: Distribution of the study sample according to best solution for medical waste incinerators

As depicted in figure 4.29 the vast majority (93.7%) of the population in the surrounding area of the incinerators located in government hospitals suggest and support the removal of the medical waste incinerator to a place far away from population residency.

4.6 Analysis of population knowledge and awareness

The following table (4.11) contains 11 questions focusing on the knowledge and awareness of the population living near medical wastes incinerators. The question were formulated to test the participants have adequate information on the adverse health effects that could result from the gases and odors emitted from these incinerators.

Table 4.11: Means and tests results for knowledge and awareness

Questions	Yes	No	S.D	Mean	%	Rank
	Number	Number				
	%	%				
I think I am aware enough about the health harms resulted from burning the medical waste.	64	62	0.507	0.50	50.8	10
	50.8	49.2				
I know types of gases resulted from the burning unit.	48	78	0.381	0.48	38.1	11
	38.1	61.9				
I know types of diseases caused by gases resulted from the burning unit.	65	61	0.515	0.50	51.6	9
	51.6	48.4				
I am aware that living near the burning unit exposes me to more health dangers.	124	2	0.984	0.12	98.4	2
	98.4	1.6				
I know that attending sessions related to health and environmental dangers resulted from the burning protect residents from these dangers.	117	9	0.928	0.25	92.9	6
	92.9	7.1				
I distinguish between smoke emitted from the burning and smoke emitted from other places.	120	6	0.952	0.21	95.2	3
	95.2	4.8				
I know ways of protection against health dangers resulted from the burning.	65	61	0.515	0.50	51.6	8
	51.6	48.4				
I know the causes of the increase in the health dangers resulted from the burning due to incomplete burning of medical waste.	74	52	0.587	0.49	58.6	7
	58.7	41.3				
I know that the incinerators must be away from the population**.**	126	0	1.000	0.00	100	1
	100	0				
I know that these burning devices must conform to international standards**.**	120	6	0.952	0.21	95.2	4
	95.2	4.8				
I know that these burning devices must work under international standards.	118	8	0.936	0.24	93.7	5
	93.7	6.3				

The results in table 4.11show the following:

Question number 9 "I know that the incinerators must be away from the population" has occupied the first rank. Because the people who are living near the incinerators are exposed to its emissions, 100% of the participants expressed their knowledge that such incinerators should be away from the population and their households.

Regarding question number 5 " I know that attending sessions related to health and environmental dangers resulted from the burning protect residents from these dangers", about 92.9% of all participants in the study They said that they know the importance of attendance and participation in seminars related to environmental and health dangers that may result from such incinerators, where they know how to avoid the dangers that may affect their health. This question has occupied the sixth rank. And also the high percentage of the participants to such courses and lectures to take care of health and the environment, shows the people's interest in scientific and cultural aspect and those they are educated.

Concerning question number 2 " I know the types of gases resulting from the incinerators". This is the lowest rate, which represents a value of 38% of the participants in this study that have the knowledge and awareness of the extent to what level that their knowledge of the types of diseases it could occur as a result of exposure to certain gases emitted from the incineration of medical waste. And this question has occupied the last position in ranking.

4.7 Analysis of the relationships between variables

4.7.1. Consanguinity and deaths of fetuses, infants and children with congenital anomalies:

Table 4.12: Show the relationship between the consanguinity with: fetuses' deaths just before delivery, infants' deaths after birth without knowing the reason and children with congenital malformation.

		No	Yes	Total	P-value
Infants deaths right after birth without knowing the reason					
Consanguinity	Near	46	3	49	0.254
	Far	44	6	50	
Total		90	9	99	
Fetuses deaths just before delivery					
Consanguinity	Near	38	11	49	0.204
	Far	43	7	50	
Total		81	18	99	
Children with congenital malformation					
Consanguinity	Near	47	2	49	0.349
	Far	46	4	50	
Total		93	6	99	

As shown in table 4.12, it is clear from the study that there is no statistically significant relationship between consanguinity and the death of fetuses just before delivery, with p-value of 0.204 which is greater than 0.05. And also with deaths after birth without knowing the reason there is no statistically significance with p-value of 0.254 which is greater than 0.05, and the same with having children with congenital anomalies, with p-value of 0.349.

4.7.2. Smoking with deaths fetuses, infants and congenital anomalies:

Table 4.13: The relationship between smoking and fetuses deaths just before delivery, infant's deaths after birth without knowing the reason and children with congenital malformation.

		No	Yes	Total	P-value
Infant deaths right after birth without knowing the reason					
Smoking	No	72	7	79	0.341
	Yes	41	6	47	
Total		113	13	126	
Fetuses deaths just before delivery					
Smoking	No	68	11	79	0.204
	Yes	37	10	47	
Total		105	21	126	
Children with congenital malformation					
Smoking	No	77	2	79	0.138
	Yes	43	4	47	
Total		120	6	126	

The results in table 4.12 showed that, it was seemed clear from the study that there is no statistically significant relationship between the smoking and the death of fetuses just before delivery, with a p-value of 0.204 which is greater than 0.05, also with deaths after birth without knowing the reason with a p-value of 0.341 in which is greater than 0.05, and with having children with congenital anomalies, with a p-value of 0.138.

4.7.3. Permanent residence and deaths of fetuses and children congenital anomalies:

Table 4.14: The relationship between the permanent residence with fetuses' deaths just before delivery, infant deaths after birth without knowing the reason and children with congenital malformation

		No	Yes	Total	P-value
Infant deaths after birth without knowing the reason					
Permanent residence	Al-Shifa	74	6	80	0.143
	Nasser	39	7	46	
Total		113	13	126	
fetus deaths just before delivery					
Permanent residence	Al-Shifa	67	13	80	0.527
	Nasser	38	8	46	
Total		105	21	126	
Children with congenital malformation					
Permanent residence	Al-Shifa	77	3	80	0.382
	Nasser	43	3	46	
Total		120	6	126	

As shown in table (4.14) above, the study demonstrated that there is no statistically significant relationship between the place of permanent residence (near Shifa Hospital, near Nasser hospital) and both the death of fetuses before birth (p-value 0.527), and after birth without knowing the reason (p-value 0.143), and having children with congenital anomalies (p-value 0.382), where all the p-values are greater than 0.05.

Table 4.15: The relationships between the permanent residence and chronic illness and the immune system weakness.

		No	Yes	Total	P-value
Chronic illness					
Permanent residence	Al-Shifa	43	37	80	0.050
	Nasser	17	29	46	
Total		60	66	126	
Immune system					
Permanent residence	Al-Shifa	72	8	80	0.023
	Nasser	46	0	46	
Total		118	8	126	

The above table (4.15), shows that there are statistically significant relationships between the place of permanent residence (near Shifa Hospital, near Nasser hospital) and both the suffering of a family member of any chronic illness (p-value 0.050), and weakness in the immune system(p-value 0.023), where they found the values of the p-value equal and less than 0.05.

Table 4.16: The relationship between the permanent residence and respiratory diseases, eye diseases, skin diseases, kidney disease and Liver disease

		No	Yes	Total	P-value
Respiratory diseases					
Permanent residence	Al-Shifa	39	41	80	0.136
	Nasser	17	29	46	
Total		56	70	126	
Eye diseases					
Permanent residence	Al-Shifa	37	43	80	0.549
	Nasser	21	25	46	
Total		58	68	126	
Skin diseases					
Permanent residence	Al-Shifa	52	28	80	0.072
	Nasser	23	23	46	
Total		75	51	126	
Kidney disease					
Permanent residence	Al-Shifa	71	9	80	0.239
	Nasser	38	8	46	
Total		109	17	126	
Liver disease					
Permanent residence	Al-Shifa	73	7	80	0.295
	Nasser	44	2	46	
Total		117	9	126	

The results in table 4.16 show that there is no statistically significant relationship between the place of permanent residence (near Al-Shifa Hospital, near Nasser hospital) and suffering of a family member of any respiratory diseases with a p-value of 0.136, eye diseases with a p-value of 0.549 , skin diseases with a p-value of 0.072, kidney problems with a p-value of 0.239 , liver problems with a p-value of 0.295, where all the p-values are greater than 0.05.

4.7.4. Type of house:

Table 4.17: The relationship between the type of house and kidney disease

		Kidney disease		Total	P-value
		No	Yes		
Type of house	Concrete	89	17	106	0.042
	Asbestos	20	0	20	
Total		109	17	126	

In table 4.17 shows that, there is a statistically significant relationship between the type of home the family lives in (concrete, asbestos) and the suffering of the family members (at least one of the family member) from problems related to kidney and may cause kidney diseases with a p-value of 0.042, where p-values less than 0.05. This indicates that, those who live in concrete houses have higher cases (17) of kidney diseases than those who live in houses made of asbestos with zero cases.

4.7.5. Smelling any unpleasant odors:

Table 4.18: The relationship between the smelling any unpleasant odors and chronic illness and skin diseases

		No	Yes	Total	P-value
Chronic illness					
Smell any unpleasant odors	No	12	2	14	0.002
	Yes	48	64	112	
Total		60	66	126	
Skin diseases					
Smell any unpleasant odors	No	12	2	14	0.029
	Yes	63	49	112	
Total		75	51	126	

As shown in table 4.18, that there are statistically significant relationships between the inhalation of smell any unpleasant odors in the place of residence, and at least one member of the family members suffering from any chronic disease in which the p- value 0.002, and with skin diseases in which the p-value equal 0.029. Where these p-values are less than 0.05. In which the smelling any unpleasant odors increase and aggravated the chronic illnesses and skin diseases.

Table 4.19: The relationship between the smelling unpleasant odors and respiratory, eye, kidney, liver and immune diseases

		No	Yes	Total	P-value
Respiratory diseases					
Smell any unpleasant odors	No	9	5	14	0.097
	Yes	47	65	112	
Total		56	70	126	
Eye diseases					
Smell any unpleasant odors	No	8	6	14	0.274
	Yes	50	62	112	
Total		58	68	126	
Kidney diseases					
Smell any unpleasant odors	No	13	1	14	0.405
	Yes	96	16	112	
Total	93	109	17	126	
Liver diseases					
Smell any unpleasant odors	No	13	1	14	0.666
	Yes	104	8	112	
Total		117	9	126	
Immune diseases					
Smell any unpleasant odors	No	13	1	14	0.621
	Yes	105	7	112	
Total		118	8	126	

As shown in table 4.19, there are no statistically significant relationships between smelling any unpleasant odors in the place of residence near or at the surrounding area to the medical wastes incinerators in the target areas of this study, and the suffering of any of the following diseases: respiratory diseases (p-value 0.097) , eyes diseases (p-value 0.274), kidney diseases (p-value 0.504) , liver problems (p-value 0.666), and weakened immune system (p-value 0.621), where all p-values are greater than 0.05.

4.7.6. Smells and emissions aggravation and increasing of the chronic diseases:

Table 4.20: The relationship between the smells and emissions if it exaggerate and increase of the chronic diseases

		Chronic illness		Total	P-value
		No	Yes		
Smells and emissions if it exaggerate and increase the disease	No	19	3	22	0.01
	Yes	41	63	104	
Total		60	66	126	

As shown in table 4.20, there is statistically significant relationship between the suffering of a family members (at least one member of the family) from any chronic illness, when they are exposed to smells or emissions that arise from the medical wastes incinerator and the aggravation and increase of the chronic diseases, with p-value of 0.01 which is lower than 0.05. This means that, exposure to odors and emissions increases and aggravates the chronic illnesses.

4.7.7. Housing site from medical waste incinerator and smelling unpleasant odors:

Table 4.21: The relationship between housing site from medical waste incinerator and smelling unpleasant odors

		Smell any unpleasant odors in your place of residence		Total	P-value
		No	Yes		
Housing site from medical waste incinerator	East	1	26	27	0.01
	West	0	15	15	
	North	12	18	30	
	South	1	30	31	
	Southeast	0	23	23	
Total		14	112	126	

The study shows that there is a very statistically significant relationship between smelling unpleasant odors in the place of residence and the direction of housing from the medical waste incinerator, with a p-value 0.01 which is less than 0.05 as shown in table 4.22. This means that those who live in houses located to the north of incinerators suffer the least from the odors and emissions compared to those living in the east, west, south and southeast directions.

Table 4.22: The relationship between housing site from medical waste incinerator and skin diseases and liver diseases

		No	Yes	Total	P-value
Skin diseases					
Housing site from medical waste incinerator	East	13	14	27	0.039
	West	8	7	15	
	North	25	5	30	
	South	18	13	31	
	Southeast	11	12	23	
Liver disease					
Housing site from medical waste incinerator	East	27	0	27	0.013
	West	15	0	15	
	North	24	6	30	
	South	28	3	31	
	Southeast	23	0	23	

As shown in table 4.23, there are statistically significant relationships between the direction of housing from both medical wastes incineration and at least one member of the family members suffering from skin diseases with a p-value of 0.039, and problems related to the liver with a p-value of 0.013, which are less than 0.05. This means that those who live in houses located around the incinerators from all directions to Al-Shifa and Nasser hospitals are suffering from skin and liver diseases.

Table 4.23: The relationship between housing site from medical waste incinerator and chronic, respiratory, eye, kidney and immune diseases

		No	Yes	Total	P-value
Chronic illness					
Housing site for medical waste incinerator	East	8	19	27	0.07
	West	6	9	15	
	North	19	11	30	
	South	13	18	31	
	Southeast	14	9	23	
Respiratory diseases					
Housing site for medical waste incinerator	East	12	15	27	0.385
	West	4	11	15	
	North	17	13	30	
	South	12	19	31	
	Southeast	11	12	23	
Eye diseases					
Housing site for medical waste incinerator	East	11	16	27	0.738
	West	5	10	15	
	North	16	14	30	
	South	15	16	31	
	Southeast	11	12	23	
Kidney disease					
Housing site for medical waste incinerator	East	23	4	27	0.211
	West	11	5	15	
	North	28	2	30	
	South	25	6	31	
	Southeast	22	1	23	
Immune system					
Housing site for medical waste incinerator	East	26	1	27	0.106
	West	14	1	15	
	North	25	5	30	
	South	30	1	31	
	Southeast	23	0	23	

The results shown in table (4.24) indicate that there is no statistically significant relationship between the direction of housing from the medical wastes incinerator and the suffering of a family members (at least one member) of any chronic disease where the p-value equals 0.07, respiratory diseases (p-value 0.385), eye diseases (p-value 0.738), problems related to kidney disease (p-value0.211), weakened immune system (p-value 0.106), all the p-value are greater than 0.05.

4.8 Statistical methods

In order to answer the questions of the study and the premise, the researcher used the following statistical methods:

Data collection mechanism and preparation for analysis: The researcher used the statistical analysis program version (SPSS 18). (Statistical Package for Social Science) to unpack and compile data and handle.

Statistical treatment: Methods used in the statistical analysis of the following:

- Repetition "Frequencies" and percentages: Tool gives the frequency distribution for qualitative or quantitative variables, broken down into categories.
- Chi square test: Measures the relationship between two variables generic.
- Medium: It is the sum of the values on the number.
- Standard deviation: It is a deviation values for the arithmetic average.
- The relative weights.

Graphs used:

- Columns Bar: Columns used to represent one variable is qualitative, is also used columns fragmented and duplicative, and is used in the comparison between the variables has been used in most of the variables.

- The Circle Pie-plot: A description of one variable in the form of a circle, divided into several areas (or parts) as a variable percentage, has been used to describe the variables.

Chapter 5

Conclusions and Recommendations

Chapter 5: Conclusions and Recommendations

5.1 Conclusions

This chapter presents the main conclusions of this study, as well as some recommendations for decision makers that may help in adopting the better and safety process for medical wastes incineration at governmental hospitals in Gaza Strip. The medical waste management, mainly disposal process in Gaza Governorates needs more concern, effort and coordination. Medical wastes are collected from all health care sectors in Gaza Strip as: MOH, UNRWA, NGOs, and other special health care providers. Part of medical waste transported to domestic waste and the other part to the incinerators at Al-Shifa and Nasser hospitals. Supervision and monitoring on incinerators is weak, and protective devices for workers in the incinerators are nearly absent.

This study was conducted in the period between May and October 2010, at the surrounding area of Al-Shifa and Nasser hospitals. The sample was 176 households, with 126 (71.5%) response rates. The results of this study revealed that the fetuses deaths just before delivery in the targeted areas had a percentage of 10.3%. Infant deaths after delivery without knowing the reason in the targeted areas had 16.7%. Smokers represent among the study 37.3%. Chronic disease represents about 52.4. Congenital anomalies had 4.8%. About 83.3% of those with congenital anomalies the conditions were apparent, while in 16.7% it was invisible. Chronic diseases represent the following: Diabetes mellitus represent about 25.2% of the surveyed population. This percentage is higher than that of the Palestinian average of 9.0%; hypertension represents about 31.7% of the surveyed population, heart disease about 15.4%, asthma 21.2% and the other chronic diseases 6.5%. Respiratory disease was 76.2% of the surveyed population; bronchial asthma accounts for 8.6%, chronic bronchitis 10% and allergy accounts for 81.4% of the respiratory diseases cases.

Eye diseases represent 77.8% of all study population. From all cases affected with eye diseases 15.8% suffered from redness. About 73% suffered from sensitivity and irritation and 11.2% suffered from increase eye secretion. In addition, skin diseases represent 30% of all study population. Kidney diseases represent 13.5% of all study population. Those who suffer from liver diseases account for 7.1%, and weakened immune system represents 6.3%. Those who smell unpleasant odors in their place of residence account for 88.9%.

From all participants 88.8 % said that these bad smells are from medical waste incineration. About 71.4% of all participants claim that there is no specific time for emissions and odors and they smell it along the day, and 92.9% suffer from aggravation of the diseases they are affected with duo to exposure to the smells and emissions that arise from the incinerators. Also 89.7% of all study population claimed that there are flying ash and dust around their houses. In addition 98.4% of the total study population indicates that there is on governmental or nongovernmental agencies have visited the place. About 93.7% from all the study participants agree to the removal of the medical waste incinerators to a place far away from population residency.

The relationships between variables show that there are no statistically relationships between consanguinity and fetuses deaths (p-value of 0.204), and also with deaths after birth without knowing the reason (p-value of 0.254), and the same with having children with congenital anomalies (p-value of 0.349). In addition to that there are statistically relationships between the place of permanent residence (near Al-Shifa and Nasser hospitals) and both the suffering of a family member of any chronic illness (p-value of 0.050), and weakness in the immune system (p-value 0.023). Also there are statistically significant relationships between the inhalation of smell any unpleasant odors in the place of residence, and at least one member of the family members suffering from any chronic disease in which the p- value 0.002, and with skin diseases in which the p- value equal 0.029. Where these p-values are less than 0.05. In which the smelling any unpleasant odors increase and aggravated the chronic illnesses and skin diseases.

The study shows that there is a very statistically significant relationship between smelling unpleasant odors in the place of residence and the direction of housing from the medical waste incinerators, with a p-value 0.01 which is less than 0.05 as shown in table 4.22. This means that those who live in houses located to the north of incinerators suffer the least from the odors and emissions compared to those living in the east, west, south and southeast directions. And finally, the results of the awareness and knowledge of the study sample of the hazards associated with medical waste incineration show that, Question number 9 "I know that the incinerators must be away from the population" has occupied the first rank. Because the people who are living near the incinerators are exposed to its emissions, 100% of the participants expressed their knowledge that such incinerators should be away from the population and their households. And question number 2 " I

know the types of gases resulting from the incinerators". This is the lowest rate, which represents a value of 38% of the participants in this study.

5.2 Recommendations

In the light of the above mentioned conclusions and observations, a number of recommendations are hereby made with the hope of controlling and monitoring the incineration process of medical waste in governmental hospitals at Gaza Strip, to enhance the performance of these incinerators that lead to the reduction of the hazardous emissions. Environmental pollution leads to serious threats to the health of humans as a result of emissions emitted from incineration of medical waste in government hospitals. The following recommendations could enhance the operating efficiency of medical waste incineration in the hospitals, or at least in the process of disposal of medical waste which is considered as a branch of medical waste management:

- Increase awareness of the surrounding population regarding the effect of medical wastes incineration and methods of prevention.

- Provide regular screening programs, for the surrounding population to early detection and management of health hazards or conditions.

- Establishing efficient rules and regulations related to medical waste disposal and monitoring by MOH.

- Enforcement of legislations for the process of medical waste incineration through the cooperation between all parties such as MOH, EQA, municipalities, donors and NGOs.

- Establishing written medical waste incineration standers that congruent with international standers.

- Using other methods than incineration to decrease the quantity of medical waste hazards such as autoclaves, microwave and chemical disinfection.

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Annexes

Annex (1) Arabic questionnaire

بسم الله الرحمن الرحيم

عنوان البحث

"الآثار الصحية الناجمة عن حرق المخلفات الطبية على السكان المحيطين بالمستشفيات الحكومية".

هذه الدراسة يقوم بها الباحث كمتطلب للحصول على درجة الماجستير في الصحة العامة تخصص صحة البيئة بجامعة القدس كلية الصحة العامة.

يشكر الباحث لكم حسن المشاركة في هذه الدراسة من خلال الإجابة على أسئلة الاستبيان والتي لا تستغرق أكثر من 25 دقيقة من وقتكم الثمين وان مشاركتكم تسهم في إنجاح الدراسة التي تهدف للتعرف المشكلات الصحية التي من الممكن أن يتعرض له السكان المجاورين لمحارق النفايات الطبية الموجودة في المستشفيات الحكومية .

و يود الباحث التأكيد على أن المعلومات ستبقى سرية و لهدف البحث العلمي لذلك لا داعي لذكر الأسماء علما بأنه من حق المشارك الامتناع عن إجابة أي سؤال أو رفض المشاركة.

شكرا لكم على المشاركة

الباحث/عبدالله عمر حمدونة
كلية الصحة العامة - جامعة القدس

ملاحظة: أرجو الاتصال بالباحث للاستفسار عن أي معلومات تتعلق بالاستبيان.

- الباحث / عبدالله عمر حمدونة
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الرقم التسلسلي ( ) **استبيان** التاريخ: / /2010

المعلومات الشخصية:

1-العمر :.....

2-الجنس: 1/ذكر ☐ 2/ أنثى ☐

3-الحالة الاجتماعية: 1-أعزب ☐ 2-متزوج/ة ☐ 3 – مطلق/ة ☐ 4- أرمل/ة ☐

4- درجة قرابة الزوجين: 1- قريب ☐ 2- غريب ☐

5- عدد أفراد الأسرة ( ) 1- ذكور ( ) 2- إناث ( )

6-العمل: 1- بدون ☐ 2- زراعة ☐ 3 – صناعة ☐ 4- تجارة ☐
5-وظيفة عامة ☐ 6- مهني ☐ 7- عامل ☐

7- الدخل الشهري مقدرا"بالشيكل:.....

8-هل الدخل الشهري يغطي الاحتياجات الشهرية؟ 1- نعم ☐ 2- لا ☐

9- مستوى التعليم: 1- ابتدائي ☐ 2- إعدادي ☐ 3- ثانوي ☐ 4- جامعي ☐

10- هل توفى لكم أطفال قبل الولادة؟ 1-نعم ☐ 2-لا ☐

11- هل توفي أي من أطفالكم بعد الولادة ؟ 1- نعم ☐ 2-لا ☐

12- إذا كانت الإجابة نعم كم كان عمر الطفل المتوفى:.....

13-سبب الوفاة:.....

14- هل تم إنجاب أطفال مصابين بتشوهات خلقية؟ 1- نعم ☐ 2-لا ☐

15- هل التشوهات ظاهرة؟ 1-نعم ☐ 2- لا ☐

16- هل أنت مدخن/ة: 1-نعم ☐ 2- لا ☐

17-كم عدد سنوات التدخين؟.....

ظروف و بيئة المسكن:

18- مكان الإقامة الدائم: 1- قرب مستشفى الشفاء ☐ 2-قرب مستشفى ناصر ☐

19- تاريخ السكن في هذا المكان منذ : .....

20-يقع المسكن بالنسبة لمحرقة النفايات الطبية في الجهة :

1/الشرقية ☐ 2/الغربية ☐ 3/الشمالية ☐

4/الجنوبية ☐ 5/الجنوب الشرقي ☐ 6/الشمال الشرقي ☐

21-كم عدد الغرف في المنزل؟.....

22-نوع المنزل الذي تعيش فيه العائلة:1/الباطون ☐ 2/الاسبست ☐ 3/ غير ذلك.....

23-هل التهوية في المنزل؟ 1/عالية ☐ 2/متوسطة ☐ 3/رديئة ☐

24-هل تدخل الشمس في المنزل بصورة؟ 1/عالية ☐ 2/متوسطة ☐ 3/رديئة ☐

الحالة الغذائية للأسرة:

25 – هل تعتمد الأسرة في غذائها على الأنواع التالية؟

1–خضروات ☐ 2 –فواكه ☐ 3 –لحوم ☐

4– اسماك ☐ 5– كل ما سبق ☐

26– هل تتناول الأسرة جزء من طعامها (فواكه–خضار)من حديقة المنزل؟ 1– نعم ☐ 2–لا ☐

27–هل تعتمد الأسرة في غذائها على طعام؟ 1–طازج ☐ 2–مجمد ☐ 3–كلاهما ☐

الوضع الصحي للأسرة:

28– هل عانى أو يعانى احد أفراد الأسرة من أي مرض مزمن ؟

1 –نعم ☐ 2–لا ☐

29– إذا كانت الإجابة نعم فهل هو؟ (ممكن اختيار أكثر من إجابة)

1/ السكري ☐ 2/ الضغط ☐ 3/ القلب ☐

4/الأزمة ☐ 5 / سرطان الدم ☐ 6/ سرطان الرئة ☐ أمراض مزمنة أخرى ☐

30–هل تتلقى علاجا منتظما" للأمراض المزمنة؟ 1–نعم ☐ 2– لا ☐

31–حسب تقديرك كم عدد زيارات أفراد الأسرة للمراكز الصحية للعلاج شهريا"؟

1/ من **2– 4** مرات ☐ **2/** من **4–6** مرات ☐ **3/ 6** مرات فأكثر ☐

32–هل عانى أو يعاني احد أفراد الأسرة من أي أمراض صدرية؟ 1–نعم ☐ 2–لا ☐

33–إذا كانت الإجابة السابقة نعم فهل المرض هو:

1/ ربو شعبي ☐ 2/ التهاب الشعب الهوائية المزمنة ☐ 3/ انتفاخ الرئتين ☐ 4/ حساسية ☐

34-هل أصيب أحد أفراد الأسرة بأمراض العيون؟

1 -نعم ☐ 2-لا ☐

35-إذا كانت الإجابة نعم فهل الأمراض مثل:

1/ احمرار ☐ 2/ حساسية و تهيج ☐ 3/ زيادة في إفراز الدمع ☐

36-هل عانى أو يعاني احد أفراد الأسرة من أي أمراض جلدية؟ 1-نعم ☐ 2-لا ☐

37-هل واجه أي من أفراد الأسرة مشاكل تتعلق بالكلى؟ 1 -نعم ☐ 2-لا ☐

38- هل واجه أي من أفراد الأسرة مشاكل تتعلق بالكبد؟ 1-نعم ☐ 2-لا ☐

39- هل واجه أي من أفراد الأسرة ضعف في الجهاز المناعي؟ 1 -نعم ☐ 2-لا ☐

الانبعاثات و الروائح :

40-هل تستنشقون روائح كريهة في مكان سكناكم؟

1 -نعم ☐ 2-لا ☐

41-هل هذه الروائح باعتقادكم منبعثة من؟

1/ حرق النفايات الصلبة ☐ 2/ حرق النفايات الطبية ☐

3/ انبعاثات من عادم السيارات ☐ 4/ غير ذلك.....

42-هل هناك وقت محدد حسب رأيكم تكون فيه تلك الانبعاثات و الروائح كثيرة و مزعجة؟

1 -نعم ☐ 2-لا ☐

43-إذا كانت الإجابة نعم هل باعتقادكم الوقت يكون في :

1/الصباح ☐ 2 /الظهيرة☐ 3/ المساء ☐ 4/جميع الأوقات ☐ 5/لا اعلم ☐

44-هل هذه الروائح و الانبعاثات حسب رأيكم:

1/مريحة ☐ 2/ غير مريحة ☐ 3/ كريهة ☐ 4/ ليس لها رائحة ☐

45-هل باعتقادكم أن هذه الانبعاثات و الروائح تعمل على تهييج و زيادة المرض1-نعم ☐ 2-لا ☐

46-هل تقومون بملاحظة الغبار و الرماد المتطاير حول منزلك؟ 1-نعم ☐ 2-لا ☐

47-إذا كانت الإجابة نعم فهل تعتقدون أن مصدرها من ؟

1/ حرق النفايات الصلبة ☐ 2/ حرق النفايات الطبية ☐

3/ انبعاثات من عادم السيارات ☐ 4/ غير ذلك.....

48-أكثر الأماكن التي يتساقط عليها الغبار و الرماد؟

1/الشرفات ☐ 2/غرف المعيشة ☐ 3/ المطبخ ☐

4/ الملابس المغسولة ☐ 5/ الحديقة المنزلية ☐ 6/ جميع ما سبق ☐

49-هل يتم زيارتكم من أي جهة حكومية أو غير حكومية لمتابعة هذه المشكلة؟ 1-نعم ☐ 2-لا ☐

50-باعتقادك ما هو أفضل حل لهذه المشكلة:

1.التخفيف من كمية الحرق ☐ 2. الحرق في أوقات معينة و معروفة ☐ 3. إزالة المحرقة من المكان ☐

4.إطالة عمود المدخنة ☐ 5. إضافة تقنيات حديثة على جهاز الحرق مثل الفلتر ☐

المعرفة و الوعي:

الرقم	العبارة	نعم	لا
1	اعتقد أنني املك المعرفة الكافية عن الأضرار الصحية الناجمة عن حرق المخلفات الطبية.		
2	اعرف أنواع الغازات الناتجة من المحرقة.		
3	اعرف أنواع الأمراض التي تسببها الغازات الناتجة عن المحرقة.		
4	اعلم جيدا أن قرب سكنى من المحرقة يعرضني لأخطار صحية أكثر.		
5	اعلم أن المشاركة في ندوات ذات علاقة بالأخطار البيئية و الصحية الناتجة عن المحرقة تجنب السكان هذه الأخطار.		
6	أميز بين رائحة الدخان الناتج من المحرقة و دخان ناتج من أماكن أخرى.		
7	اعرف طرق الوقاية من الأخطار الصحية الناتجة من المحرقة.		
8	اعرف أسباب زيادة المخاطر الصحية الناتجة عن المحرقة نتيجة الحرق غير الكامل للمخلفات الطبية.		
9	أعرف أن هذه المحارق يجب أن تكون بعيدة عن السكان.		
10	أعرف أن هذه المحارق يجب أن تكون مطابقة للمواصفات العالمية.		
11	أعرف أن هذه المحارق يجب أن تعمل طبقا" للمواصفات العالمية.		

شاكرين لكم حسن تعاونكم،،،،،،،،،،،،،،،

ملاحظة:أرجو الاتصال بالباحث للاستفسار عن أي معلومات تتعلق بالاستبيان.

- الباحث / د. عبدالله عمر حمدونة
- بريد الكتروني/ abedhamdona@hotmail.com
- جوال/0598855257

Annex (2) English questionnaire

Explanatory letter

"The Impact of Medical Wastes Incineration at Governmental Hospitals on the Households in the Surrounding Areas"

Dear Participant,

This study carried out by the researcher as a requirement to obtain a master's degree in public health specialty of environmental health at the Al-Quds University – Palestine

Thank researcher you for your participation in this study by answering the questions of the questionnaire and that takes no more than 25 minutes of your valuable time and your participation contribute to the success of the study, which aims to identify health problems that could be exposed population adjacent to medical waste incinerators in governmental hospitals.

And the researcher would like to emphasize that the information will remain confidential and for the purpose of scientific research that does not need to mention names, note that the right to refrain from participating answer any questions or refused to participate.

Thank you for your participation

Researcher,
Dr. Abdallah Omer Hamdouna
Mobile: 0598855257
Email: abedhamdona@hotmail.com

S.N. ( ) Questionnaire Date: \ \2010

Personal data:

1- Age:……..

2- Gender: 1- Male ☐ 2- Female ☐

3-Marital status: 1-Single ☐ 2-Married ☐ 3-Divorced ☐ 4- Widow ☐

4-Consanguinity: 1- near ☐ 2-far ☐

5-Number of family members: ( ) 1- Male ( ) 2- Female ( )

6-Type of job:1- without ☐ 2- Agriculture ☐ 3- Industry ☐ 4-Trade ☐
5- Public job ☐ 6-Technician ☐ 7-worker ☐

7-Monthly income:..... shekel

8-Did the income meet the expenses 1- Yes ☐ 2- No ☐

9-Education:

1- Elementary ☐ 2- Preparatory ☐ 3-Secondary ☐ 4-University ☐

10-Did you have fetuses' deaths just before delivery? 1-Yes ☐ 2- No ☐

11-Did any of your infant deaths after birth without knowing the reason?

1-Yes ☐ 2-No ☐

12- If the answer is yes, how old was the born-baby?.....

13-Cause of death:……

14-Do you have any children with congenital malformation? 1-Yes ☐ 2-No ☐

15- Are those malformations apparent and clearly manifested? 1-Yes☐ 2-No ☐

16-Are you a smoker? 1-Yes ☐ 2- No ☐

17-How long have you been smoke ..... years.

Housing

18-Place of residence: 1- near Al-Shifa hospital ☐ 2- near Nasser hospital ☐

19-Date of permanent residence:.....

20 Housing site for medical waste incinerator in the:

1-East ☐ 2-west ☐ 3-north ☐

4-south ☐ 5-Southeast ☐ 6-northeast ☐

21 How many rooms are there in the house?.....

22 Type of house that the family live in: 1-Concrete☐ 2-Asbestos ☐ 3-Others……..

23 Is exposure to air? 1-High ☐ 2-moderate ☐ 3-low ☐

24 Is entrance of sun rays to the house? 1-High ☐ 2-moderate ☐ 3-low ☐

Diet status to family:

25 Does the family depends on?

1- Vegetables ☐ 2-fruits ☐ 3-Meat ☐ 4-fish 5-all previous ☐

26 Does the family have its food (fruit - vegetables) from the house garden?

1- Yes ☐ 2- no ☐

27-Does the family depends on? 1- Fresh food☐ 2-Frozen food ☐ 3-Both ☐

Health status of the family:

28 Does/did one of the family members suffer from any chronic illness? 1- Yes☐ 2- no ☐

29 If yes, does it? (You can choose more than one answer)

1-Diabetes mellitus ☐ 2-hypertension ☐ 3-heart disease ☐ 4-Asthma ☐

5-blood cancer ☐ 6-lung cancer ☐ 7-other chronic disease ☐

30 Do you receive regular treatment for chronic diseases? 1-Yes ☐ 2-No ☐

31 In your opinion, how many times do the family members visits clinics for treatment monthly?

1\ 2-4 times ☐ 2\ 4-6 times ☐ 3\ more than 6 times ☐

32Do/did you suffer from any of respiratory diseases? 1-Yes ☐ 2- No ☐

33If the previous answer is yes, the disease is:

1-Bronchial Asthma ☐ 2-Chronic Bronchitis ☐ 3-Emphysema ☐ 4-allergy ☐

34 Are any of the family members infected with eye diseases? 1-Yes ☐ 2- No ☐

35 If yes, the diseases are:

1-Redness ☐ 2-Sensitivity and irritation ☐ 3-Increase in the secretion of tears ☐

36 Does any of the family members infected with skin diseases?

1- Yes ☐ 2- no ☐

37 Does any of the family members infected with kidney disease?

1- Yes ☐ 2- no ☐

38 Does any of the family members infected with Liver disease? 1- Yes ☐ 2- No ☐

39 Does any of the family members infected with immune system? 1- Yes ☐ 2- No ☐

Emissions and odors:

40 Do you smell any unpleasant odors in your place of residence?

1- Yes ☐ 2- no ☐

41 Do you think this smells emanating from?

1- Burning of solid waste ☐ 2- incineration of medical waste ☐

3- Emissions from vehicle exhaust ☐ 4- etc..... ☐

42 In your opinion, is there a specific time for emissions and odors?

1- Yes ☐ 2- no ☐

43 If yes, do you think the time is at?

1- morning ☐ 2- afternoon ☐ 3- evening ☐ 4- all times ☐ 5- I do not know ☐

44 Are these smells and emissions in your opinion?

1- Nice ☐ 2- not nice ☐ 3- bad ☐ 4- doesn't have smell ☐

45 Do you think these smells and emissions exaggerate and increase the disease?

1- Yes ☐ 2- no ☐

46 Do you watch the flying ash and dust around house?

1- Yes ☐ 2- no ☐

47 If the answer is yes, what is the source in your opinion?

1-Burning solid waste ☐ 2- Burning medical waste ☐

3-Emission of vehicles exhausts ☐ 4- Others…….. ☐

48 The most places where ashes and dusts drop

1- Balconies ☐ 2- Living rooms ☐ 3- kitchen ☐

4- Washed clothes ☐ 5- house garden ☐ 6-all of the above ☐

49 Do any governmental or nongovernmental unit visit you to investigate this problem?

1- Yes ☐ 2- no ☐

50 In your opinion what is the best solution?

1- Reducing the burning ☐ 2- Burning in certain and declared times ☐

3- Removing burning spot ☐ 4- Extending the smokestack ☐

5- Installing modern technology to the burning device such as filters ☐

Knowledge and awareness

S.N.	Statement	Yes	No
1	I think I am aware enough about the health harms resulted from burning the medical waste.		
2	I know types of gases resulted from the burning unit.		
3	I know types of diseases caused by gases resulted from the burning unit.		
4	I am aware that living near the burning unit exposes me to more health dangers.		
5	I know that attending sessions related to health and environmental dangers resulted from the burning protect residents from these dangers.		
6	I distinguish between smoke emitted from the burning and smoke emitted from other places.		
7	I know ways of protection against health dangers resulted from the burning.		
8	I know the causes of the increase in the health dangers resulted from the burning due to incomplete burning of medical waste.		
9	I know that the incinerators must be away from the population		
10	I know that these burning devices must conform to international standards.		
11	I know that these burning devices must work under international standards.		

Note: You are kindly invited to contact the researcher for any inquiry about the questionnaire

Researcher: Dr. Abdallah Omer Hamdouna

Email: abedhamdona@hotmail.com

Cell phone: 0598855257

Annex (3) approval of Helsinki

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Palestinian National Authority
Ministry of Health
Helsinki Committee

السلطة الوطنية الفلسطينية
وزارة الصحة
لجنة هلسنكي

التاريخ7/6/2010

Name:

الاسم: عبدالله عمر حمدونة

I would like to inform you that the committee has discussed your application about:

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:-

The impact of medical wastes incineration at governmental hospitals on the households in the surrounding areas.

In its meeting on June 2010

و ذلك في جلستها المنعقدة لشهر 6 2010

and decided the Following:-

و قد قررت ما يلي:-

To approve the above mention research study.

الموافقة على البحث المذكور عاليه.

Signature
توقيع

Member
عضو

Member
عضو

Chairperson

Conditions:-

- Valid for 2 years from the date of approval to start.
- It is necessary to notify the committee in any change in the admitted study protocol.
- The committee appreciate receiving one copy of your final research when it is completed.

Annex (4) Arabic abstract

ملخص الرسالة

"الآثار الصحية الناجمة عن حرق المخلفات الطبية على السكان المحيطين بالمستشفيات الحكومية"

إن هذه الدراسة تهدف إلى تقييم الآثار الصحية التي من الممكن أن تؤثر على صحة المواطنين الذين يقطنون بالقرب من المستشفيات الحكومية في قطاع غزة و التي تحتوي على وحدات الترميد الخاصة بحرق النفايات و المخلفات الطبية التي يتم جمعها من المراكز الصحية حكومية كانت أو غيرها من المؤسسات الأهلية الصحية. وقد تمت هذه الدراسة في عام 2010 ميلادية في كل من مدينة غزة و مدينة خان يونس _ قطاع غزة. كان حجم العينة بيتا"126 وتم اختيارها بطريقة المسح وتم توزيع الاستبيانات على كلِ بيت بالقرب من مستشفى الشفاء و مستشفى ناصر على حد سواء و من كل الاتجاهات المحيطة بالمستشفيين. في حدود مسافة 500 مترو كانت العينة كالتالي: كل البيوت حول مستشفى الشفاء بغزة80 بيتا"، و كل البيوت حول مستشفى ناصر بخان يونس 46 بيتا"، وذلك حسب الكثافة السكانية. وهدفت الدراسة إلى تقييم الآثار السلبية على صحة الإنسان وذلك نتيجة للتعرض للغازات المنبعثة من هذه المحارق و تتضمن التأثير على الجهاز التنفسي و الجهاز المناعي وكلاً من الجلد والعيون و على أعضاء أخرى في الجسم. لهذا الغرض صممت دراسة وصفية تحليلية لتطبيق البحث وجمع البيانات. لقد تم توزيع الاستبيانات باللغة العربية على العينة وكانت نسبة الاستجابة 71.5.% (126 من 176) ولتحليل البيانات تم استخدام المجموعة الإحصائية للعلوم الاجتماعية.

أما بالنسبة للنتائج فكانت فيما يتعلق بوفاة الأطفال قبل الولادة في المناطق المستهدفة نسبة 10.3 ٪. وكانت وفيات الأطفال بعد الولادة من دون معرفة السبب في المناطق المستهدفة 16.7 ٪. الأمراض المزمنة 52.4%. و التشوهات الخلقية بنسبة 4.8% و كانت التشوهات الظاهرة منها بنسبة 83.3% وغير الظاهرة بنسبة 16.7%. و أيضا كانت نسبة الإصابة بمرض السكري و الضغط و أمراض القلب و الأزمة و الأمراض المزمنة الأخرى هي 52.2%، 31.7%، 15.4%، 21.2%، 6.5% على التوالي. أما أمراض الجهاز التنفسي فكانت النسبة 76.2% من كل العينة المستهدفة و تمثلت بالآتي: الأزمة 8.6%، التهاب الشعب الهوائية 10%، و الحساسية 81.4%.أمراض العيون تمثلت بنسبة 77.8% منها 15.8% احمرار العيون و 73% حساسية و 11.2% كانوا يعانون من زيادة في إفراز الدمع. أما الأمراض الجلدية فكانت 30% و أمراض الكلى 13.5% و أمراض الكبد 7.1% و أمراض متعلقة بالجهاز المناعي 6.3%. أما بالنسبة لاستنشاق الروائح الكريهة في المكان فكانت النسبة 88.9% و يعتقد 88.8% من العينة أن مصدرها محرقة النفايات الطبية و 92.9% يعانون من تهيج المرض نتيجة استنشاق هذه الروائح. و قد أفاد 98.4% من السكان بأنه لم يتم زيارتهم من أي جهة حكومية أو غير حكومية لحل المشكلة. و 93.7% يفضلون إزالتها من المكان. و أظهرت الدراسة بأن هناك علاقة ذات دلالة إحصائية بين السكن الدائم بالقرب من محرقة النفايات و الإصابة بالأمراض المزمنة و الإصابة بضعف المناعة، و هذا يشير إلى أن من يقطن بالقرب من المحارق يكون أكثر تعرض للإصابة بهذه الأمراض. و وجد من خلال الدراسة إلى انه لا يوجد علاقة ذات دلالة إحصائية بين درجة القرابة و موت الأجنة و موت الأطفال بعد الولادة و التشوهات الخلقية. و قد أظهرت الدراسة العديد من العلاقات الأخرى.

وكانت من أهم توصيات الدراسة العمل على إعادة وضع هذه المحارق و الأخذ بعين الاعتبار و تكاتف الجهود من كل المعنيين بتحسين عمل و آلية حرق النفايات الطبية و أيضاً استخدام طرق أخرى لمعالجة المخلفات الطبية وزيادة الوعي لدى السكان بمخاطر الانبعاثات التي تنطلق نتيجة حرق المخلفات الطبية لدى المواطنين.