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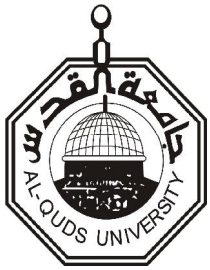

Deanship of Graduate Studies
Al-Quds University

Relationships between Burning of Solid Wastes and the Development of Clinical Signs of Adverse Health Effects in Biet Fourik and Jabalia Camp, Palestine

Submitted by
Salim Eid El-Abed Ramadan

MPH Thesis

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AL-Quds University

December 2009

Dedication

To His Highness Royal Prince

AL-WALEED BIN TALAL

Without his generous donation this work might not be completed.

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 a higher degree to any other university or institution.

Signed

Dr. Salim Eid El-Abed Ramadan

Date: December 2009

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List of Abbreviations

Ah	Aryl hydrocarbon
ATSDR	Agency for Toxic Substances and Disease Registry
C3	Complement Factor
CDDs	chlorinated dibenzo-p-dioxins
CDFs	chlorinated dibenzofurans
CdO	Cadmium Oxide
CFHP	Chief Field Health Programs
cm^3	Cubic Centimeter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COPD	Chronic Obstructive Pulmonary Disease
Cr	Chromium
Cr III	Trivalent Chromium
Cr VI	Hexavalent Chromium
CVD	Cardiovascular Disease
DCFHP	Deputy Chief Field Health Programs
DDT	Dichlorodiphenyltrichloroethane
DLC	dioxins like compounds
DM	Diabetes mellitus
FDCO	Field Disease Control Officer
Fe^{2+}	Ferrous
Gm	Gram
GNP	Gross National Product
H_2SO_4	sulfuric acid
HbCO	Carboxyhemoglobin

HCl	Hydrogen Chloride
Hg	Mercury
Hg^{+}	mercurous state
Hg^{2+}	mercuric state
HgS	mercuric sulfide
HNO_3	nitric acid
IARC	International Agency of Research on Cancer
IgA	Immunoglobulin A
IgG	Immunoglobulin G
IgM	Immunoglobulin M
JICA	Japan International Cooperation Agency
Kcal	Kilocalorie
Kg	Kilogram
Km	Kilometer
LD	Lethal Dose
M	Meter
m.t	Metric Ton
M:F	Male : Female ratio
m^3	Cubic Meter
Mg	Milligram
MOH	Ministry of Health
MOPIC	Ministry of Planning and International Cooperation
MSW	Municipal solid wastes
$N_2 O_4$	dinitrogen tetra oxide
N_2O	nitrous oxide
N_2O_3	dinitrogen trioxide

N_2O_5	Dinitrogen penta oxide
NaCl	Sodium Chloride
NAP	The National Academies Press
Ni	Nickel
Ni $(CO)_4$	Nickel carbonyl
NIOSH	National Institute for Occupational Safety and Health
NO	Nitric oxide
NO_2	nitrogen dioxide
NOx	Nitrogen Oxides
OSHA	Occupational Safety and Health Administration
PCBs	polychlorinated biphenyls
PEL	permissible exposure limit
PNA	Palestinian National Authority
POPs	persistent organic pollutants
Ppm	Parts-per-million
Ppt	Parts-per-trillion
PVC	polyvinyl chloride
S_2O	Disulfur monoxide
S_3O	Trisulfur monoxide
SO	sulfur monoxide
SO_2	sulfur dioxide
SO_3	sulfur trioxide
SOx	Sulphur oxides
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin, simply2,3,7,8-TCDD,
TEF	Toxic Equivalency Factor
TEQ	Toxicity Equivalence

TSAC	Technical and Scientific Advisory Committee
UNEP	United Nations Environment Program
UNRWA	United Nations for Relief and Work Agency
US	United States
USEPA	United States Environment Protection Agency
USFDA	United states Food and Drug Agency
USGBC	United States Green Building Council's
VOCs	Volatile Organic Compounds
WHO	World Health Organization

Abstract

The study of "Relationships between Burning of Solid Wastes and the Development of Clinical Signs of Adverse Health Effects in Beit Fourik and Jabalia Camp, Palestine" was conducted in the year 2009 at Jabalia camp block 3, in Gaza strip and at Beit Fourik town in the West Bank. The study sample was 375 subjects chosen by random systemic selection (every fourth family subject of the study population); about 20% from Jabalia camp and 80% from Beit Fourik which had been divided into four equal areas according to the location from the landfill. The 75 subjects in each group were chosen by random systemic selection. The study aimed at assessing the adverse effects due to the exposure to emitted gases and particulate matters from open burning of solid waste on health status of the surveyed population in the two specific areas. These adverse health effects include carcinogenic, male fertility and sex ratio, congenital anomalies, Diabetes mellitus and respiratory system diseases. A comparative descriptive study was designed and had been used to implement the research and to collect the data, and a self-administered questionnaire (Arabic language) was distributed to all randomly selected population. The response rate was 94.4% (354 persons of 375) and 99.4% (352 of 354) of returned answered questionnaires were properly answered. The SPSS statistical package was used to analyze the collected data. The results revealed that about 3.6% of the surveyed populations have had cancer compared to 0.05% Palestinian average; about 10% had congenital anomalies which is three times higher than that of 3.16 for Egypt. In about 66.7% of those with congenital anomalies the conditions were apparent, while in 33.3% it was invisible. Diabetes mellitus represent about 10.6% of the surveyed population with a mean of age of 41.30 at the time of diagnosis. This percentage is higher than that of the Palestinian average of 9.0%. Respiratory disease was15.2% of the surveyed population; bronchial asthma accounts for 48.0%, chronic bronchitis 46.0% and pulmonary emphysema 6.0% of the respiratory diseases cases. Results for fertility and sex ratio were; family size average of surveyed total population is 6.51 members while in Jabalia camp 7.13 and in Beit Fourik 6.33 compared to Gaza strip average of 6.5 and 5.5 for the West Bank. The results show more female count in area of study, and the sex ratio of males to females is 100.6 to 100.0 compared to that of Palestine (103:100). The closure of all random landfills, prohibition of the open burning of solid waste, encouragement of recycling, reuse, reduction of the solid waste generation and the increase of awareness campaigns are the main recommendations that may help reduce the adverse health effects of the current practices.

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Chapter1: Introduction

1.1 Background

The environment is an integral part of human life, the quality of which plays a critical role in human health**.** Human health is very closely linked to environmental quality, as the etiology of most of the human diseases being related to the status of the living environment of man. According to statistics, 25% of all preventable illnesses are caused by detrimental environmental factors (UNEP 2002, WHO 2002). In Africa, the environmental influence on disease incidence is even higher, being about 35%**.** Both the developed and developing countries are faced with the problems related to environmental pollution, sourced in air, water or land, and caused by anthropogenic activities of man, disturbing the habitat around. Smoky indoor air, polluted ambient air, poor sanitation and contaminated water play a crucial role in causing ill health (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 can be classified into different types depending on their source:

-Municipal solid wastes (MSW) which consist of all solid and semisolid materials discarded by a community. The fraction of MSW produced in domestic household is called refuse which is composed of garbage (food wastes), rubbish (glasses, tin cans and paper) and trash (larger items like tree limbs, old appliances and pallets) (Peirce, et al., 1998).

-Industrial waste such as hazardous waste.

-Biochemical waste or hospital waste as infectious waste. (Peirce, et al, 1998-a).

Burning of solid waste under conditions of low temperature (250-700 C^{o}), oxygen-starved and the presence of hydrochloric acid or chlorine, and mixed garbage will produce several air toxicants. These toxicants include total dioxins and furans, volatile organic compounds, toxic metals including mercury, arsenic, barium, cadmium, lead, chromium and titanium, particulate matter, hydrogen chloride (HCl), carbon monoxide (CO), and oxides of sulfur and nitrogen. Of major concern to the medical and environmental communities of the uncontrolled random burning of solid wastes is the production and emission of dioxins and furans into the immediate environment of humans.

1.1.1 DIOXINS:

The dioxins, furans and dioxins like compounds (DLC) are classified as primary, qualitative and non-biodegradable environmental pollutants.

Pollutants which are substances (smoke), chemicals (SO, dioxins) or factors which cause potential or actual adverse effects on the nature or any constituents of the environment are classified as:

-Primary or secondary pollutants: the primary pollutants are persistent in the environment in the form they passed into it e.g. (dioxins).

-Qualitative or quantitative: qualitative pollutants do not normally occur in the environment but are passed into it through human activities e.g. (dioxins).

-Biodegradable and non-biodegradable: Non-biodegradable pollutants persist for a long period in the environment e.g. dioxins (Peirce, et al.1998).

Dioxins are organic environmental pollutants sometimes referred to as one of the most toxic man made chemical compounds made by mankind. They are a group of chemical compounds that share certain chemical structures and biological characteristics, which include 75 different chlorinated dibenzo-p-dioxins (CDDs), 135 chlorinated dibenzofurans (CDFs) and certain polychlorinated biphenyls (PCBs). The one considered most toxic and extensively studied is referred to as 2,3,7,8-tetrachlorodibenzo-p-dioxin, simply 2,3,7,8-TCDD, TCDD or dioxin (Halden, 2004).

Dioxin is formed as an unintentional by-product of many industrial and chemical processes as pesticides, cosmetics manufacturing and smeltering. Also they are produced as a result of incineration of commercial and municipal wastes, backyard burning of household wastes, especially plastics, chlorine bleaching of pulp and paper and burning of fossil fuels (automobiles exhaust, coal, oil, and natural gas). Cigarette smoking also contains small amounts of dioxins. This is mostly the anthropogenic sources of dioxins which dominate the natural sources as forest fires or volcanoes (USFDA, 2008).

Dioxins are very small white crystals in its pure state. When both anthropogenic and natural dioxins are emitted into the air, some dioxins may be transported to long. Because of this, dioxins are ubiquitous in the world. When dioxins are released into water, they tend to settle into sediments where they can be further transported or ingested by fish and other aquatic organisms. Dioxins decompose very slowly in the environment and can be deposited on plants and taken up by animals and aquatic organisms. Dioxins may be concentrated in the food chain so that animals have higher concentrations than plants, water, soil, or sediments. Within animals, dioxins tend to accumulate in fat as it has a great affinity to adipose tissues.

As the humans are on the top of food chain, they are the most affected due to high accumulation of dioxins. It is also excreted in the milk, so it can pass to breast fed babies (USFDA, 2008).

Dioxins can travel long distance in the atmosphere, and because of this, dioxins are found in most places in the world, which means that a country like Palestine may be exposed to dioxins created in other countries. When dioxins (water insoluble) are released into water, tend to settle into sediments where they can be further transported or ingested by fish and other aquatic organisms .As it decomposes very slowly in the environment, they can be deposited on plants and taken up by animals mainly herbivores, these substances work their way up the food chain by dissolving and remaining stored in the body fat of animals and aquatic organisms. So the meat, dairy products and fish have higher levels of dioxins than plants, water, soil, or sediments. Most of the population has low-level exposure to dioxins. Although dioxins are environmental contaminants, most dioxin exposure occurs through the diet, with over 95% coming through dietary intake of animal fats. Small amounts of exposure occurs from breathing air containing trace amounts of dioxins on particles and in vapor form, from inadvertent ingestion of soil containing dioxins, and from absorption through the skin contacting air, soil, or water containing very small amounts of dioxins.

Dioxins are excreted as glucuronide or sulfate conjugated forms through bile into feces and through breast milk of nursing mothers in an intact form or hydroxylated and methoxylated metabolites of dioxins (ATSDR, 2006). Dioxins are most often found in mixtures rather than as single compounds and they have different toxicities. The most toxic forms of dioxin is 2, 3, 7, 8-TCDD.The method for comparing the toxicity of different types or mixtures of dioxins to the toxicity of 2, 3, 7, 8-TCDD is called Toxicity Equivalence (TEQ).

There is no safe level of dioxins; even concentrations of parts-per-trillion (ppt) can impact human and animal tissue. Some of the health effects of dioxins occur at levels to which all of us are exposed in our daily lives.

1.1.2 Hydrogen Chloride (HCL):

Hydrogen Chloride is a Diatomic Molecule which consists of two atoms. The atoms in diatomic molecules may be similar (e.g. Oxygen, Nitrogen, and Hydrogen) or they may be dissimilar (e.g. Carbon Monoxide, Hydrogen Chloride.) (www.ucc.ie).

Effects on Humans: Hydrogen chloride is irritating and corrosive to the eyes, skin, and mucous membranes. Exposure to high concentrations can cause laryngitis, bronchitis, and

pulmonary edema (Rom 1983). Brief exposures (up to a few minutes) to concentrations in the range of 1,300 to 2,000 ppm are lethal to humans (Braker and Mossman, 1980).

1.1.3 Carbon Monoxide (CO):

Carbon monoxide is a colorless, odorless, tasteless and highly toxic gas. Its molecules consist of one carbon atom and one oxygen atom, connected by a covalent double bond and a dative covalent bond, burning in air with a characteristic blue flame, producing carbon dioxide (CO_2) poisoning occurs after the inhalation , being colorless, odorless, tasteless, and non-irritating, it is very difficult for people to detect. Exposures at 100 ppm can be life-threatening. (Ernst, Zibrak, 1998). Carbon monoxide poisoning is the most common type of fatal poisoning in many countries (Omaye, 2002). It combines with hemoglobin forming carboxyhemoglobin in the blood and prevents binding of oxygen, so causing anoxemia (Buckley, Isbister, Stokes and Juurlink 2005).

Symptoms of mild poisoning include headaches, vertigo, and flu-like effects; larger exposures can lead to significant toxic effect on the heart and central nervous system and even death. Carbon monoxide can also have severe effects on the fetus of a pregnant woman

1.1.4 Sulfur Oxides:

Sulfur oxide (SO_x) refers to one or more of the following: Lower sulfur oxides (SnO, S_7O_2 and S_6O_2), sulfur monoxide (SO), sulfur dioxide (SO_2), sulfur trioxide (SO_3) and higher sulfur oxides (Greenwood, Norman, Earnshaw, 1997).

1.1.5 Nitrogen Oxides:

The term nitrogen oxide typically refers to any binary compound of oxygen and nitrogen, or to a mixture of such compounds: Nitric oxide (NO), nitrogen dioxide (NO_2), nitrous oxide (N_2O), dinitrogen trioxide (N_2O_3), dinitrogen tetra oxide (N_2O_4) and dinitrogen penta oxide (N_2O_5). NOx react with ammonia, moisture, and other compounds to form nitric acid vapor which can penetrate deeply into sensitive lung tissue and damage it, causing premature death in extreme cases. Inhalation of such particles may cause or worsen respiratory diseases such as emphysema and bronchitis it may also aggravate existing heart disease. (www.epa.gov/air/urbanair).

NOx react with volatile organic compounds in the presence of heat and sunlight to form ozone. Ozone can cause adverse effects such as damage to lung tissue and reduction in lung function mostly in susceptible populations (children, elderly, and asthmatics). Ozone can be

transported by wind currents and cause health impacts far from the original sources. (www.epa.gov/airscience). NOx (especially N_2O) destroys ozone layer where this layer absorbs ultra violet rays, which is potentially damaging to life on earth. (NOAA, 2009)

1.2 Problem statement

During the first Intifada (1987-1993) the Palestinian people has burned thousands of vehicles' tiers and solid wastes. Due to absence of law and regulation enforcement, all types of solid wastes which collected in random landfills are burned in open air exposing the people to the hazards of emitted gases and particulate matter which may adversely affect the health of people. The effects of emitted gases and particulate matter on human health in Palestine had not been studied before, this research try to describe the clinical signs of the adverse effects of the emitted gases and particulate matter resulting from burning of plastics and solid wastes in open air.

1.3 Purpose

To study the effects of emitted gases and particulate matter as a result of burning of solid waste on the Palestinian people health in specific areas in the Gaza Strip and the West Bank.

1.4 Objectives

- To assess the carcinogenic effects of exposure to emitted gases and particulate matter resulting from burning disposables and plastic materials on health status of surveyed population in selected areas in Palestine.
- To assess the clinical effect of emitted gases and particulate matter on male fertility and sex ratio.
- To assess the effect of emitted gases and particulate matter on congenital anomalies.
- To assess the clinical effect of emitted gases and particulate matter on Diabetes.
- To assess the clinical effect of emitted gases and particulate matter on respiratory system
- To compare the effects of emitted gases and particulate matter in the selected areas.
- To suggest suitable recommendations to mitigate the adverse impacts on health in Palestine through more effective preventive measures.

1.5 Research Questions

What are the effects of burning solid waste on health?

Is there a relationship between burning solid waste and cancer?

Is there a relationship between burning solid waste and infertility and offspring sex ratio?

Is there a relationship between burning solid waste and congenital anomalies?

Is there a relationship between burning solid waste and diabetes mellitus?

1.6 Justification of the study

Till 2009, Palestine is still under occupation and not independent. One of the occupation consequences is the absence of a constitution, civilian laws and independent institutions and decision making to regulate the civilian affairs. This has lead to a weak and ineffective infrastructure which had been knocked out during the revolutions and uprising against the occupation forces. All these factors together result in pollution by smoke of burned tires and other plastic materials and from the burning of all types of disposables and solid waste in open air and burning of MSW in random landfills in open air for long periods, which are usually located nearby the residential areas, villages or cites, lead to expose the residents to the hazards of the emitted gases and particulates. The licensed and non licensed factories get red of their disposables and emissions in an improper way. Due to lack of energy resources and poverty the people use an alternative way for cooking and heating water. This primitive method depends on burning plastics, rubbers and any available refuse.

To what extent all the above mentioned factors affect the health in Palestine, the researcher tried to answer this question, especially in the absence of local references and literature.

1.7 Country Profile:

1.7.1 Palestine

Palestine lies to the west of the Asian continent between longitudes 15-34 and 40-35 to the east, and between latitudes 30-29 and 15-33 to the north. Palestine constitutes the southwestern part of a huge geographical unity in the eastern part of the Arab world, which is Belad El-Sham. In addition to Palestine, Sham contains Lebanon, Syria and Jordan. It used to have common borders with these countries, in addition to Egypt.

The borders of Palestine start with Lebanon at Ras El-Nakoura at the Mediterranean Sea and head in a straight line to the east till it reaches the area beyond the small Lebanese city of Bent Jubayel. The border with Jordan begins to the south of Tabarriyya Lake at the

drainage of Al-Yarmouk River. It continues along the River Jordan. From the fountain of the River Jordan, the border heads south across the geometrical middle of the Dead Sea and the Araba Valley till it reaches the Gulf of Aqaba. The borders with Egypt could be compared to a straight line that separates the semi-island of Seena and Al-Naqab desert. The border begins at Rafah at the Mediterranean Sea till it reaches Taba at the Gulf of Aqaba.

On the west side, Palestine lies next to the international open waters of the Mediterranean Sea at a distance of about 250 km from Ras El-Nakoura in the north to Rafah in the south (www.Palestine-Info).Geographically it consists of four regions, Jordan valley and Aghwar, coastal and inner plains, Mountain and Hills and Southern Desert. *The coastal plains of Palestine are divided by Saruunah plain, Mount Carmel plain and the Acre plain.* In the category of the geography of Palestine the location of Jordan Valley is below the sea level and Aghwar. It results in the quality of the soil to be of very high standard but the resource of water is very limited (www.mapsofworld.com).

1.7.2 Solid Waste Management in Palestine:

Local surveys estimate that household's waste represents 45-50%, industrial and construction sector 20-25% and commercial 25-30% of the total solid waste (MoPIC, 1995). Solid waste production per capita per day in Palestine, refugee camp 0.5- 0.8 kg, rural areas 0.4-o.6 kg, town0.6-0.8 kg and cities 0.9-1.2 kg(Al-Hamidi, 2002). Less than the half of the collected amounts disposed of at official landfill, the remaining disposed of in random landfills, open spaces, roads and peaches. Communal collection system is applicable in most municipalities; the people bring their waste to municipal containers (Afifi 1999)

1.7.3 Palestine people

The ethnicity of the Palestinians is Arab. A substantial large number of Palestinians speak the Arabic language as their mother tongue. The Palestinian accent is heard all over the world. A large number of persons of Palestinian origin are scattered all over the globe. Palestinians are found in large numbers in South American countries. North American countries like the United States of America have a substantial Palestinian diaspora. The majority of the Palestinians are Muslims. There is a significant Christian minority. Religious offshoots like the Druze are also found to be living in Palestinian territories (mapsofworld.com).

1.7.4 Beit Fourik

Site:

The town lays 7 km East of Nablus city at the western end of the Jordan Basin halfway to Nablus. It is (570 m) above sea level .The mountainous feature of the town is interrupted by a set of plains and deep valleys , stretched at the Valley's borders .The eastern lands of Beit Fourik are wider than the western parts .

Borders:

Nablus city and Rujeep village are to the west , Salem, Deir Al Hatab and Azmout villages to the east , a range of mountains (Sharariyya , Mohammed and Jaddoo' mounts) to the south , while Taraneeque Mount and Yanoon village to the east.

Area: 36,663 Km^2

Master Plan Area: 4,658 Km^2

Population: 10,500 inhabitants

Climate: Hot, dry summers, cold wet winters. Wind direction, north westerly at most of the year (www.beitfoureek.com).

1.7.5 Nablus random landfill:

The Nablus random landfill, about 2km to the west of Biet Fourik town, had been established in 1964 and had been closed in 1999 by a decision of the Palestine National Authority. The started area of the landfill was 56 dunums and had increased to 80 dunums by the year of closure. The amount of solid wastes which had been burned is estimated at about 1.25 million tons. (Dr. Hallawa, 2009)

1.7.6 Jabalia Refugees Camp

Jabalia Refugees Camp is the largest of the Gaza Strip's eight refugee camps. It covers 1.4 km^2 and is located north of Gaza close to a village by the same name. About 35,000 refugees settled in the camp after the Arab-Israeli war in 1948, most having fled from villages in southern Palestine. Now, it houses a population of about 195,250 refugees.

The camp population is estimated at about 195,250 by December 31, 2008. About 107,590 are living in the camp and 87,660 outside the camp. The camp house 18.19 % of Gaza total refugee population (www.un.org/unrwa/refugees/gaza/jabalia.html).

Chapter 2: Literature review

2.1 Solid wastes definition:

-Solid or semi-solid, non-soluble material that include gases and liquids in containers such as agriculture refuse, demolition waste, industrial waste, mining residues, municipal garbage, and sewage sludge(www.businessdictionary.com).

-Non-liquid, non-soluble materials ranging from municipal garbage to industrial wastes that contain complex and sometimes hazardous substances. Solid wastes also include sewage sludge, agricultural refuse, demolition wastes, and mining residues. Technically, solid waste also refers to liquids and gases in containers (dictionary.babylon.com).

-Materials, which are not in liquid form, and has no value to the person who is responsible for it and "garbage", "trash", "refuse" and "rubbish" are terms used as synonyms for solid waste(Zubrugg, 2003).

-By-products of human activity, physically it contains the same materials as those found in useful products. It differs from useful one by its lack of value. This is due to mixed and unknown composition of the waste (Farnke and Hindle, 1999).

-Substances or objects which are disposed of, intended to be disposed of or required to be disposed of by the provisions of national law (UNEP, 1989).

-Solid wastes include all domestic refuse and non-hazardous wastes such as commercial and institutional wastes, street sweepings and construction debris. In addition to human wastes such as night soil, ashes from incinerators, septic tank sludge and sludge from sewage treatment plants (JICA, 1993).

2.2 Solid Waste Generation:

Municipal solid waste is produced as a result of economic productivity and consumption. Countries with higher incomes produce more waste per capita and per employee, and their wastes have higher portions of packaging materials and recyclable wastes. In low income countries, there is less commercial and industrial activity, as well as less institutional activity, thus resulting in lower waste generation rates. In countries where personal incomes are low, there is a need of necessity, extensive recycling at the source, Annex 12and 13 (Cointreau-Levine, S. 2006).

2.3 Solid Waste Management Costs:

Solid waste collection, transport and sanitary landfill costs vary in developing countries, while the per capita quantities of wastes and labor costs are low, the costs of providing solid waste management are not proportionately low. Equipment capital costs and fuel costs in low income countries are comparable to those in high income countries, and sometimes are higher because of importation.

Resulting that the solid waste management cost is higher in low-income countries, when viewed as a percentage of personal income. Sanitary landfill is the disposal method of choice, because it is usually the lowest cost of the environmentally acceptable solutions. Sanitary landfill costs roughly 3-8 times more than open dumping.

Incineration, a capital and energy intensive option is 5-10 times more costly than sanitary landfill for developing countries, and composting is 2-3 times more costly. Incineration and composting, like sanitary landfill, should be designed to comparable environmentally acceptable standards, Annex 14 (Cointreau-Levine, S. 2006).

2.4 Burning of solid waste:

Even in high-income countries where there are good pollution controls now in place, air pollution levels may be up to 4 times higher than background within 1-2 km of an incinerator. High levels of carbon monoxide occur if combustion is incomplete or there is excess air in the system. Some of the volatile organic compounds are believed to be potentially carcinogenic (Elliott, et al., 1996).

Incineration is not generally considered economic for developing countries, because their wastes are too wet and low in combustibles to burn without supplemental fuel. Where incineration is implemented in a developing country, air pollution control measures which address standards comparable to those required in high income countries should be implemented. For adequate health protection, the cost of such air pollution control would increase the basic cost of incineration by at least 25% (World Health Organization, 1993).

Particulate emissions from incinerators in high income countries are carefully controlled through air pollution equipment such as electrostatic precipitators.

Pollutants emitted by solid waste incinerators include volatile organic compounds (polychlorinated dibenzodioxins and dibenzofurans, and polycyclic aromatic hydrocarbons), in addition to particulates, heavy metals (lead, cadmium, mercury, nickel, chromium), and

inorganic gases, hydrogen chloride, hydrogen fluoride, sulfur dioxide (Elliott, et al. 1996 and Carotti and Smith,1974).

2.4.1 Open Burning of solid waste:

Open burning means the burning of any type of combustible material in the open, where smoke and other emissions are released directly to the air. During open burning, air pollutants do not pass through a stack, chimney, or flue (www.des.nh.gov).

2.5 Pollutants from Burning of solid waste:

2.5.1 Particulate matter:

It is the general term for particles of soot and dust in the atmosphere. Particulates are composed of organic matter and compounds containing sulfur, nitrogen and metals. These particles when inhaled irritate the respiratory system and prolonged exposure may increase the number and severity of chronic respiratory disease cases (www.se.gov.sk.ca).

Many heavy metals are associated with incineration's bottom ash and fly ash, particulate emissions control, in high income countries incinerators limits these constituents from creating air pollution with carcinogenic risk. The same is not true, however, for many incinerators in developing countries, which are built only with short stacks and no particulate control. For workers and for residents living downwind of the incinerators there are increased health risks of respiratory illness, as well as increased risks of cancer. (www.se.gov.sk.ca and Rahkonen P. 1992).

2.5.2 Heavy metals

Pollutants emitted by solid waste burning include heavy metals lead, cadmium, mercury, nickel and chromium (Elliott P., et al 1996).

2.5.2.1 Cadmium:

It is an extremely toxic metal commonly found in industrial workplaces, particularly where any ore is being processed or smelted. Due to its low permissible exposure limit (PEL), overexposures may occur even in situations where trace quantities of cadmium are found in the parent ore or smelter dust.

Cadmium is also present in the manufacture of some types of batteries. Cadmium emits a characteristic brown fume of CdO upon heating, which is relatively non-irritating, and thus does not alarm the exposed individual.

Health Effects:

The adverse health effects of exposure to cadmium may be

Acute:

Acute health effects usually result from acute exposure with flu-like symptoms of weakness, fever, headache, chills, sweating and muscular pain. Acute pulmonary edema usually develops within 24 hours and reaches a maximum by three days. If death from asphyxia does not occur, symptoms may resolve within a week.

Chronic:

The most serious consequence of chronic cadmium poisoning is cancer (lung and prostate). The first observed chronic effect is generally kidney damage, manifested by excretion of excessive (low molecular weight) protein in the urine. Cadmium also is believed to cause pulmonary emphysema and bone disease (osteomalcia and osteoporosis). The latter has been observed in Japan ("itai-itai" disease) where residents were exposed to cadmium in rice crops irrigated with cadmium-contaminated water.

Cadmium may also cause anemia, teeth discoloration and loss of smell (anosmia). (www.osha.gov)

2.5.2.2 Lead

Exposure:

Exposure to lead and lead chemicals can occur through inhalation, ingestion and dermal contact. Most exposure occurs through ingestion, inhalation or dermal contact. Mostly occurs through ingestion through hand-to-mouth contacts or through contaminated food (lead can be ingested through fruits and vegetables contaminated by the high levels of lead in the soils) or water approximately 20%- 70% of ingested lead is absorbed (ATSDR 2005).

Inhalation is the second major pathway of exposure, especially for workers in lead-related occupations. Almost all inhaled lead is absorbed into the body (ATSDR 2005). Dermal contact exposure may be significant for a narrow category of people working with organic lead compounds, but is of little concern for general population. The rate of skin absorption is also low for inorganic lead (ATSDR 2005). Lead remains in the body for long periods in mineralizing tissue (i.e., teeth and bones). The stored lead may be released into the bloodstream, especially in times of calcium stress (e.g., pregnancy, lactation, osteoporosis), or calcium deficiency, and is of particular risk to the developing fetus (ATSDR 2005).

Lead Toxicity

Lead adversely affects numerous body systems and causes many forms of disease that arise after acute exposure (periods of exposure as short as days) or chronic exposure (as long as several years). The frequency and severity of medical symptoms increases with the concentration of lead in the blood. Symptoms of acute lead poisoning are loss of appetite, nausea, vomiting, stomach cramps, constipation, difficulty in sleeping, fatigue, moodiness, headache, joint or muscle aches, anemia, and decreased sexual drive. Acute poisoning from uncontrolled exposures has resulted in fatalities.

Chronic overexposure to lead may result in severe damage to the blood-forming, nervous, urinary, and reproductive systems. (www.osha.gov).

The concern about lead's role in cognitive deficits in children, lead exposure has been linked to learning disabilities (Howard, Hu., 1991). High blood levels are associated with delayed puberty in girls (Schoeters, G., et al. 2008). Lead has been shown many times to permanently reduce the cognitive capacity of children at extremely low levels of exposure (Needleman, H. 1990). Appears to be no detectable lower limit, below which lead has no effect on cognition.

2.5.2.3 Mercury (Hg)

Mercury is a heavy, silvery-white metal. As compared to other metals, it is a poor conductor of heat, but a fair conductor of electricity (Hammond, C., 2000). It is one of six chemical elements that are liquid at or near room temperature and pressure, (Senese, F., 2007) and (Norrby, L., 1991) the others being cesium, francium, gallium, bromine, and rubidium. Mercury is the only metal that is liquid at standard conditions for temperature and pressure. With a melting point of −38.83 °C and boiling point of 356.73 °C, mercury has one of the widest ranges of its liquid state of any metal.

Mercury occurs in deposits throughout the world mostly as cinnabar chemically, the pigment is mercuric sulfide (HgS), which is the source of the red pigment vermilion (an opaque orangish red pigment), and is mostly obtained by reduction from cinnabar. Cinnabar is highly toxic by ingestion or inhalation of the dust, and mercury poisoning can also result from exposure to soluble forms (such as mercuric chloride or methyl mercury), inhalation of mercury vapor, or eating fish contaminated with mercury.

Mercury poisoning is a disease caused by exposure to mercury or its compounds. Mercury occurs in several forms, all of which can produce toxic effects in high enough doses. Its zero oxidation state HgO exists as vapor or as liquid metal, its mercurous state Hg^{+} exists as inorganic salts, and its mercuric state Hg^{2+} may form either inorganic salts or organomercury compounds; the three groups vary in effects. Toxic effects include damage to the brain, kidney, and lungs (Clifton, J., 2007). Mercury poisoning can result in several diseases, including acrodynia (pink disease), Hunter-Russell syndrome, and Minamata disease (Davidson, P., Myers, G., Weiss, B., 2004).

Symptoms typically include sensory impairment (vision, hearing, speech), disturbed sensation include peripheral neuropathy (presenting as paresthesia or itching, burning or pain), neuropsychiatric symptoms (emotional liability, memory impairment, insomnia), skin discoloration (pink cheeks, fingertips and toes), edema, and desquamation, hyperhidrosis (profuse sweating), tachycardia , mercurial ptyalism (hyper salivation) and Hypertension and a lack of coordination. The type and degree of symptoms exhibited depend upon the individual toxin, the dose, the method and duration of exposure (www.en.wikipedia.org/wiki/Mercury_element).

Affected children may show red cheeks and nose, erythematous lips , loss of hair, teeth, and nails, transient rashes, hypotonia , and photophobia. Other symptoms may include kidney dysfunction e.g. Fanconi syndrome is a disorder in which the proximal tubular function of the kidney is impaired, resulting in decreased reabsorption of electrolytes and nutrients back into the bloodstream (www.en.wikipedia.org/wiki/Mercury_element)

2.5.2.4 Nickel (Ni):

Nickel is a chemical element, with the atomic number 28. It is a silvery-white lustrous metal with a slight golden tinge. It is one of the four ferromagnetic elements at about room temperature, other three being iron, cobalt and gadolinium (Charles, K., 1996)

Toxicity:

Allergic dermatitis sensitized individuals may show skin allergy, also known as sensitivity, to nickel which may also be present in patients with dyshidrosis.

Late stage of dyshidrosis on the hands
(www.en.wikipedia.org/wiki/Dyshidrosis)

Dyshidrosis is also termed Dyshidrosis Eczema, Pompholyx, Acute vesiculobullous hand eczema, (James, Berger and Elston, 2005). Dyshidrotic Dermatitis is a skin condition that is characterized by small blisters on the hands or feet. It is an acute, chronic, or recurrent dermatosis of the fingers, palms, and soles, characterized by a sudden onset of many deep-seated pruritic, clear vesicles; later, scaling, fissures and lichenification (an epidermal thickening characterized by visible and palpable thickening of the skin with accentuated skin markings, and is the hallmark of chronic eczematous dermatitis)

This condition is not contagious to others, but due to its unsightly nature can cause significant distress in regards to social interactions with others (Marks and Miller, 2006). It was voted Allergen of the Year in 2008 by the American Contact Dermatitis Society (Nickel Named 2008 Contact Allergen of the Year). Exposure to nickel metal and soluble compounds should not exceed 0.05 mg/cm³ in nickel equivalents per 40-hour work week. Nickel sulfide fume and dust is believed to be carcinogenic, and various other nickel compounds may be as well (Kasprzak, Sunderman and Salnikow, 2003 and Dunnick, et al, 1995). Nickel carbonyl, [Ni (CO) $_4$], is an extremely toxic gas. The toxicity of metal carbonyls is a function of both the toxicity of a metal as well as the carbonyl's ability to give off highly toxic carbon monoxide gas. It is explosive in air (www.msds.chem.ox.ac.uk).

2.5.2.5 Chromium (Cr):

Chromium is a chemical element which has an atomic number 24. It is a steely-gray, lustrous, hard metal that takes a high polish and has a high melting point. It is also odorless, tasteless, and malleable. Many of its compounds are intensely colored.

Chromium was regarded with great interest because of its high corrosion resistance and hardness. A major development was the discovery that steel could be made highly resistant to corrosion and discoloration by adding chromium and nickel to form stainless steel. Although trivalent chromium (Cr III) is required in trace amounts for sugar and lipid metabolism in humans and its deficiency may cause a disease called chromium deficiency (Jeejeebhoy, K., 1999). Hexavalent chromium (Cr VI) is toxic and carcinogenic (www.en.wikipedia.org/wiki/Chromium).

2.5.3 Sulphur oxides (SO_x):

This chemical may be released if refuse being burned contains sulphur compounds. Studies of serious air pollution occasions found an increase in mortalities among people with existing heart and lung disease. Even when concentrations are below what may be considered serious; there may be a noticeable increase in acute and chronic respiratory disease cases. Healthy people may experience sore throats, shortness of breath and breathing difficulties. Sulphur oxides can cause vegetation damage, corrode many materials and contribute to acid rain (www.se.gov.sk.ca).

Sulfur oxides (SOx) refer to one or more of the following:

2.5.3.1 Lower sulfur oxides are a group of chemical compounds consisting of:

a. Sulfur monoxide, monomer (SO) and dimer (S_2O_2)
   These are stable molecules that have been trapped at low temperature.
b. Disulfur monoxide, S_2O
c. Trisulfur monoxide, S_3O
   This unstable neutral molecule has been found in the gas phase. Both ring and chain structures were found (Meschi and Myers, 1959). "
d. S_nO : These are a number of monoxides S_nO where n= 5-10 and the oxygen is bond to one member of the Sn sulfur ring. The compounds are all dark colored and decompose to give and sulfur dioxide(Greenwood, Norman N., Earnshaw, A.,1997).
e. S_6O_2, S_7O_2
f. Polymeric sulfuroxides

These have been studied to determine whether they are a factor in the observed color of Io (de Petris, Rosi, andTroiani, 2006).

2.5.3.2 Sulfur dioxide (SO_2):

Sulfur dioxide is the chemical compound with the formula SO_2. It is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulfur compounds, they generate sulfur dioxide. Further oxidation of SO_2, usually in the presence of a catalyst such as nitrogen dioxide (NO_2), forms sulfuric acid (H_2SO_4) (Holleman and Wiberg, 2001).

Sulfur dioxide causes a wide variety of health and environmental impacts because of the way it reacts with other substances in the air. Particularly sensitive groups include people with asthma who are active outdoors and children, the elderly, and people with heart or lung disease.

Respiratory Effects from Gaseous SO_2:

Peak levels of SO_2 in the air can cause temporary breathing difficulty for people with asthma who are active outdoors. Longer-term exposures to high levels of SO_2 gas and particles cause respiratory illness and aggravate existing heart disease.

Respiratory Effects from Sulfate Particles:

SO_2 reacts with other chemicals in the air to form tiny sulfate particles. When these are breathed, they gather in the lungs and are associated with increased respiratory symptoms and disease, difficulty in breathing, and premature death (http://www.epa.gov/air/urbanair/so2/hlth1.html).

2.5.3.3 Sulfur trioxide (SO_3):

Sulfur trioxide is the chemical compound with the formula SO_3. In the gaseous form, this species is a significant pollutant, being the primary agent in acid rain. It is prepared on massive scales as a precursor to sulfuric acid.

2.5.3.4 Higher sulfur oxides (SO_{3+x} where $0<x\leq1$):

These are a group of chemical compounds with the formula SO_{3+x} where x lies between 0 and 1.They contain peroxo (O-O) groups and the oxidation state of sulfur is +6 as in

SO_3.Monomeric SO_4 can be isolated at low temperatures(below 78 °C) following the reaction of SO_3 and atomic oxygen or photolysis of SO_3 /ozone mixtures. Colorless polymeric condensates are formed in the reaction of gaseous SO_3 or SO_2 with O_2 in a silent electric discharge (Greenwood, Norman, and Earnshaw, 1997).

2.5.4-Carbon monoxide (CO):

CO is a common pollutant which may be released from the incomplete combustion of municipal waste. This compound binds chemically to the hemoglobin in the blood stream, the substance which carries oxygen to the heart, brain and other body tissues. Exposure to carbon monoxide causes dizziness, headaches, slowed reflexes and reduces the ability to perform physical exercise. Even at relatively low concentrations, carbon monoxide can affect mental function, visual acuity and alertness.

Carbon monoxide, with the chemical formula CO, is a colorless, odorless and tasteless, yet highly toxic gas. Its molecules consist of one carbon atom, burning in air with a characteristic blue flame, producing carbon dioxide. Carbon monoxide is produced from the partial oxidation of carbon-containing compounds; it forms in preference to the more usual carbon dioxide (CO_2) when there is a reduced availability of oxygen, such as when operating a stove or an internal combustion engine in an enclosed space.

Human physiology:

Carbon monoxide is produced naturally in the human body as part of normal metabolism, such as the breakdown of heme (a part of the hemoglobin molecule) by the enzyme heme oxygenase to CO, biliverdin and a Fe^{3+} cation. The endogenously produced CO may have important physiological roles in the body, such as a neurotransmitter or a blood vessels relaxant. It provides 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).

Toxicity:

Carbon monoxide poisoning is the most common type of fatal poisoning in many countries (Omaye, S. 2002). Carbon monoxide is colorless and odorless, but extremely toxic: it combines with hemoglobin in the blood to produce carboxyhemoglobin (HbCO), which is

ineffective for delivering oxygen to the body tissues (a condition known as anoxemia). Low concentrations, as low as 667 ppm (part per million), can cause about 50% of the body's hemoglobin to change to HbCO. In the United States, OSHA limits long-term workplace exposure levels to 50 ppm.(OSHA CO guidlines).

The most common symptoms of CO poisoning are flu-like symptoms, including headache, nausea and vomiting, dizziness, lethargy and a feeling of weakness. Infants may be irritable and feed poorly. Neurological signs include confusion, disorientation, visual disturbance, syncope and seizures (Blumenthal, 2001). In his pioneering 1846 study, Claude Bernard observed that the blood of poisoned dogs was more rutilant in all the vessels, a fact now known to be due to the formation of HbCO. Some classic descriptions of CO poisoning cite also retinal hemorrhages, bright reddish skin, and an abnormal cherry-red blood hue (Ganong, 2005), but in most clinical diagnoses these signs are seldom seen (Blumenthal, 2001).

Carbon monoxide is believed to compromise other important molecules such as myoglobin, and mitochondrial cytochrome oxidase. Exposures can lead to significant damage to the heart and central nervous system, especially to the globus pallidus (Prockop and Chichkova, 2007) often with long term sequelae. Carbon monoxide can also have severe effects on the fetus of a pregnant woman.

2.5.5 Volatile Organic Compounds (VOCs):

Refers to a large group of compounds which may be released during the incomplete burning in municipal landfills of almost any kind of organic material including fats, meat, coffee, rubber and other material. Many VOCs are known to have direct toxic effects on humans, ranging from cancer risks to nervous system disorders. VOCs also contribute to the formation of ground level ozone smog. Elevated ozone levels have been shown to cause adverse health effects on the human respiratory system and are strongly suspected of playing a role in the long term development of chronic lung disease. Ozone effects on vegetation damage are well documented with millions of dollars estimated in crop damage in certain areas of Canada due to elevated ozone levels. Because of Volatile Organics has high vapor pressures and low solubilities, volatile organic compounds are observed in solid waste decomposition gases.

One study identified 92 different volatile organic compounds in the headspace loading area of solid waste collection trucks, including alcohols, aldehydes, ketones, carboxylic acids, and esters. Total volatile organic concentration varied from 0.9 to 8.1 mg/m^3 in the loading

area headspace. Furthermore, sudden peaks in exposure are likely to occur when the lids of waste containers are opened (Poulsen, et al, 1995). Some of the volatile organic compounds are believed to be potentially carcinogenic. Even in high-income countries where there are good pollution controls now in place, air pollution levels may be up to 4 times higher than background within 1-2 km of an incinerator (Elliott, et al 1996).

2.5.6 Hydrogen Chloride:

The compound hydrogen chloride has the formula HCl. At room temperature, it is a colorless gas, which forms white fumes of hydrochloric acid upon contact with atmospheric humidity. Hydrogen chloride gas and hydrochloric acid are important in technology and industry. The formula HCl is often used to refer, somewhat misleadingly, to hydrochloric acid, an aqueous solution derived from hydrogen chloride.

Hydrogen chloride forms corrosive hydrochloric acid on contact with water found in body tissue. Inhalation of the fumes can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory system failure, and death. Skin contact can cause redness, pain, and severe skin burns. Hydrogen chloride may cause severe burns to the eye and permanent eye damage (www.en.wikipedia.org/wiki/Hydrogen_chloride).

2.5.7 Nitrogen Oxides (NO_x):

This chemical term refers to the nitrogen oxides produced during combustion. The term nitrogen oxide typically refers to any binary compound (a chemical compound that contains exactly two different elements of oxygen and nitrogen)or to a mixture of such compounds such as nitric oxide (NO), nitrogen dioxide (NO_2), nitrous oxide (N_2O), dinitrogen trioxide (N_2O_3), dinitrogen tetraoxide (N_2O_4) and dinitrogen pentaoxide (N_2O_5). The last three are unstable (www.en.wikipedia.org/wiki/Nitrogen_oxide). NO_x is a generic term for mono-nitrogen oxides (NO and NO_2). These oxides are produced during combustion, especially combustion at high temperatures.

At ambient temperatures, the oxygen and nitrogen gases in air will not react with each other. In an internal combustion engine (www.britannica.com), combustion of a mixture of air and fuel produces combustion temperatures high enough to drive endothermic reactions between atmospheric nitrogen and oxygen in the flame, yielding various oxides of nitrogen. In the presence of excess oxygen, nitric oxide will be converted to nitrogen dioxide NO_2 (NO_x Removal).

NO_x may be released in the open burning of municipal refuse. Certain nitrogen compounds may cause adverse health effects to the human respiratory system. The primary concerns with NO emissions are their contribution to the formation of ground level ozone and acid rain. To a lesser extent, some NO compounds contribute to stratospheric ozone layer depletion and global warming. (www.se.gov.sk.ca)

Health effects

NO_x react with ammonia, moisture, and other compounds to form nitric acid (HNO_3), vapor and related particles. Small particles can penetrate deeply into sensitive lung tissue and damage it, causing premature death in extreme cases. Inhalation of such particles may cause or worsen respiratory diseases such as emphysema (a lung disease, characterized by an abnormal, permanent enlargement of air spaces distal to the terminal bronchioles. The disease is coupled with the destruction of walls, but without obvious fibrosis (www.emedicine.medscape.com) and bronchitis (is inflammation of the mucous membranes of the bronchi, the airways that carry airflow from the trachea into the lungs). Bronchitis can be classified into two categories, acute and chronic:

1-Acute bronchitis is characterized by the development of a cough, with or without the production of sputum that is expectorated from the respiratory tract (Cohen, and Powderly, 2004).

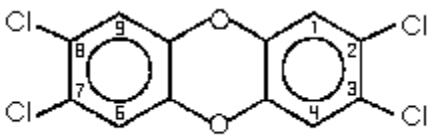
2-Chronic bronchitis, a type of chronic obstructive pulmonary disease, is characterized by the presence of a productive cough that lasts for 3 months or more per year for at least 2 years. Chronic bronchitis most often develops due to recurrent injury to the airways caused by inhaled irritants. Cigarette smoking is the most common cause, followed by air pollution (Cohen, and Powderly, 2004).

Also the exposure to NO_x may aggravate existing heart disease (How nitrogen oxides affect the way we live and breathe). NO_x react with volatile organic compounds in the presence of heat and sunlight to form Ozone. Ozone can cause adverse effects such as damage to lung tissue and reduction in lung function mostly in susceptible populations (children, elderly, and asthmatics). Ozone can be transported by wind currents and cause health impacts far from the original sources. The American Lung Association estimates that nearly 50 percent of United States inhabitants live in counties that are not in ozone compliance (www.epa.gov/airscience/quick-finder/ozone.htm). NO_x (especially N_2O) destroys ozone layer. This layer absorbs ultraviolet light, which is potentially damaging to life on earth (Ozone layer).

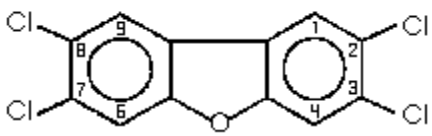
2.5.8 What are dioxins?

Dioxins are environmental pollutants. They have dubious distinction of belonging to the "dirty dozen"- a group of persistent organic pollutants (included in Stockholm convention on persistent organic pollutants).They are of great concern because of their highly toxic potential and when they enter the human body they remain for long time because of their chemical stability and their liability to be absorbed by fat tissue, where they are stored (WHO, 2007).

Chemically the term dioxins, covering polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzo- furans (PCDFs) and other chemically related compounds like polychlorinated biphenyl (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. The most toxic one is 2, 3, 7, 8-tetrachlorodibenzo-p-dioxin (2, 3, 7, 8-TCDD or simply TCDD). Only dioxins that have more chlorine atoms added to 2, 3, 7, 8-TCDD structure are more toxic but to a lesser extent 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).



TCDD



TCDF

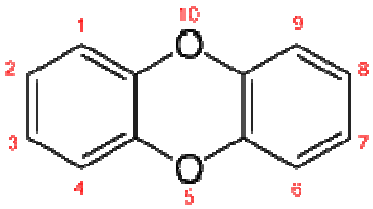
Dioxins are a class of chemicals, and the most toxic of these compounds is 2, 3, 7, 8-tetrachlorodibenzo-p-dioxin (commonly referred to as TCDD or dioxin). There are many forms of dioxins and “dioxin-like compounds” (DLCs) that share most, if not all, of the toxic potential of TCDD, although nearly all are considerably less potent. Included in the list of DLCs are chlorinated forms of dibenzofurans and certain polychlorinated biphenyls (PCBs).

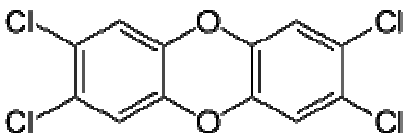
Unlike PCBs, TCDD and other dioxins have never been intentionally produced. TCDD, other dioxins, and DLCs persist and bioaccumulation in the environment, which means that they break down slowly and build up through the food chain. Human exposure to TCDD,

other dioxins, and DLCs occurs primarily from eating foods, such as beef, dairy products, fish, shellfish, and pork (NAP, 2006).

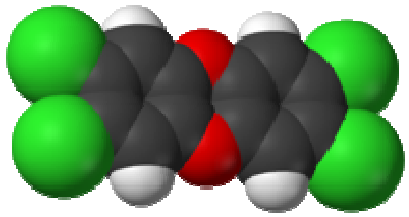
Chemical structure and space filling model DIOXINS and 2, 3, 7, 8-TCDD

Dioxins Skeleton





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



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

2.5.8.1 Historical perspective

Low concentrations of dioxins existed in nature prior to industrialization due to natural combustion (forest fire) and geological processes (volcanoes). Dioxins were first unintentionally produced as by-products from the year 1848 onwards as Leblanc process plants started operating in Germany (Weber, R., 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 A, et al, 2006). Later, dioxins were found in Times Beach, Missouri (USEPA, 2007-b) and Love Canal, New York (USEPA, 2007-a) and Seveso, Italy (4 Seveso, 2007). More recently, dioxins have been in the news with the poisoning of President Viktor Yushchenko of Ukraine in 2004,

(Yushchenko,2004), the Naples Mozzarella Crisis (Italy's waste crisis, 2008) and the Irish pork crisis of 2008 (Irish crisis, 2008).

2.5.8.2 Sources of Dioxins:

Human made dioxins occur as by-products in manufacturing of organochlorides, incineration of chlorine containing materials e.g. polyvinyl chloride (PVC) and in bleaching of paper, and the natural sources include forest fire and volcanoes (Milton, R., et al 1987). Dioxins are unintentionally but unavoidably, produced during the manufacture of materials containing chlorine, PVC and including other chlorinated plastic feedstock (Carroll W., et al., 2001).

They are also produced through combustion of chlorinated materials accidentally or during disposal. Polyethylene, polypropylene and other plastics that do not contain chlorine are not associated with large dioxin releases. The following are the top sources of dioxin from human activities described in the USEPA's dioxin source inventory (USEPA 2006-a).

2.5.8.2.1- Barrel burning

The largest well-quantified source of dioxin in the USEPA inventory of dioxin sources is barrel burning of household waste (USEPA 2006-c). Studies of household waste burning indicate consistent increases in dioxin generation with increasing PVC concentrations (Costner, 2005-b).

2.5.8.2.2- Landfill fires

According to the EPA dioxin inventory, landfill fires are likely to represent an even larger source of dioxin to the environment (USEPA 2006-a). A survey of international studies consistently identifies high dioxin concentrations in areas affected by open waste burning and a study that looked at the homologue pattern found the sample with the highest dioxin concentration was “typical for the pyrolysis of PVC”. Other EU studies indicate that PVC likely “accounts for the overwhelming majority of chlorine that is available for dioxin formation during landfill fires (Costner 2005-a and Thornton 2005)."

The United States Green Building Council's (USGBC) Technical and Scientific Advisory Committee (TSAC) also pointed to the significant impact of these two dioxin sources in its independent 2007 analysis on PVC: *“When we add end of life with accidental landfill fires and backyard burning, the additional risk of dioxin emissions puts PVC consistently among the worst materials for human health impacts…* (Altshuler , et al., 2007).”The Vinyl

Institute countered this conclusion with the assertion that "landfill fires are rare (Vinyl Institute, 2007)."

The U.S. Fire Administration, however, reports that an average of 8,400 landfill fires is reported each year in the United States, about 23 per day (US Fire Administration, 2002). The USEPA inventory indicates that the combination of landfill fires and backyard burn barrels likely contribute roughly as much dioxin to the environment as all other human generated sources combined.

2.5.8.2.3- Waste incinerators

The next largest sources of dioxin in the EPA inventory are medical and municipal waste incinerators (Beychok, 1987). Studies have shown a clear correlation 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, Takeo, 2002 and Wagner, J., Green, 1993).

The burning of waste is the major source of dioxin discharges to air in New Zealand. Waste combustion takes place predominantly in open fires at landfills, in backyard fires, in commercial incineration units such as those that burn medical waste, and in combustion units that are not designed to handle waste, such as boilers. Landfill fires have the worst discharges by far. There are no municipal waste incinerators in New Zealand.

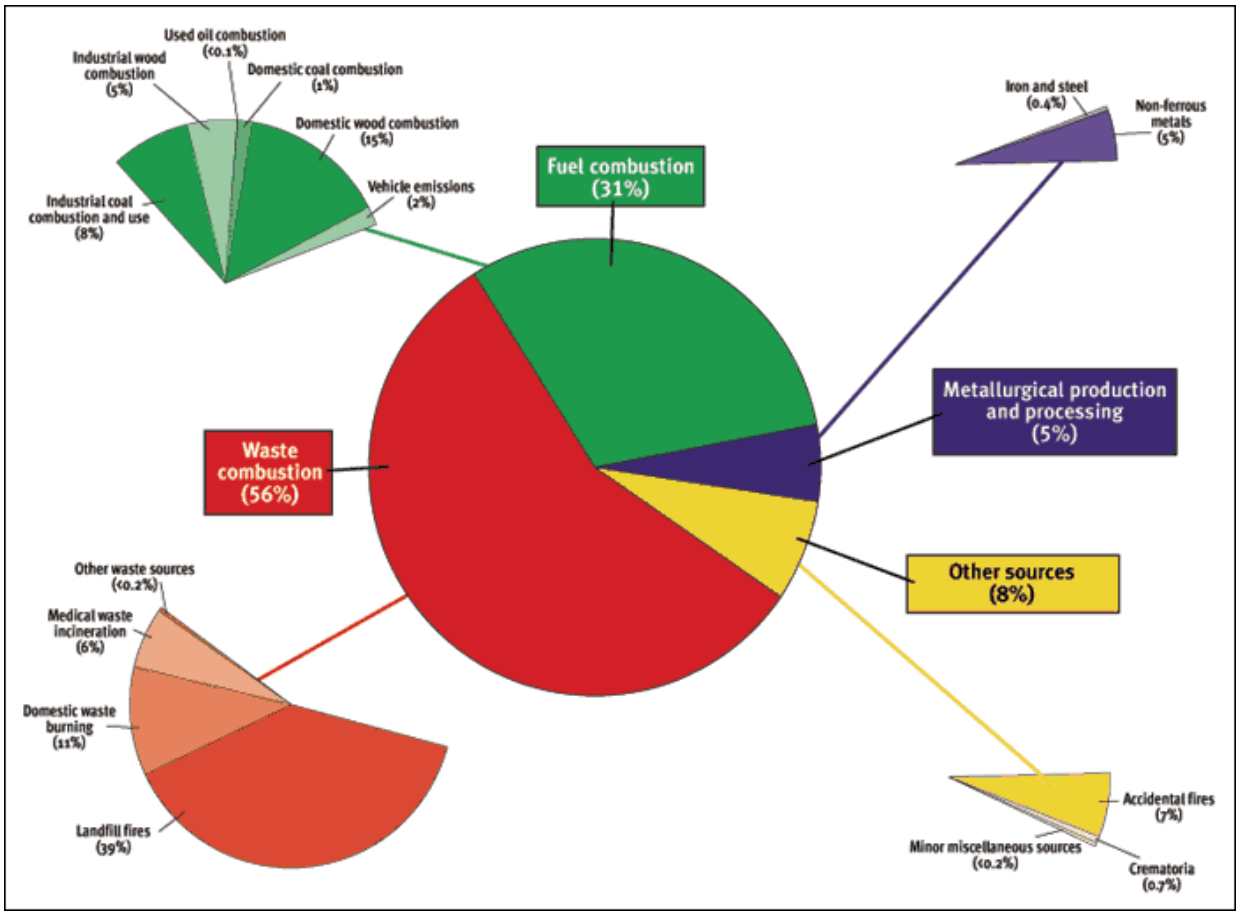


Figure 2.1: Sources and Relative Sizes of Dioxin Discharges to Air in New Zealand

Source: Ministry of Environment –New Zealand Web site 2009.

2.5.8.3 Meaning of natural background and current background for dioxins:

Natural background is a term referred to the dioxins in the environment due to natural processes (forest fire and volcanoes), and dioxins level can not be measured, while the current background referred to the level of dioxins in the environment today, and is primarily from manmade sources

2.5.8.4 Toxicology:

Generally, ingestion is the main route of exposure to dioxins and, to lesser extent is inhalation of contaminated air. Food-producing livestock may contact dioxins from pesticide application, wood preservatives, and application of swage sludge to the fields. Dioxins accumulate in fatty tissue and milk of livestock providing an entry into food chain. Also plants like pumpkins, courgette, outer layers of potatoes and carrots can take dioxins and have a role in its distribution.

Accidental industrial exposure, like what happened in Seveso, Italy 1976.And occupational exposure during manufacturing chlorinated herbicide, wood preservatives, pesticides and during paper and pulp bleaching and during emergency response to fire. Occupational exposure to dioxins is generally by skin contact or inhalation (ATSDR, 1998). Absorption of dioxins, already stored in the fatty tissue or vegetable oils, takes place in the gastrointestinal tract as chylomicrons (microscopic newly absorbed fatty droplets surrounded by lipoprotein membrane) to blood stream and lymphatic system.

The chylomicrons are rapidly taken by liver and fatty tissue, where the dioxins appear. Meanwhile a small proportion of dioxins remain attached to serum lipoproteins. Dioxins can cross the placenta barrier to the fetus. This is as seen in the experimental animals (Gullen, S II 2003 USEPA).

Fecal excretion is the main route of elimination of dioxins in humans. The majority of dioxins are excreted through fecal excretion, but small proportion is excreted as metabolites and its conjugated salts. Half of the absorbed dioxins are excreted within 28 days in both mice and rats, but it takes longer time in humans according to age and health status of exposed human .i.e. young adults more rapidly get red of dioxins and more than elderly ones, so the half life time ranges from 5 to11 years respectively.

Not all compounds of dioxins have the same toxicity; the most toxic is 2,3,7,8 TCDD.

The 2, 3, 7, 8-TCDD is given value of 1 by WHO on its Toxic Equivalency Factor (TEF) scale. Other dioxins showing 2, 3 ,7 ,8- substitution are ranked in relation to 2,3,7,8-TCDD from the most to least toxic. Meanwhile 1, 2, 3, 7,8-pentachlorodibenzo-p-dioxin is also ranked 1 by WHO, the Hexa-, Hepta-, and Octa-chlorinated compounds that show the 2, 3, 7, 8- pattern of substitution are ranked 0.1, 0.01, and 0.0001 respectively. Dioxins are most usually present in mixture in the environment, each compound has an additive effect, and exerts its toxic action independently of the other compounds in the mixture, Annexes15, 16and 17 (Ahlborg, et al. 1994).

The toxic effects of dioxins occur through binding to intracellular aryl hydrocarbon (Ah) which leads to persistent and undesirable metabolic changes, as observed in animal studies (ATSDR, 1998).The health effects of dioxins are mediated by their action on Ah receptors (Bock, Kohle, 2006)."Ah receptor mediates most of the toxicity produced by TCDD and other PCDDs, PCDFs, and coplanar PCBs that are Ah receptor agonists.

Although Ah receptors is necessary, the ability of TCDD, other dioxins, and DLCs to produce their biochemical and toxicological effects results from downstream events regulated by Ah receptor and Ah receptor –dependent gene expression. The role of Ah

receptor in the toxic and biological effects of the TCDD, other dioxins, and DLCs has been supported by a substantial number of quantitative structure-activity relationship, biochemical, genetic, and targeted Ah receptor knockout studies(USEPA, 2006-f)."

2.5.8.5-Effect of Dioxins

2.5.8.5.1- Factors affecting the severity of dioxins toxicity:

- 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 (ATSDR, 2006).

2.5.8.5.2- Possible toxic effects of dioxins

The dioxins have many aspects of toxic effects in human body at different levels:

1- Biochemical effect:

Dioxins Exert its toxic effects by acting on Cytochrome enzyme p450 (Detoxification enzyme)

- Estrogen receptors.
- Cytokinase (Tumor necrosis factor) and interleukins(1 and 6).
- Generation of oxidative species that lead to oxidative stress.
- Growth factors.

2- Cellular effects:

The effects on the growth regulation cells induce or block programmed cell death (apoptosis) leading to cell proliferation or differentiation resulting in either hyperplasia, hypoplasia, metaplasia (transformation)or neoplasia (tumor formation).

3- Carcinogenicity:

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

4- Confirmed human health effect (non cancerous):

- Skin disorder (chloracne)
- Transient mild liver damage (hepatotoxicity).
- Neuropathy (damage of peripheral nerves).

5- Suspected health effect:

- Respiratory tract cancers.
- Prostate cancer
- Multiple myeloma (malignancy of bone marrow)
- Prophyra cutanea tarda (liver dysfunction and photosensitive skin lesion)
- Diabetes mellitus type 2.
- Neurobehavioral disorder.
- Decreased male births.
- Decreased reproduction.
- Congenital defects.

2.5.8.5.3- Effects on animals

The effect of dioxins had been established more in experimental animals, due to the difficulties that faced the application of controlled dose experiments on humans. TCDD show teratogenic effect, mutagenic effects, carcinogenic effect, immunotoxic effect and hepatotoxic effect. Also an alternation in many endocrinal system and growth factor system had been reported. The most sensitive effects most likely to be the developmental effects including immune, reproductive and nervous systems. (Birnbaum, Tuomisto, 2000).

There is strong evidence that TCDD causes the following effects in the studied animals:

-Birth defects (teratogenecity), in rodents including rats (National Toxic Program, 2006), mice(Peters JM., et al., 1999), hamsters and guinea pigs(Kransler, McGarrigle and Olson, 2007), birds (Bruggeman, et al., 2003) and fish (Carney, et al., 2006).

-Cancer (including mammalian lung, oral cavity, nasal cavity, thyroid gland, adrenal glands, liver, squamus cell carcinoma), in rodents (NTP, 2006 and Mann, P.C. 1997), and in fish (Grinwis, et al., 2000).

-Hepatotoxicity in rodents (Mann, 1997), chicken (El-Sabeawy, et al., 2001) and fish (Zodrow, et al., 2004).

-Endocrinal effects in rodents and fish (Heiden, et al., 2006).

-Immunosuppression in rodents (Holladay, 1999) and fish (Spitsbergen, et al., 1986).

2.5.8.5.4 Effects on humans:

In the evaluation of the evidence of effects of dioxins, only studies with serum or adipose tissue measurements were considered (WHO, 2007).

2.5.8.5.4.1 Acute high exposure:

Acute high level of exposure to TCDD lead to chloracne, sever form of persistence acne (Geusan , et al., 2001).The most typical effects to high level of dioxin is chloracne. In addition to other changes of unknown clinical significant, e.g. modulation of thyroid gland hormones, testosterone plasma level, glucose tolerance and neurological effects (Ahkborg, 1992).

Acute effects of TCDD on humans (are not exposed to pure TCCD combinations with other associated chemicals 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, chloracne, 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).

2.5.8.5.4.2 Human carcinogenicity

The most informative studies for the evaluation of the carcinogenicity of TCDD are four cohort studies of herbicide producers (in the United States , the Netherlands and two in Germany), and one cohort of residents in a contaminated area from Seveso, Italy , in addition to a multi-country cohort study from International Agency of Research on Cancer (IARC). In most epidemiological studies, exposure was to mixtures of dioxins.

These studies involve subjects with the highest recorded exposures to TCDD. Increased risks for all cancers combined were seen in the occupational cohort studies. The magnitude of the increase was generally low; it was higher in sub-cohorts considered to have the heaviest TCDD exposure. Positive dose – response trends for all cancers combined were present in the largest and most heavily exposed German cohort and in the smaller German cohort where an accident occurred with release of large amounts of TCDD. Increased risks for all cancers combined were also seen in the longer-duration longer-latency sub-cohort of the United States study, and among workers with the heaviest exposure in the Dutch study.

These positive trends with increased exposure tend to reinforce the overall positive association between all cancers combined and exposure to dioxins. In Seveso, all-cancer mortality did not differ significantly from that expected, in any of the contaminated zones,

although excess risks were seen for specific cancers. Follow-up for the Seveso cohort was shorter than for the occupational cohorts. In most of these studies excess risks were observed for soft tissue sarcoma and also for lung cancer, non-Hodgkin lymphoma and digestive tract cancers. In summary, the epidemiological evidence from the most highly TCDD exposed cohorts studied produces the strongest evidence of increased risks for all cancers combined, along with less strong evidence of increased risks for cancers of particular sites. The relative risk (R.R.) for all cancers combined in the most highly exposed and longer-latency sub-cohorts are 1.4. (www.who.int/ipcs).

Also TCDD was classified as Group 1 (Carcinogenic to humans) by IARC (IARC, 1997). USEPA concludes that TCDD is carcinogenic to humans, this conclusion is based on epidemiological evidences from cohort occupational studies that dioxin exposure increase 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 (Ott and Zober 1996, Becher et al. 1998, Steenland et al. 2001).

These three cohorts differ in the sample size of studied population and the range of exposure. Ott and Zober 1996 studied relatively small number of men (243), number of the cancer deaths were 13 due to accidental release of dioxins in 1953. Becher et al. 1998 examined cohort of 1189 men employed in herbicide and pesticide production, from which 124 deaths were identified. Fingerhut et al. 1990, 1991 studied relatively large number (5172 male) of employee worked in 12 chemical production facilities. This study had been updated by Steenland et al. 1999 and also in 2001 sub cohort of the same previous study done by the same authors. In the above cohort the dioxin serum level had been estimated, the exposure duration and time of the studies had been taken in consideration.

In follow up studies of Hooiveld et al. (1996) a statistically significant increase in the cancer mortality among workers in one of the tow chemical plants which had been studied. The follow up analysis report by Hooiveld et al. (1998) indicated a statistically increase incidence of mortality due to malignancy among 140 workers involved in 1963 industrial accidents.

Bueno de Mesquita et al. 1993 found no statistically significant increase in cancer mortality among the workers in one industrial accident (Evaluation of the EPA 2003 reassessment). Follow-up of the population exposed to dioxin after the 1976 accident in Seveso, Italy, was extended to 1996. During the entire observation period, all-cause and all-cancer mortality did not increase. Fifteen years after the accident, mortality among men in high-exposure zones increased from all cancers , rectal cancer, and lung cancer , with no latency- related

pattern for rectal or lung cancer. An excess of lymphohemopoietin neoplasm was found in both genders. Hodgkin's disease risk was elevated in the first 10-year observation period, whereas the highest increase for non-Hodgkin's lymphoma and myeloid leukemia occurred after 15 years. No soft tissue sarcoma cases were found (0.8 expected). An overall increase in diabetes was reported, notably among women.

Chronic circulatory and respiratory diseases were moderately increased, suggesting a link with accident-related stressors and chemical exposure. Results support evaluation of dioxin as carcinogenic to humans and corroborate the hypotheses of its association with other health outcomes, including cardiovascular- and endocrine-related effects (Bertazzi, et al, 1996).

2.5.8.5.4.3 Cancer incidence rate in Palestine:

The incidence rate of cancer in Palestine 1998-1999 was 58.7 per 100,000 of the population in male 58.3 per 100,000 while in female was 59.2 per 100,000 (MOH, 2002). In 2005 cancer incidence rate was 43.1 per 100,000 population, incidence in male was 37.3 per 100,000 of the population and female was 48.3 per 100,000 (MOH, 2005).

West Bank 1998-1999 cancer incidence rate was 60.1 per 100,000 of the population, 60.8 male and 59.5 female (MOH, 2002), while the incidence rate was 49.2 per 100,000 of the population as reported (MOH, 2005). Gaza Strip 1995-2000 cancer incidence rate was 59.9 per100, 000 of the population; 57 males and 62.9 females (MOH Cancer 1995-2000, 2002), while it was 32.7 per 100,000 of the population as reported by MOH in 2005.

The cancer incidence rate among persons aged 50 years and above was 405.2 per 100,000 of the population, males: 205 and females: 325. The solid cancers were about 81% and the rest 19% was hematological malignancies (MOH Cancer 1995-2000, 2002).

The most common cancer morbidities in the general population were: Breast cancer (15.7%), lymphomas (9.1%), bone marrow (9.1%) bronchus and lung (8.7%), colorectal (7.4%), brain and nervous system (4.8%),urinary bladder (4.7%), stomach (3.5%), liver (3.3%) and prostate (2.9%). Meanwhile the bronchus and lung is the first leading morbidity in male, the breast cancer is the first leading morbidity in females (MOH Cancer 1995-2000, 2002).

According to children age under 15 year the incidence rate was 13.2 per 100,000 children (15.5 among males and 10.9 among female). Sarcoma account 40.2% in children under age 15 year while the hematological malignancy cases 31.4% (60.9% male and 38.1% female). The common cases of pediatric cancer were lymphomas 27.3% and it is the leading cause

cancer morbidity in male children, bone marrow was 23.8% and it is the leading cause cancer morbidity in female children, brain and nervous system 17.6%, kidney 5.2%, adrenal gland 4.5%, bone 4.2%, eye 2.7%, skin 2.5%, liver 2.2%, mediastinum 1.2%, and small intestine 1.2% (MOH Cancer 1995-2000, 2002).

In Palestine, cancer mortality rate was of 27.8 per 100,000 of the population in 2005, while it was 27.4 per 100,000 of the population in the year 2000. Trachea, bronchus and lung cancer occupied the first leading cause of death from cancer deaths (15.4%),. with a mortality rate of 4.3 per 100,000 population.. 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).

2.5.8.5.4.4 Reproductive and developmental effects:

Studies of highly exposed population suggest that TCDD, other dioxins and PCBs can have reproductive effects (Eskinazi, et al., 2000, Kogevinas, 2001, Vreugdenhill, et al., 2002a, and Pesatori, et al., 2003). Follow-up studies of male residents that were exposed to 2,3,7,8-(TCDD) after the Italian Seveso accident in 1976 have shown reduced sperm counts and sperm motility in adults that were 1–9 years of age when exposed while opposite effects were seen if exposure took place during puberty 10–17 years of age and the sperm count for men over 17 year old at the time of exposure were not affected (Mocarelli, et al., 2008). Prof. Paulo Mocarelli said "Dioxin permanently affects the reproductive system and there is inhibition in infancy and stimulation in puberty. When mature there is no effect (Telegraph, 2008)."

In studies in Yucheng, Taiwan (who ingested rice oil contaminated with dioxins) population, 8 stillbirths of 39 fetuses exposed in utero. Surviving children showed signs of intrauterine growth retardation and congenital anomalies at birth, deficit of cognitive development up to 7years of age, defect in musculoskeletal development and pigmentation (WHO, 1997).

The offspring male sawmill workers, whom exposed to dioxins contaminated chlorophenate wood preservative, were at increased risk for developing congenital anomalies of the eye, particularly congenital cataract, anencephaly, spina bifida and genital organs anomalies (Dimich-Ward, H., et al., 1996).The sex ratio of the children had been analyzed according to maternal and paternal exposure, decrease the number of boys for exposed fathers while normal number for exposed mothers (Ryan, J., 2002).

Exposure of men to TCDD is linked to a lowered male/female ratio in the offspring in general population in several industrial countries and in selected population such as sawmill industry workers and those exposed to air pollution from incinerators, which may persist for long time after exposure (Mocarelli, et al, Lancet 2000).

When experimental and wild life contamination studies had shown that fetal and reproductive tissues are very sensitive target of TCDD. An extensive study of TCDD effects on human reproductive system both in people exposed when young and in adults, which for the first time showed lower sex ratio at birth in the offspring of people highly exposed to TCDD (Mocarelli, et al., Lancet 1996).

2.5.8.5.4.5 Effects on cardiovascular system:

Strong association between dioxin exposure and mortality due to ischemic heart disease (IHD) and to lesser extent due to all other cardiovascular disease(CVD), that was the result of systematic review of 12 cohort , 10 of it were occupationally exposed (Humblet, et al. 2008). The Seveso accident in 1976 caused a large, populated area north of Milan, Italy, to be contaminated by TCDD. That area showed an increase in mortality from circulatory diseases in the first years after the accident (Consonni, et al., 2007).

2.5.8.5.4.6 Effects on Diabetes Mellitus:

The aim of a cross sectional study which had been performed on general inhabitants in Japan to evaluate the association between the environmental exposures of dioxins (the inhabitants who were not occupationally exposed to dioxins) with diabetes. The result of the collected data from general inhabitants in Japan showed association of environmental exposure to dioxins with diabetes (Uemura, et al, 2008).

Conclusions of analysis of the data from National Institute for Occupational Safety and Health (NIOSH) and United States Air Force veterans (Ranch Hand) showed that there was little evidence that the exposed workers were at higher risk than the non-exposed to TCDD of diabetes. However, the Ranch Hand subjects showed positive dose-response for diabetes, whereas the more highly exposed NIOSH subjects did no (Steenland, et al., 2001).

Suggestion of a possible association between exposure to dioxin-like compounds (DCLs) and diabetes in human population had been done by recent epidemiologic studies. The public health significance of such an association is that all populations are exposed to small but measurable level of DCLs, which may hasten the onset of type 2 diabetes in susceptible individuals (Remillard, Bunce, 2002). Across-sectional study in Sweden where the most

important source of exposure to persistent organic pollutants (POPs) is the fatty fish, the assessment of the association between serum level of POPs and prevalence of diabetes in Swedish fishermen and their wives, with high consumption of fatty fish, provided support that POPs exposure might contribute to diabetes mellitus type 2 (Rylander, L. et al., 2005).
The Seveso accident in 1976 caused a large, populated area north of Milan, Italy, to be contaminated by TCDD. That area also showed an increase in mortality from diabetes mellitus among females (Consonni, et al., 2007).

2.5.8.5.4.7 Effects on immunity:

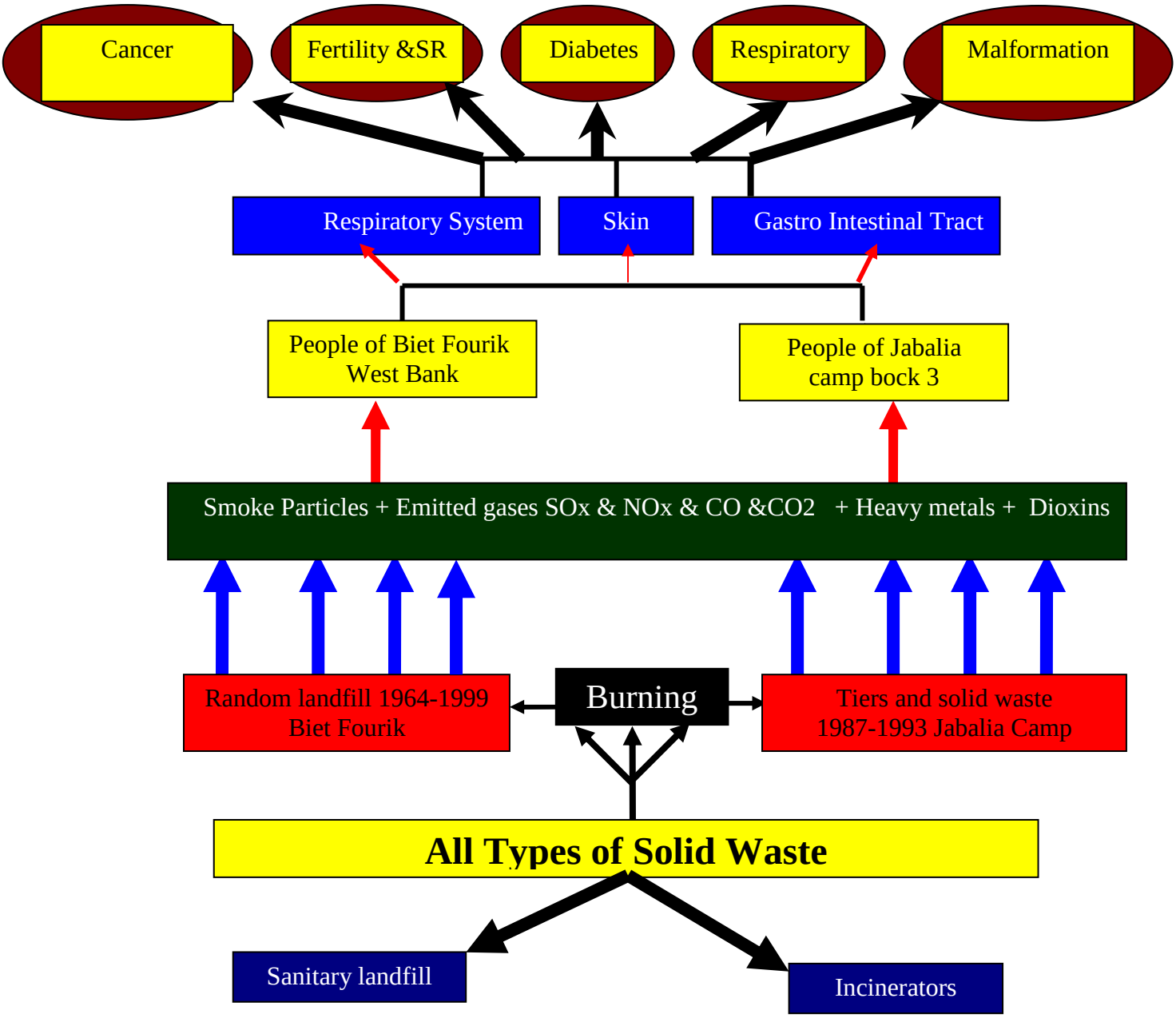
The immunotoxic effects of TCDD in humans are poorly characterized, because the immune system of known and documented TCDD exposure had been examined by few studies. It is important for laboratory researchers to focus on defining TCDD-sensitive immunologic markers in animals model that can be used in human, and must understand species differences in immunotoxicity of TCDD before extrapolate the effects in animals to humans (Kerkvliet, N. 1995).
After 20 years of Seveso, Italy accident, the immunoglobulin and plasma complements had been measured in the highly exposed zone. A significant decrease in immunoglobulin G (IgG) with increasing TCDD plasma concentration meanwhile immunoglobulin M (IgM), immunoglobulin A (IgA), C3 and C4 plasma concentration did not exhibit any consistent association with TCDD levels (Baccarelli, et al., 2002).
"We performed a systematic review of all articles published between 1966 and 2001 on human subjects exposed to TCDD reporting information on circulating level of immunoglobulins and/or complement complements. The literature indicates the evidence for effects of TCDD on humoral immunity is sparse."(Baccarelli, et al., 2002). TCDD inhibits immunoglobulin secretion and decrease s resistance to bacterial, viral and parasitic infection in exposed animals (Nohara, et al., 2002).
There is a strong inverse relationship between plasma IgG and increasing TCDD levels. Plasma TCDD level was not correlated with IgA, IgM, C3 or C4 plasma level. Long- term immunologic effect of TCDD may be coupled with the increased incidence of lymphatic tumors in area of exposure (Bertazzi, et al., 2001). A decrease in IgG plasma level, mainly the subclass IgG1, the most prevalent of human IgG molecules is in the workers exposed to PCDDs and PCDFs in Germany (Neubert, et al., 2000).

2.6 International Efforts to Control Dioxins

2.6.1 Stockholm Convention on Persistent Organic Pollutants

It is a global treaty adopted in 2001 and enters into force on 2004, requires the parties to take measures to eliminate or to reduce the persistent organic pollutants (POPs). POPs are chemicals remain in the environment for long period, widely geographical distributed and accumulate in fatty tissue of human, animals and wildlife. The exposure to these chemicals produces serious adverse health impacts on human health, e.g. certain cancers, birth defects, dysfunction of immune system and dysfunction of reproductive system. The POPs in the convention till now include 12 elements; one of them is the dioxins and furans (http://chm.pops.int/Convention).

2.7 Conceptual Framework



Chapter 3: Methodology

3.1 Study design

A cross sectional study design had been used to implement the research, where this type of study is used to estimate the relationship between an outcome of interest and population variables as they exist at one particular time. It saves time, effort and money.

3.2 Methods

A questionnaire was prepared and used to collect the data on all sample subjects chosen for the study sample. To save time and efforts, the questionnaire was answered by the subjects with the help of the researcher himself or the assistants.

3.3 Study areas

Two areas had been chosen. The first area was block 3 of Jabalia camp, northern area of Gaza Strip, which has been exposed to smoke of tiers burning for a long period of time during the first Intefada 1987-1993.

The other chosen area was Beit Fourik in Nablus governorate in the North of the West Bank. It has been exposed to the smoke resulting from garbage burning in random solid waste landfill, 1964-1999.

3.4 Study population

The sample had been chosen from the people living in the above mentioned areas, Beit Fourik population is 10,339 (Palestinian central Bureau of Statistics, 2006) and Block 3 at Jabalia camp population is 1,900 (Special Environmental Health Program UNRWA).

3.5 Study sample

Random sample had been chosen from the study population of both areas.

At block 3 of Jabalia camp, 75 families had been chosen by systemic random selection (every fourth and so on), and then one member of the chosen family had been selected randomly.

At Biet Fourik, the town had been divided into 4 areas as a follow:

-Biet Fourik A (BFA). 3.5 Km

- Biet Fourik B (BFB). 7.4 Km
- Biet Fourik C (BFC). 3.8 Km
- Biet Fourik D (BFD). 3.0 Km

Every area consists approximately from 250 families; the divisions had been done according to the distance from the site of random landfill and the direction of the wind.
In every division of the town 75 families had been chosen by systemic random selection (every fourth and so on), then one member of the chosen family had been selected randomly.

3.6 Sample size

To calculate the desired size of the study sample, the researchers estimated the prevalence of health effects at 40 %. A 95% level of confidence, an estimating error of 5 %. Based on these data using Epi info program calculation, the desired sample size was370. About one fifth (75 subjects) of the sample had been randomly selected from Jabalia camp, block 3 and four fifths (300 subjects) from Beit Fourik.

3.7 Data collection

A closed ended questionnaire had been administrated for all sample individuals by the researcher himself and his assistances.

3.8 Data analysis

The collected data had been statistically analyzed by using SPSS program to get the suitable information and construct 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.

3.9 Response rate

About 94.4%% of surveyed people answered the questionnaire properly and returned it in due time.

3.10 Questionnaire

As the Arabic language is the only official language in Palestine, the questionnaire was designed in Arabic language, and translated to English (annex 2), it was a self well constructed questionnaire, easy to read and containing questions covering the majority of clinical signs and factors related to the topic was used. The questionnaire had been sent to 10 experts to review it, 7 feedbacks which I received were helpful to reach the final design.

Generally the questionnaire was divided into:

- General data:

a. Personal data.

b. Exposure data.

- Medical histories: present, past and family history.
- For the signs and symptoms resulting from the exposure to of the smoke of burned tires and garbage.

Pilot Study:

The pilot study had been conducted by the researcher prior to data collection which consider as pre-test, by using a sample of fifteen participants whom been selected randomly from block three at Jabalia Camp. The response rate was 100%. In the light of the results of the pilot study some useful modifications were made, and the final form of the questionnaire was produced.

Content validity:

The questionnaire had reviewed by 7 experts, whom were helpful to reach the final design and enriching the content of the questionnaire.

3.11 Limitations of the study

- Budget
- The restricted movement between Gaza Strip and West Bank.
- Limited local and regional literature.
- Absence and fragmentation of governmental medical data.

3.12 Ethical matters

The author obtained all the necessary ethical documents to conduct the study (annexes 6-10); an official letter of approval to conduct the research had been obtained from Helsinki Committee-Gaza strip (Annex 5).

Furthermore, confidentiality was maintained at all levels during the study; a full explanation was given for all participants both verbally and written (Annex 1) to assure confidentiality and optional participation then consent forms has been distributed and signed at the time of data collection.

Chapter 4: Results and Discussion

Three hundred seventy five questionnaire forms were distributed among the randomly selected study sample. Three hundred fifty four subjects responded, giving a response rate of 94.4%, and two questionnaire forms answers had been rejected, thus 99.4% of the responding forms had been accepted.

Note: The discrepancies between the total numbers in the tables and that of total sample numbers is due to different responses of the subjects to each question in the questionnaire.

4.1 Characteristics of the Study Samples:

4.1.1 Socio-demographic Characteristics:

Residency:

According to the area of residency, 74 (21.0%) of the study sample live in Jabalia camp, block 3 while 278 (79.0%) live in Beit Fourik town as shown in table 4.1.

Table 4.1: Distribution of the Study Population According to Residency

Area	Number of Subjects	Percentage
Jabalia camp, block 3	74	21.0%
Beit Fourik	278	79.0%

Years of living in the same area were as follows: less than 21 years 66 subjects (20.5%); between 21 to 40 years 139 (43.2%) and more than 41 years 117 (36.3%). The mean number of years is 34.7 with a standard deviation of 17.49 (table 4.2).

Table 4.2: Distribution According to Years of Living in the Same area

Number of Years	Number of Subjects	Percentage
< 21	66	20.5%
21- 40	139	43.2%
≥ 41	117	36.3%

The above table shows that about 20.5% of the study population was exposed to the pollutants resulting from burning of solid waste with a maximum of five years in Jabalia Camp and ten years in Beit Fourik. While 79.5% was expose at least for five years in Jabalia Camp and for 10 years at Beit Fourik. Nearly 40% of Beit Fourik population was exposed at least for 30 years.

Gender

Sex distribution was 254 male (72.2%) and 98 female (27.8%).

Age

The following table (4.3) shows the age groups of all respondents.

Table4.3: Distribution of the Study Population According to Age Group

Age Group	Residency				Total	
	Jabalia camp		Beit Fourik			
<31 Year Old	16	16.5%	81	83.5%	97	100%
31-40 Year Old	19	21.3%	70	78.7%	89	100%
41-50 Year Old	22	25.3%	65	74.7%	87	100%
>50 Year Old	13	17.8%	60	82.2%	73	100%
Total Count & % within age group	70	20.2%	276	78.8%	346	100%

The mean of age is 40.4 years and the standard deviation is 13.5.

Table 4.4: Distribution of the Study Population at Jabalia Camp According to years of exposure

Age in Years	Number of Population	Percentage
17 – 25	9	12.9%
≥26	61	87.1%

As shown in table 4.4, about 87.1% (≥ 26 years) of the population was exposed to the pollutants resulting from burning of solid waste for seven years (Intifada 1987 -1993) at Jabalia Camp, and 12.9% (17 – 25 years) of the population was exposed for/ or less than 7 years.

Table 4.5: Distribution of the Age Group Study Population at Beit Fourik According to years of exposure

Age in Years	Number of population	Percentage
11-45	193	69.9%
≥46	83	30.1%

Nearly, about 30.1% (≥46 years) of the study population at Beit Fourik was exposed for thirty five years to the pollutants resulting from burning of solid waste in Nablus random landfill, and about 69.9% (11-45 years) was exposed for less than 35 years.

Marital Status

Table 4.6: Distribution of the Study Population by marital status

Marital status	Number of population	Percentage
Married	291	82.7
Single	44	12.5
Divorced or widowed	17	4.8

As shown in table 4.6, the majority of the study population was married 291 (82.7%). Forty four (12.5%) are single and 17 (4.8%) are divorced or widows. In Jabalia Camp, the number of married subjects is 67 (90.5%), single 6 (8.1%) and widow 1 (1.4%), and in Beit Fourik the married represents 224 (80.6%), single 38 (13.7%) and widow and divorced 16 (5.85%).

Table 4.7: Distribution of study sample by Consanguinity

Relativity	Jabalia Camp		Beit Fourik		Total	
First kin relatives	18	26.1%	43	18.2%	61	20.0%
Second kin relatives	14	20.3%	82	34.7%	96	31.5%
Non relative	37	53.6%	111	47.1%	158	48.5%
Total	69	100%	236	100%	305	100%

The above table (4.7) shows the consanguinity marriage in Beit Fourik is 125 (52.9%) and in Jabalia Camp the non relative marriage is 37(53.6%) of the same population.

Occupation

The majority of the study population, about 107 (31.0%), are employees and the minority are the industrial workers of about 4.6%. The total jobless subjects represent 23.2% (table 4.8).

Table 4.8: Comparison between Occupations of Study Population

Occupation	Jabalia Camp		Beit Fourik		Total	
Jobless	28	38.9%	52	19.0%	80	23.2%
Agriculture	00	00.0%	34	12.5%	34	9.9%
Industrial	00	00.0%	16	5.9%	16	4.6%
Mercantile	02	2.8%	26	9.5%	28	8.1%
Employee	28	38.9%	79	28.9%	107	31.0%
Technician	03	4.2%	40	14.7%	43	12.5%
Worker	11	15.3%	26	9.5%	37	10.7%
Total	72	100%	273	100%	345	100%

The above table shows that Jabalia camp is suffering of unemployment more than Beit Fourik because the refugees who live in the camp have no agriculture activity and no industrial jobs also. This may be attributed to the deterioration of the political, military and economic situation in Gaza strip. The people in both areas depend on the employments with the governmental or nongovernmental sectors, while Beit Fourik has more technicians.

Monthly Income

The mean monthly income of all groups is 370.67 JD, median 300JD and standard deviation 351.9**.** Mean monthly income of Jabalia camp group is 247.7, median 155 and standard deviation 320.7, while the mean monthly income of Beit Fourik is 410.5, median 350 and standard deviation of 353.0. With a poverty level of 1.25 US$/person/day (World development indicators, 2008), the majority of Jabalia Camp group (more than 60%) fall under the poverty level.

Accordingly, 102 (33.8%) of all population feel that their monthly income meets their needs while 200 (66.2%) of the same population feel not. At Jabalia Camp, only 9 (12.2%) said yes it is enough, but the majority 65 (87.8%) said it is not enough. Of Beit Fourik

population, 93 (40.8%) answered yes they can meet their daily needs and the remaining 135 (59.2%) answered no.

Educational level:

As shown in table (4.9) number of illiterate persons in the study population is 13 (3.7%) and those with at least an elementary level and higher represent 336 (96.3%) of the study population.

Table 4.9: Educational Level of the Study Population

Education level	Jabalia Camp		Beit Fourik		Total	
Illiterate	3	4.1%	10	3.6%	13	3.7%
Elementary	7	9.6%	42	15.2%	49	14.0%
Preparatory	13	17.8%	62	22.5%	75	21.5%
Secondary	23	31.5%	75	27.2%	98	28.1%
University	26	35.6%	82	29.7%	108	30.9%
Post graduate	1	1.4%	5	1.8%	6	1.7%
Total	73	100%	276	100%	349	100%

Family Size:

The following table (4.10) shows the family size of the study Population.

Table 4.10: Comparison between Family Size of the Study Population

Family size	Jabalia Camp		Beit Fourik		Total	
1 -6	30	40.5%	144	54.8%	174	51.6%
7 – 9	27	36.5%	89	33.8%	116	34.5%
10 – 15	17	23.0%	30	11.4%	47	13.9%
Total	74	100%	263	100%	337	100%

The above table shows that Jabalia camp population has the highest family size percentage. About 59.5% of the families consist of more than 7 members (7-15). Jabalia camp study population mean family size is 7.14 with a standard deviation of 3.02 and a median of 7.00. Beit Fourik mean family size is 6.33, with a standard deviation of 2.58 and a median of 6.00. All study population mean family size is 6.51, standard deviation 2.70 and median 6.00.

Smoking

The number of smokers among the study population of both Jabalia camp and Beit Fourik was 145 persons representing about 41.5%, and the nonsmokers were 204 (58.5%). Table 4.10 shows the data on smoking among the study population.

Table 4.11: Smoking Habits in the Study Population

Smoke	Jabalia camp		Beit Fourik		Total	
Yes	35	47.7%	110	40.0%	145	41.5%
No	39	52.7%	165	60.0%	204	58.5%
<10 cigarette/day	2	6.5%	3	2.9%	5	3.8%
10-20 cig/day	25	80.6%	41	40.2%	66	49.6%
> 20 cig/day	4	12.9%	58	56.9%	62	46.6%
Shisha	5	6.7%	18	6.5%	23	6.5%
<16 years duration	13	40.6%	53	50.5%	66	48.2%
16-25 years	10	31.3%	30	28.6%	24	29.2%
≥26 years	9	28.1%	22	21.0%	31	22.6%

As shown in the above table, the majority (51.8%) of smokers has been smoking for more than 15 years. The mean number of cigarettes smoked/person/day was 24.56 the median was 20.00 with a standard deviation of 12.17.

There are no large differences in the data concerning smoking habits except that those who smoke 10-20 cigarettes in Jabalia camp are two times more than those at Beit Fourik, while Beit Fourik was four times more than Jabalia in case of smoking more than 20 cigarettes / person/ day.

Eating Habits

About 313 (89%) of the surveyed population has undefined meals; only 12 (3.4%) prefer vegetables and low fat diet, 10 (2.8%) meat and 5 (1.4%) prefer fatty diet. About 124 (35.6%) eat fresh food, 10 (2.9%) frozen food and 214 (61.5%) eat both types of food.

Meanwhile 255 (73.5%) ask about the sources of the food and 92 (26.5%) do not. One hundred fifty two (43.6%) eat the food produced from the same area of residence and 197 (56.4%) not from the same area of residence.

At Beit Fourik 111 persons (40.4%) of the study population eat fresh food, 5 (1.8%) eat frozen food and 159 (57.8%) eat both fresh and frozen foods. Two hundred and one (73.4%) ask about the sources of the food they eat, 73 (26.6%) did not ask and 115 (41.8%) said that they eat the food produced in Beit Fourik itself while the remaining 160 (58.2%) eat food from outside sources.

At Jabalia camp 13 (17.8%) eats fresh food, 5 (6.8%) eats frozen food and 55 (75.3%) eats both types of food, 54 (74.0%) asking about the sources and 19 (26.0%) did not ask and 37 (50.0%) of food sources from the area of Jabalia meanwhile 37 (50.0%) from out side.

4.2 Cancer:

In the whole study population 12 (3.6%) have cancer and 321 (96.4%) do not have. Nine (75.0%) of the cancer cases had been diagnosed in Palestine while 3 (25.0%) of the cases had been diagnosed outside Palestine. All the cancer cases have been treated for cancer; 2 (16.7%) had blood cancer (leukemia) and 10 (83.3%) had other solid tissue cancer. Duration of cancer was for less than 5 years 7 (58.3%), for 5 – 10 years 4 (33.3%) and for 11 -15 years 1 (8.3%). Table 4.12 shows the data on cancer cases in the two study areas.

Table 4.12: Cases of Cancer Data in Different Areas

Cancer		Jabalia Camp		Beit Fourik		All groups	
Cancer Cases	Yes	6	8.7%	6	2.3%	12	3.6%
	No	63	91.3%	258	97.7%	321	96.4%
Place of Diagnosis	Palestine	4	66.7%	5	83.3%	9	75.0%
	Outside Palestine	2	33.3%	1	16.7%	3	25.0%
Type of Cancer	Blood	1	16.7%	1	16.7%	2	16.7%
	Solid Tissues	5	83.3%	5	83.3%	10	83.3%
Treatment	Yes	6	100%	6	100%	12	100%
	No	0	0.0%	0	0.0%	00	0.0%
Duration	Less than 5 years	4	66.7%	3	50.0%	7	58.3%
	5 -10 years	1	16.7%	3	50.0%	4	33.3%
	11 – 15 years	1	16.7%	0	0.0%	1	8.3%

The cancer cases percentage in all study population represent 3.6%. Table 4.12 shows that the percentage of cancer cases in Jabalia camp was 8.7% and 2.3% in the Beit Fourik which are much higher than the Palestine average (0.058%) according to (MOH, 2002) and the report on cancer in the West Bank 2006. These results need to be studied in more details and thorough investigations using other types of research methodology.

Solid tissue type of cancer in the study population is 83.3% which is to some extent equal to Palestine average of 81% (MOH Cancer 1995 – 2000, 2002).

Cancer Cases in Relation to residency:

The following tables illustrate the relationship between cancer and some socioeconomic factors in the study areas.

Table 4.13: Cancer in Relation to Residency

Cancer		Jabalia Camp		Beit Fourik		All groups	
Cancer Cases	Yes	6	8.7%	6	2.3%	12	3.6%
	No	63	91.3%	358	97.7%	321	96.4%

A p- value of 0.011 indicates that there is a positive statistically significant relationship between residency and cancer.

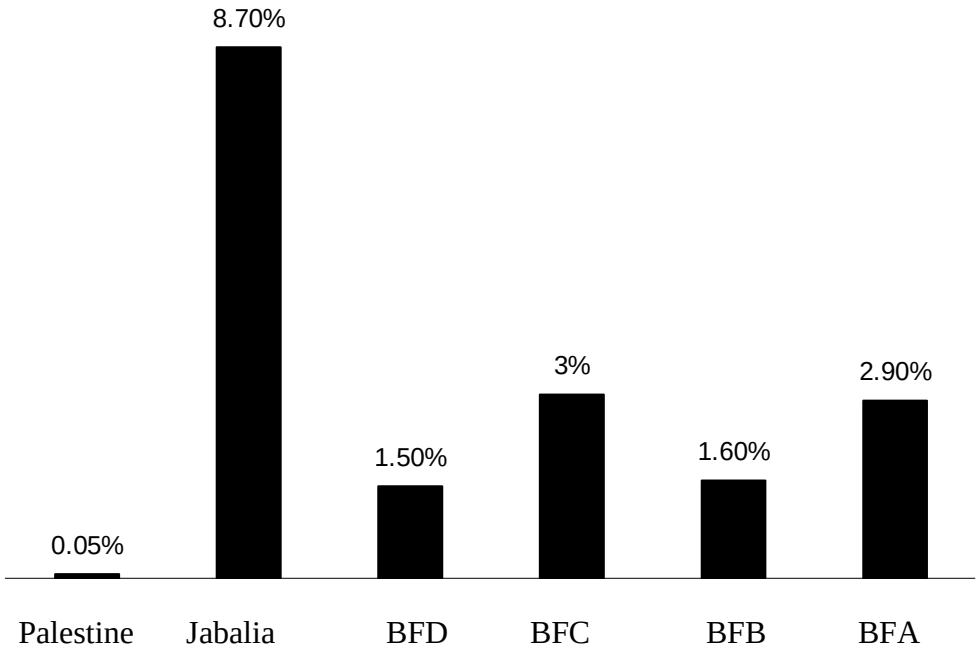
Table 4.14: First Kin Family History of Cancer Deaths

First kin cancer deaths		**Jabalia Camp**		**Beit Fourik**		**All groups**	
Cancer deaths	Yes	14	31.8%	52	22.6%	66	24.1%
	No	30	68.2%	178	77.4%	208	75.9%
Residency in same area	Yes	9	64.3%	49	94.2%	58	87.9%
	No	5	35.7%	3	5.8%	8	12.1%
Years of diagnosis	2 – 10	2	25.0%	17	33.3%	19	32.2%
	11 - 20	2	25.0%	20	39.3%	22	37.3%
	20 -60	4	50.0%	14	27.5%	18	30.5%
Years of death	1 – 10	2	22.2%	23	45.1%	25	41.7%
	11 – 20	4	44.4%	16	31.4%	20	33.3%
	21 - 57	3	33.3%	12	23.5%	15	25.0%

As shown in the table 4.14, family history of cancer mortality in the study sample is 66 (24.1%) cases which is much higher than the country average of 0.027% (MOH, 2005 and MOH 1995-2000, 2002). These results are in agreement with mortality studies of dioxin exposures of Ott and Zober, 1996 and Becher et al., 1998. Most of the mortality cases 58 (87.9%) were living in the same area, but first kin family history of cancer deaths at Jabalia camp (31.8%) more than that of Beit Fourik (22.6%) which might be due to higher percentage of cases at Jabalia camp. While the effect of residency on first kin family history of cancer deaths in Beit Fourik was 94.2% which is more than that of Jabalia camp of 64.3%. This may be due to the dispersion of the Palestinian refugees in many places after the 1948 Arab Israeli war.

Additionally, about 74 (24.8%) of all subjects has positive first kin family history, 65 (87.8%) of them live in the same area of residency and 45.5% have been living in the same area for up to 60 years.

Figure 4.1: Comparison of Cancer between Different Areas of Study Population and Palestine



According to figure 4.1 the comparison between cancers cases in Palestine and divisions of the study population which had been divided equally to 5 regions one at Jabalia camp and 4 regions at Beit Fourik (BFD, BFC, BFB, and BFA), the results show that the cancer rate in the five study divisions (from 1.5% in BFD to 8.7 in Jabalia) is much higher than that of the country (Palestine).

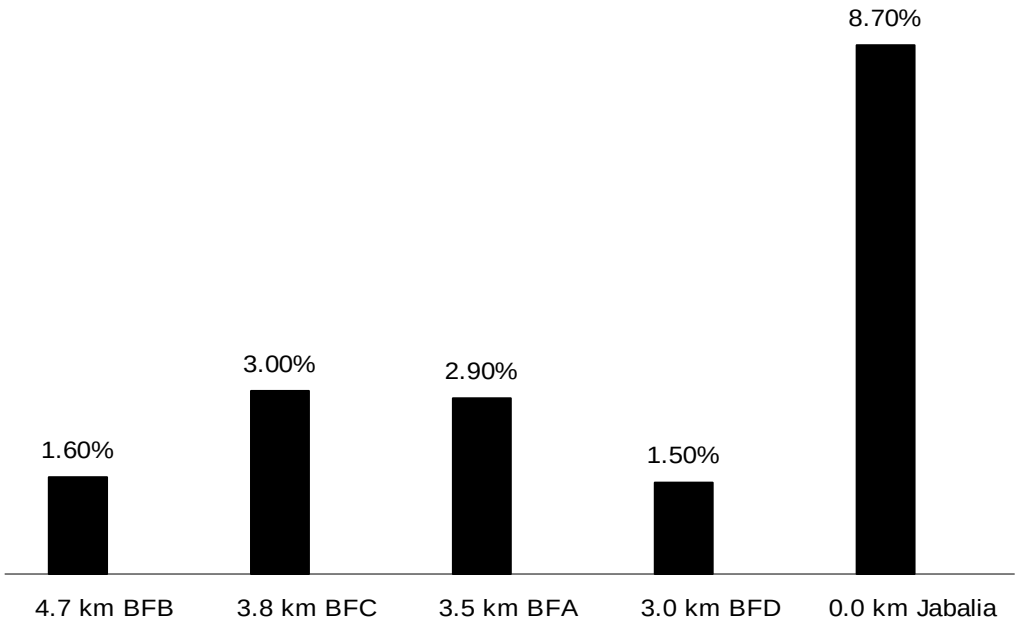


Figure 4.2: Comparison between Cancer Cases of Different Areas of Study Population According to the Distance from Solid Waste Burning Sites

4.3 Congenital Anomalies:

The current study showed that 30 (10.0%) of the subjects giving history of congenital anomalies; in 20 (66.7%) of those subjects the defects were apparent while 10 (33.3%) of the anomalies were invisible (table 4.15).

Table 4.15: Distribution of Congenital Anomalies and type among Study Population

Congenital Anomalies	Total		Apparent		Unapparent	
Yes	30	10%	20	66.7%	10	33.3%
No	270	90%	00	0.0%	00	0.0%

The above table shows that 10% of the study population who was exposed to the pollutants resulting from burning of solid waste has a history of congenital anomalies which is nearly 3 times higher than that of the studies conducted in Egypt which had shown about 3.16% of the study population have had congenital anomalies (www.emro.who.int). Also the results of the current study had been supported by study of Dimich-Ward, H. et al and published in Scandinavian Journal of Work (Dimich-Ward, H., et al. 1996).

Table 4.16: Distribution of Congenital Anomalies in Relation to Residency

Congenital Anomalies	Area of Residency			
	Jabalia Camp		Beit Fourik	
Yes	4	6.0%	26	11.2%
No	63	94.0%	207	88.8%

As noticed in the above table, Beit Fourik cases of 26 (11.2%) are higher than those of Jabalia camp of 4 cases (6.0%). The p-value is 0.212 which indicates an insignificant statistical difference. Other factors may have more influence in relation to the disease.

Table 4.17: Distribution of Congenital Anomalies among Areas of Study Population

Congenital Anomalies	Jabalia camp		Beit Fourik A		Beit Fourik B		Beit Fourik C		Beit Fourik D	
Yes	4	6.0%	6	10.2%	3	5.0%	7	12.3%	10	17.5%
No	63	94.0%	53	89.8%	57	95.o%	50	87.7%	47	82.5%

The above table (4.17) shows that the highest percentage (17.5) of cases is in area D of Beit Fourik which is the nearest to the site of solid waste burning, about 3 km from the burning solid waste site. The lowest percentage (6.0) of the cases was in Jabalia camp of zero distance from the burning site, but the difference in the period of exposure to the pollutants emitted from burning of solid waste (Beit Fourik from 1964 to 1999 and Jabalia camp from 1987 to 1993 indicates that the period of exposure may be associated with the occurrence of congenital anomalies.

Table 4.18: Distribution of Congenital Anomalies in Relation to Consanguinity

Congenital Anomalies	Consanguinity Marriage					
	First Kin		Relative		Non Relative	
Yes	6	10.3%	12	13.0%	12	8.3%
No	52	89.7%	80	87.0%	132	91.7%

Consanguineous marriage of first kin and relative of 157 of the study population (table 4.6) is still high, which might be attributed to the rural life of the majority of the study population. Also the consanguineous marriage subjects have higher percentage of congenital anomalies of 18 (12.0%) than that of the non relative 12 (8.3%) with a p-value of

0.506 which indicates a statistically insignificant relationship between consanguineous marriage and congenital anomalies.

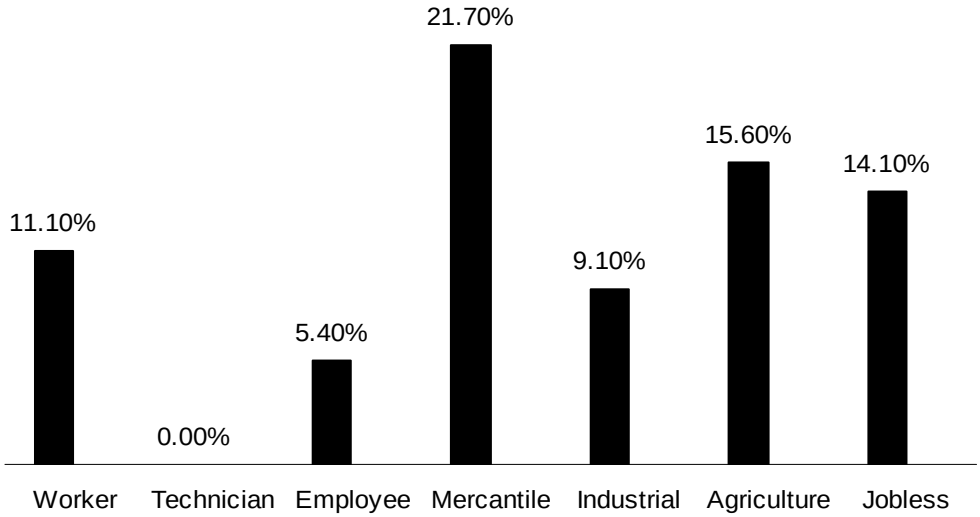


Figure 4.3 Distribution of Congenital Anomalies History in Relation to Occupation

The figure shows that the mercantile has the highest percentage of congenital anomalies.

4.4 Diabetes mellitus

In the study population, about 36 (10.6%) of the subjects have diabetes mellitus while 304 (89.4%) of the subjects have not. The mean of age (in years) at the time of diagnosis is 41.3, the standard deviation is 16.62 (minimum 1.0, maximum 73.0) and the median is 45 years. This percentage (10.6%) of population with diabetes is higher than that in the report of MOH, 2005 which gave a percentage of 9.0% according to a study conducted in the year 2000 in cooperation between Al-Quds University and the Palestinian MOH. 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).

Table 4.19: Distribution of Diabetes Mellitus in Relation to Residency

Diabetes Mellitus	Area of Residency			
	Jabalia Camp		Beit Fourik	
Yes	5	7.4%	31	11.4%
No	63	92.6%	241	88.6%

According to the above table (4.19), of the Beit Fourik study population 11.4% has diabetes that is higher than the Palestinian average of 9.0% (MOH, 2005). This increase had been explained by the studies that measure the association between the exposure to the pollutants and diabetes. Jabalia camp study population has 7.4% diabetes cases which is less than the Palestinian average of 9.0% (MOH, 2005%), but within the average of UNRWA/Gaza 8.0% (UNRWA, Diabetes mellitus Report, 2009). This is supported by the conclusion of analysis of the data from United States National Institute for Occupational Safety and Health (NIOSH) which indicate a little evidence that the exposed population to pollutants were at higher risk than unexposed to develop diabetes (Steenland, et al., 2001).

Table 4.20: Distribution of Diabetes Mellitus among Areas of the Study Population

Diabetes Mellitus	Jabalia camp		Beit Fourik A		Beit Fourik B		Beit Fourik C		Beit Fourik D	
Yes	5	7.4%	12	17.4%	2	2.9%	11	16.2%	6	9.0%
No	63	92.6%	57	82.6%	66	97.1%	57	83.8%	61	91.0%

The table (4.20) shows that in Beit Fourik town, area A which is far by3.5km from the random site of solid waste burning, is the highest (17.4%) of diabetes, while area B which is far by 4.7km from the same site is the lowest (2.9%). The distance from the site of source of pollution may have a role in developing diabetes.

P value 0.029 which is statistically significant indicating that may be an association between the distance of area of residency from site of source of pollution and diabetes.

Table 4.21: Distribution of Diabetes Mellitus in Relation to Gender

Diabetes Mellitus	Gender			
	Male		Female	
Yes	30	12.4%	6	6.1%
No	212	87.6%	92	93.9%

The above table shows that 30 (12.4%) of total male population have diabetes and 6 (6.1%) of total female have diabetes. Accordingly 30 (83.34%) of diabetic population were males and 6 (16.66%) of diabetic population were females. These results contradict the MOH report of 2007 which showed 55.19% of diabetics were females and 44.81% were males (MOH, 2007).

The p-value is 0.089 which is statistically insignificant indicating that there is no significant association between gender and diabetes.

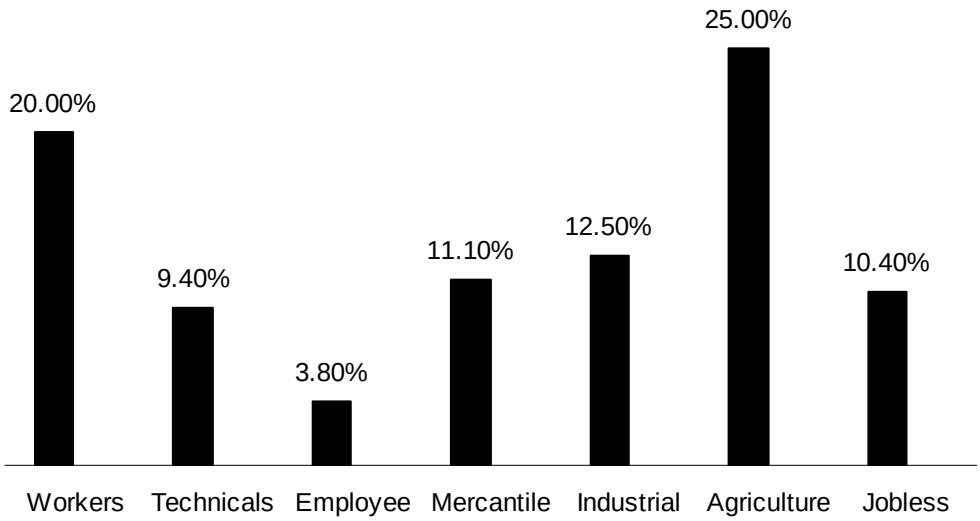


Figure 4.4: Distribution of Diabetes Mellitus in Relation to Occupation

The above figure (4.4 shows that 25.0% of the agriculture workers and simple workers 20.0% are the most vulnerable groups to diabetes mellitus. This may be attributed to the exposure to both occupational hazards in addition to pollutants emitted from burning of solid waste, as the farms and the places of work are in the same area of exposure. The p-value of 0.019 is statistically significant indicating that there is a positive association between occupation and diabetes.

4.5 Respiratory disease

The current study shows that 50 (15.2%) of all study population have had respiratory diseases and 278 (84.8%) did not have respiratory diseases; bronchial asthma accounts for

24 (48.0%) of respiratory diseases cases, chronic bronchitis for 23 (46.0%) cases and pulmonary emphysema accounts for 3 (6.0%) of the respiratory diseases cases.

The date of diagnosis of the disease ranges between a minimum of 2.0 years and a maximum of 39.0 years with a median of 10.0 , a mean of 12.08 and standard deviation of 9.66 years. This may lead to the conclusion that at Beit Fourik half of the cases of respiratory disease occurred before the closure of Nablus random landfill while the other half occurred after the closure.

Table 4.22: Distribution of Respiratory Diseases in Relation to Residency

Respiratory Diseases	Area of Residency			
	Jabalia Camp		Beit Fourik	
Yes	6	9.4%	44	16.7%
No	58	90.6%	220	84.3%

In Beit Fourik study population 44 (16.7%) had respiratory diseases, while in Jabalia camp study population 6 (9.4%) had the same diseases. In the absence of official Palestinian prevalence data of respiratory diseases, the WHO reports revealed that there are wide differences in the prevalence of chronic respiratory disease among the different countries which ranges from 4.0% to 20.0% depending on many different factors (www.who.int/gard).

The higher percentage of Beit Fourik more than Jabalia camp may be due to longer period of exposure. P value 0.145 which is statistically insignificant indicating that may be no association between the residency and respiratory diseases.

Table 4.23: Distribution of Respiratory Diseases among Areas of Study Population

Respiratory Diseases	Jabalia camp		Beit Fourik A		Beit Fourik B		Beit Fourik C		Beit Fourik D	
Yes	6	9.4%	19	27.9%	12	18.5%	7	10.6%	6	9.2%
No	58	90.6%	49	72.1%	53	81.5%	59	89.4%	59	90.8%

The above table (4.23) shows that in Beit Fourik town, area A which is about 3.5km away from the random site of solid waste burning had the highest number of respiratory diseases cases with 19 (27.9%) cases, while area B which is away from the site by 4.7km had 12 (18.5%) of the cases and the nearest from the random site of solid waste burning in Jabalia camp of 0.00km distance and area D of Beit Fourik with 3km from the burning sites were the lowest of 6 (9.4%) and 6 (9.2%) respectively. The distance from the site of source of pollution may have a role in respiratory disease. This has been proven by the fact that the p-value for the above contingency table is 0.009 which is very statistically significant indicating that there is an association between the distance of area of residence from the site of source of pollution and respiratory disease.

Table 4.24: Distribution of Respiratory Diseases in Relation to Gender

Respiratory Diseases	**Gender**			
	Male		**Female**	
Yes	36	15.4%	14	14.9%
No	198	84.6%	80	85.1%

The above table shows an equal distribution of respiratory diseases in relation to sex, where 36 (15.4%) of male study population had respiratory disease and 14 (14.9%) of the female study population had respiratory diseases. The p-value equals 0.911 which is statistically insignificant indicating that no association between gender and the respiratory diseases.

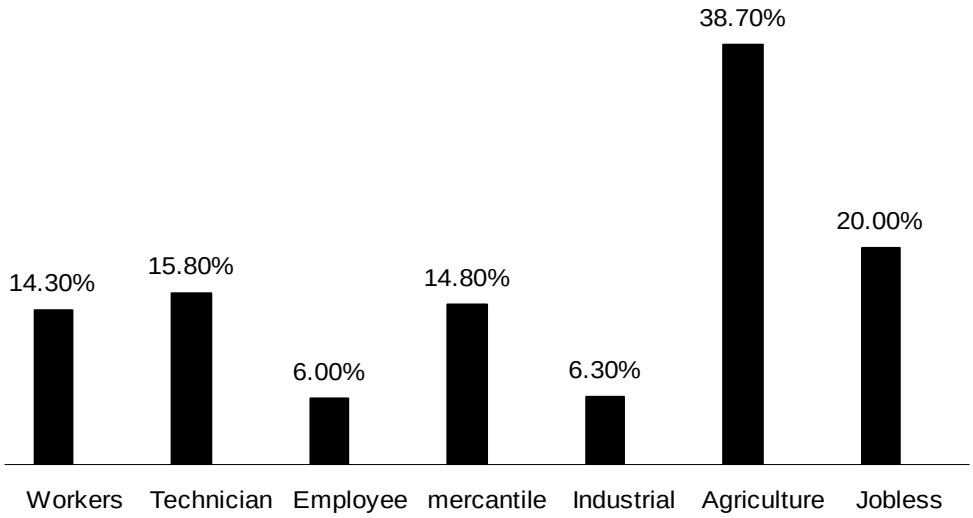


Figure 4.5: Distribution of Respiratory Diseases in Relation to Occupation

The above (4.5) figure shows that agriculture workers 38.7% are the most vulnerable group to respiratory diseases. This result may be due to the fact that agriculture workers are exposed to both occupational hazards and to the pollutants emitted from burning of solid waste, as the farms and the places of work are in the same area of exposure. The p-value equals 0.001 which is very statistically significant and indicates that there is strong association between occupation and respiratory diseases.

4.6 Fertility and Sex Ratio

In this study, the average family size of the total study population is 6.51, standard deviation 2.707 and the sex ratio of males to females equals 100.6:100.0, as shown in table 4.25.

Table 4.25: Family Size Averages and Sex Ratio According to Residency

	Area of Residency		
	Jabalia Camp	**Beit Fourik**	**Whole Population**
Mean Family size	7.13	6.33	6.51
Sex Ratio M:F	100 : 100	100.7 : 100	100.6 : 100

The above table shows that the mean family size in Jabalia camp (7.13) is higher than the mean family size in the Gaza strip (6.5) and that of the West Bank (5.5), while Beit Fourik the average family size (6.33) is higher than that in the West Bank (5.5). This difference in fertility might be explained as a result of exposure to dioxins which is one of the pollutants resulting from burning of solid waste. Many studies had supported this result and conclusion (Eskinazi, et al., 2000, Kogevinas, 2001, Vreugdenhill, et al., 2002a, and Pesatori, et al., 2003).

Sex ratio of males to females in Jabalia camp is the lowest (100:100) compared to that of Beit Fourik (100.7:100) and that of the Gaza Strip and the West Bank (103:100). Also this result had been supported the study of Mocarelli that proved the link between the long term exposure to pollutants emitted from industry and incinerators and low sex ratio regard male (Mocarelli, P., et al., Lancet 2000).

Table 4.26: Distribution of Infertility Treatment According to Residency

Infertility Treatment	Area of Residency					
	Jabalia Camp		Beit Fourik		Whole Population	
Yes	13	19.1%	51	22.4%	64	21.6%
No	55	80.9%	177	77.6%	232	78.4%

Of the whole study population 64 (21.6%) have received treatment for fertility. The majority of them 51 (22.4) are in Beit Fourik which is higher than that of Jabalia camp 13 (19.1%).

Table 4.27: Distribution of the Male Infertility According to Residency

Male infertility	Area of Residency					
	Jabalia Camp		Beit Fourik		Whole Population	
Yes	4	33.3%	27	51.9%	31	48.4%
No	8	66.7%	25	48.1%	33	51.6%

Table 4.27 shows that more than half of the infertility cases of Beit Fourik population in this study 27 (51.9%) were due to male causes, while in Jabalia camp 4 (33.3%) of the infertility cases were due to male causes.

According to the above tables 4.38, 4.39, and 4.40, Beit Fourik has the highest percentage. This may be due to the longer period (1964 – 1999) of exposure to pollutants emitted from burning of solid waste in Nablus random landfill. This is supported by the study conducted by Mocarelli, 2003 which had shown that after the Italian Seveso accident in 1976 their had been a reduction of sperm motility in adults who were 1-9 years of age when they were exposed. Opposite effects were seen if the exposure took place during puberty, 10-17 years of age, and no effects when exposure took place at puberty of more than 17 years of age (Mocarelli, et al., 2008).

Table 4.28: Distribution of the Fertility in Beit Fourik According to Age Group and Age at Exposure

Family Size	Age Groups in Beit Fourik /Age at Exposure					
	10-54 years/ Exposure at age 1-9 years		55-62 years/ Exposure at age 10-17 years		>62 years/ Exposure at age >17 years	
1 – 6	123	60.0%	6	26.1%	5	26.3%
7 – 9	70	31.8%	12	52.2%	7	36.8%
10 – 15	18	8.2%	5	21.7%	7	36.8%

N.B. The exposure period is 35 years (1964 – 1999).

The percentage of family size of 1-6 members in age group 10-54 years old which has exposed to pollutants emitted as a result of solid waste burning from Nablus random landfill at age 1-9 years represents 60% of the Beit Fourik study population, which is the highest compare to other groups. Also, table 4.41 shows that the percentage of family size of 7-9 members in the age group 55 – 62 years old who has been exposed to pollutants emitted as a result of solid waste burning from Nablus random landfill at age 10 -17 years was 52.2% which is the highest if compare with other groups. But in age group >62 years old which has been exposed to pollutants emitted as a result of solid waste burning from Nablus random landfill at age >17 years, the percentage of family size groups nearly are equal.

The p-value of 0.000 is highly statistically significant indicating that there may be an association between the age group in Beit Fourik and the age at exposure and family size. This results are supported by the study conducted by Mocarelli, 2003 which showed that

after the Italian Seveso accident in 1976 there has been a reduction of sperm motility in adults who were 1-9 years of age at the time of expose, while opposite effects were seen if the exposure took place during puberty 10-17 years of age, and no effects when exposure took place at more than 17 years of age (Mocarelli, et al., 2008). And in the Telegraph, professor Paulo Mocarelli said "*Dioxins permanently affect the productive system and their inhibition in infancy and stimulation in puberty, when mature there is no effect"* (Telegraph, 2008).

Table 4.29: Distribution of the Fertility in Jabalia Camp According to Age Group and Age at Exposure

Family Size	Age Groups in Jabalia Camp /Age of Exposure					
	17- 31 years Exposure at age 1-9 years		32-39 years Exposure at age 10-17 years		>39 years Exposure at age >17 years	
1 – 6	12	75.0%	4	25.0%	13	34.2%
7 – 9	00	0.00%	10	62.5%	15	39.5%
10 – 15	4	25.o%	2	12.5%	10	26.3%

During the exposure period of 7 years (1987 – 1993), the percentage of family size of 1-6 members in age group of 16 - 31 years old which had been exposed to pollutants emitted as a result of solid waste and rubber tires burning during the first Intifada (1987 – 1993) at the age of 1-9 years is 75.0%. This percentage is the highest compared to other family size groups, while the percentage of family size of 7-9 and age group 32 - 39 years old which had been exposed to pollutants emitted as a result of solid waste and rubber tiers burning during first Intifada at age 10 -17 years was 62.5% which is the highest compared to other family size groups. But in age group >39 years old which had been exposed to pollutants emitted as a result of solid during first Intifada at age >17 years, the percentage of family size groups nearly equal.

The p-value of 0.003 is highly statistically significant indicating that there is an association between these age groups in Jabalia camp and age of exposure, and family size. These results are also supported by the study conducted by Mocarelli, 2003.

Table 4.30: Distribution of Sex Ratio in Relation to Age Groups /Age of Exposure in Beit Fourik

Family Gender	Age Groups in Beit Fourik /Age of Exposure					
	10-54 Years/ Exposure at Age 1-9 Years		55-62 Years/ Exposure at Age 10-17 Years		>62 Years/ Exposure at Age >17 Years	
Male (M)	215	50.3%	23	50.0%	19	50.0%
Female (F)	213	49.7%	23	50.0%	19	50.0%
Sex Ratio M:F	100.9 : 100		100 : 100		100: 100	

In the 2007 census of West Bank, the sex ratio was 103 males to 100 females (M:F 103:100). When compared with the results of the current study in Beit Fourik, it is concluded that there is a decrease in the sex ratio in Beit Fourik, it is concluded that there is a decrease in the sex ratio in Beit Fourik may be either to increase of female number or due to decrease male numbers.

This conclusion is supported by the results of a study conducted by Ryan, 2002 which shows a decrease in the number of boys for exposed fathers while normal number for expose mothers. Also the result is supported by Mocarelli in many studies that showed a decrease of male to female ratio when the population is exposed to dioxins (one of the major pollutants that result from burning of solid wastes) for a long period of time (Mocarelli, et al., Lancet 2000).

The p-value of 0.004 for female distribution and p-value of 0.101 for male distribution in Beit Fourik indicate a highly positive statistically significant association between female number and age of subject at exposure, while it is the opposite for males.

Table 4.31: Distribution of Sex Ratio in Relation to Age Group /Age of Exposure in Jabalia Camp

Family Gender	Age Groups in Jabalia Camp /Age of Exposure					
	17-31 years Exposure at Age 1-9 Years		32-39 years Exposure at Age 10-17 Years		>39 years Exposure at Age >17 Years	
Male (M)	15	22.1%	16	23.5%	37	54.4%
Female (F)	14	20.6%	16	23.5%	38	55.9%
Sex Ratio (M:F)	107 : 100		100 : 100		97 : 100	

In the 2007 census of Gaza Strip, the sex ratio was 103 males to 100 females (M: F 103:100). If compared with the results of the study population in Jabalia camp it is shown that there is an increase in the sex ratio of the study population who has been exposed to the emitted pollutants at the age of 1-9 years at the age of old 17-31years. Members of this group may not have enough offsprings who are actually affected. This contradicts the results of a study conducted by (Ryan, 2000 and Mocarelli, et al., Lancet 2000). The results of the other two age groups are supported by a study conducted by the same above mentioned researchers.

The p-value of 0.528 female distributions and the p-value of 0.163 for male distribution in Jabalia camp which is statistically insignificant and indicates that there is no association between male and female family members and age of subject at exposure in Jabalia camp.

Table 4.32: Relationship between Pesticides/Chemical Use and Fertility Treatment

Fertility Treatment	Pesticides/Chemical uses			
	Yes		No	
Yes	30	25.0%	28	18.2%
No	90	75.0%	126	81.8%

The above table (4.32) shows that 30 (25.0%) of pesticides/chemical users of the study population were treated for fertility, while 28 (18.2%) of the non pesticides/chemical users were treated for fertility. The p-value of 0.170 which is a statistically insignificant indicates that there is no association between pesticides/chemical uses and fertility treatment.

Table 4.33: Relationship between Work in Chemical Factories and Fertility Treatment

Fertility Treatment	Work in Chemical factories			
	Yes		No	
Yes	3	50.0%	54	20.5%
No	3	50.0%	210	79.5%

The above table shows that 3 (50.0%) of chemical factories workers of the study population were treated for fertility, while 54 (20.5%) of non chemical factories workers were treated for fertility. The p-value of 0.080 which is statistically insignificant indicates that there is no association between chemical factories workers and fertility treatment.

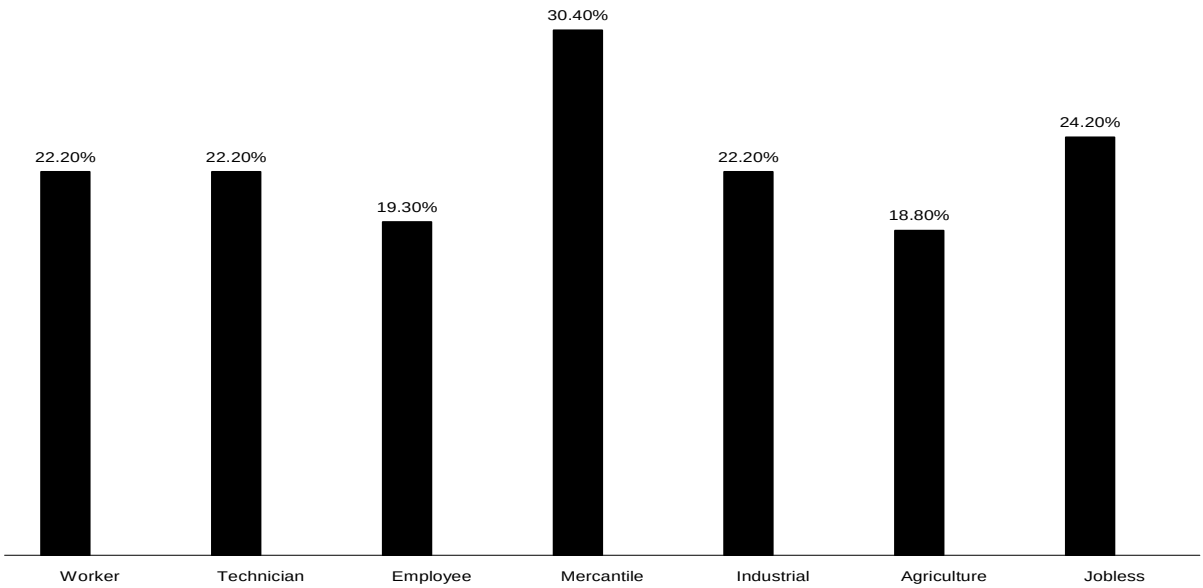


Figure 4.6: Relationship between Occupation and Fertility Treatment

The above figure (4.6) shows that of the study population, 7 (30.4%) of the mercantile occupation group had been treated for fertility which represents the highest percentage in relation to other occupations. The p-value of 0.944 which is statistically insignificant indicates that there is no association between occupation and fertility treatment

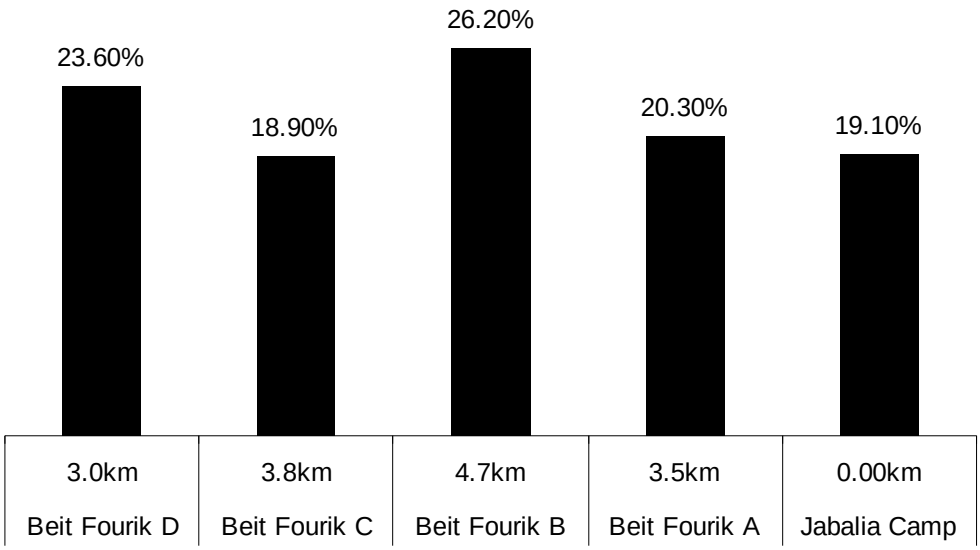


Figure 4.7: Relationship between Distance of Areas from the Site of Burning and Treatment of Fertility

The above figure shows that the distance from the site of solid waste burning has no role in fertility treatment; Beit Fourik B which is the farthest (4.7km) from the site of burning of solid waste has the highest percentage of fertility treatment. A p-value of 0.837 indicates that there is no association between distance and fertility treatment.

Chapter 5: Conclusion

This is a cross sectional study to find out the relationship between the pollutants emitted from burning of solid waste and clinical diseases that may result due to the long term exposure to those pollutants in block 3 of Jabalia camp in the Gaza strip and Beit Fourik town in the West Bank.

The socio-demographic data show that more males were included in the study population in spite of the strict random selection of the sample that had been followed by experts' data collectors of both sexes.

Poverty is obvious in Jabalia camp where more than 60.0% of the study population is under poverty line. Most of the study population is educated; around 41% of them are non smokers; the majority prefers combined frozen and fresh food; mean family size equals 6.51; the consanguinity marriage reflects the rural nature of the study population as relative marriage constitutes more than 51.5% of total marriages. One of the most important demographic data is that the total population living in the same area for a period of time more than 21 years is about 79.5% which indicates that the period of exposure was more than 5 years in Jabalia camp and more than 11 years in Beit Fourik.

Cancer cases percentage in total sample population is 3.6, which is higher than that of Palestine (0.05%). This indicates that there is an association between cancer and the residence in study areas where the population is exposed to pollutants emitted from burning of solid waste. The cancer cases distributed as 16.7% blood cancer and 83.3% solid tissue cancer. Agriculture workers (12.9%) are the vulnerable group to cancer among occupation, also the duration of smoking and cancer showed a significant positive association with a p-value 0.035. First kin family history of cancer is positive in 24.8% of total subjects where about 87.8% of them live in the same area. Fist kin family history of cancer deaths is 24.1% where about 87.9% of them live in the same area. The distance from the site of burning solid has no association with cancer with a p-value of 0.143 while the time of exposure has an association with cancer cases.

Regarding congenital anomalies, around 10.0% of the total study population giving history of congenital anomaly which is higher by three folds than that of Egypt. About two thirds of the congenital anomalies were apparent while the other 1/3 was unapparent. This increase in

the percentage of congenital anomalies may be related to the period of exposure more than the site of exposure. This is obvious if we compare Beit Fourik area D which is the highest percentage of 17.5, and away by 3km from Nablus random landfill, while Jabalia camp which is the nearest of 0.00km has the lowest percentage of cases (6.0%). Also the study shows a positive association between congenital anomalies and fertility treatment, pesticide/chemical uses and working in chemical factories.

Regarding diabetes mellitus, 10.6% of in total study population has diabetes mellitus which is higher than that of Palestinian average of 9.0%. The percentage of diabetics in Beit Fourik represents 11.4% of the study population. This increase may be associated with the exposure to pollutants emitted from burning of solid waste in Nablus random landfill (1964 – 1999). The above conclusion is supported by conclusions of analysis of the data from NIOSH and United States Air Force veterans (Ranch Hand) showed that there was little evidence that the exposed workers were at higher risk than the non-exposed to TCDD of diabetes. However, the Ranch Hand subjects showed positive dose-response for diabetes, whereas the more highly exposed NIOSH subjects did no (Steenland, et al., 2001).
The study results show that there is an association between Diabetes mellitus and the distance from the site of solid waste burning site with a p-value of 0.029 and family history of Diabetes mellitus with a p-value of 0.000.

Respiratory diseases account for 15.2% of the total population; 48.0% of them were bronchial asthma, 46.0% chronic bronchitis and 6.0% were bronchial emphysema. The WHO made one category called Chronic Obstructive Pulmonary Disease “COPD” that includes bronchial asthma, chronic bronchitis and bronchial emphysema. COPD in Beit Fourik accounts for 16.7% of the study population, and 9.4% in Jabalia camp study population which is a highly statistically significant with p-value of 0.000. The relation between the distance and COPD indicating a positive association between the distance from the site of solid waste burning and COPD.
Positive family history of COPD subjects is about 18.8%, 87.3% of them living in the same area. The p-value for the relationship equals 0.000 which is indicates a very highly statistically significant association between family history and respiratory diseases.

There is a statistically insignificant result for relation of COPD with smoking in this study population (p-value = 0.084). According to occupation, the study population shows that

38.7% of agriculture workers have developed COPD which may be attributed to the exposure to occupational hazards and to the pollutants emitted from burning of solid waste. About 16.7% of the total study population has complained from the difficulty of breathing; only 31.7% of the respiratory diseases subjects have complained from the difficulty of breathing. The p-value of 0.000 on the relation between difficulty of breathing and COPD is highly statistically significant and leads to the conclusion that there is a strong association between difficulty of breathing and COPD.

Regarding fertility and sex ratio, the study shows about 6.51%, of the study population in Jabalia camp have family size of 7.31 which is more than that of Gaza (6.5), while the family size of Beit Fourik study population was 6.33 which is more than that of the West Bank (5.5). This increase may be due to dual effects, the exposure to the pollutants emitted from the burning of solid waste (mainly dioxins) and the age of subjects at the time of exposure. Dioxins are known to decrease the sperm count in males if they are exposed at age 1-9 years old, while it cause an increase in sperm count and male fertility if male exposure take place at age 10 – 17 years, and if exposure happened at an age of more than 17 years, then no effect on sperm count is noticed.

The study shows that 21.6% of all population had received treatment for fertility. The higher percentage was 22.4% in Beit Fourik, where the population had been exposed to pollutants for longer period of time, and may be due to exposure at younger ages. About 90.6% of the study population who had received treatment for fertility knew the cause of their infertility; in Beit Fourik, 51.9% was due to male cause, while in Jabalia camp only 33.3% was due to male causes, and in the total study population it was 48.4%.

According to occupation distribution, mercantile has the highest percentage, 30.4% of those who received treatment for fertility. Fertility treatment has statistically insignificant results with type of food (p-value = 0.073), pesticide/chemical use (p-value = 0.170), chemical factories workers (p-value = 0.080) and distance from site of solid waste burning (p-value = 0.837). While fertility treatment has statistically significant results with food if the source is from the same area of residency (p-value = 0.001), history of abortion (p-value = 0.000), stillbirth (p=value 0.004), congenital anomalies (p-value = 0.000) and Diabetes mellitus (p-value = 0.042).

Sex ratio in Palestine is 103 males to every 100 females (M: F = 103:100). In the study population it is 100.6: 100; while in Jabalia camp M: F equals 100:100 and in Beit Fourik

the ratio is 100.7:100. This means that there is a decrease in male number in areas of study population.

In Beit Fourik all age groups and periods of exposure show a decrease in sex ratio (maximum M: F was 100.9:100 and minimum M: F was 100:100). In Jabalia camp also all age groups and periods of exposure shows a change in sex ratio (maximum M: F 107:100 and minimum M: F 97:100), this decrease in male offsprings had been proved by many studies.

Chapter 6: Recommendations

Serious threats to human community health may result from environmental pollution by emissions from open air burning of solid waste in random landfills. This is the main and most important conclusion of this study.

To control or mitigate the adverse health effects on humans and on the environment, all countries should adopt strategies and polices aimed at reducing this pollution and address the damage caused by such type of pollution. According to the Palestinian laws these strategies and polices should be adopted by all sectors of the community; governmental, non-governmental and local governments. This goal can be achieved through two main issues practices:

- Health and environmental education, as a principal way to face pollution issues.
- Encouragement of more environmental studies.

The following are some recommendations to achieve the main goal and objectives to protect the public from adverse health impacts of random disposal and burning of solid wastes in Palestine. These recommendations and practices can be done at three levels.

Governmental level:

- Closure of all random landfills as soon as possible all over Palestine.
- Enacting the legislations to prevents random disposal of all types of wastes.
- Provide suitable areas of lands for sanitary landfills.
- Activating and enforcing the laws for the protection of the environment and facilitating the investments in solid waste management through source reduction, recycling, reuse and energy production.
- Provision of health services, early disease detection and increase preventive disease activity to people who suffer as a result of unwise and unplanned decisions to construct random landfills and open burning of solid waste.
- Planning to reuse the lands of random landfills after closure for environmental friendly purposes that may help in recreations and economical improvement of the local residents. (In the case of Beit Fourik construction of a golf playground in place of the Nablus random landfill).

Non-governmental level:

- Play an active role in education activities to promote the health and environmental awareness.
- Provide technical assistance to the implementing parties.
- Finance beneficial projects in health and environmental health issues.
- More attention and redirection of the donors' activities to environmental health problems.

Privet sector level:

As the free market economic policy, Palestine country policy should encourage the private sector to play its important role in environmental health activity through

- More investments in environmental friendly projects.
- Environmental risk assessment, as one of the principal environmental protection measure.

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Annex 1

Explanatory letter

Relationships between Burning of Solid Wastes and the Development of Clinical Signs of Adverse Health Effects in Biet Fourik and Jabalia Camp, Palestine

Dear Participant,

Thank you for participation in this research; you were selected because you meet the se randomly.
This study is carried out as apart of requirement for the master degree in public health, Al-Quds University – Palestine.

The study aim to describe and to compare the clinical signs of the adverse health impacts due to exposure to the particulates and gases emitted from burning of solid wastes in Beit Fourik and Jabalia Camp in Palestine.

Your participation is voluntary, and you have the right to withdraw at any time during data collection. Your answers will kept confidential and they will be used for scientific research purposes only.

I appreciate your cooperation in answering this questionnaire, which may take less than 15 minutes of your time.
If you have any inquiry about the questionnaire, do not hesitate in contacting me.

Researcher,
Salim Ramadan
Mobile: 0599407895
E-mail: salimramadan1@hotmail.com

Serial No. ( )

Date:

Title of the study: *Relationships between Burning of Solid Wastes and the Development of Clinical Signs of Adverse Health Effects in Biet Fourik and Jabalia Camp, Palestine*

Please answer the following:

Personal data:

1- Gender: 1- Male ☐ 2- Female ☐

2-Date of birth ……

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

4-Monthly income:…… Jordanian dinar

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

6-Education: 1- Illiterate ☐ 2- Elementary ☐ 3- Preparatory ☐ 4-Secondary ☐
5-University ☐ 6- Higher studies ☐

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

8-Place of residence: 1- Jabalia camp ☐ 2- Beit Fourik ☐

9-Date of permanent residence:…….

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

11-Are you a smoker? 1-Yes ☐ 2- No ☐ 3- Ex-smoker ☐
If the answer is yes, do you smoke?
a- Cigarettes: Number per day…….
b- Pipe: Number of times per day…….
c- Hubble bubble(Narghile): Number of times per day……..
d-How long have you been smoke …… years.

Diet History:

12-Which meal you depends on? 1-High fat ☐ 2-low fat ☐ 3- Fish ☐ 4-Meat ☐
5-Vegetables ☐ 6-Undefined ☐

13- Do you know/ask about the source of the food you eat? 1-Yes ☐ 2-No ☐

14-Is the food you eat produced in the same area where you live? 1-Yes ☐ 2-No ☐

15-Do you depend on? 1- Fresh food ☐ 2-Frozen food ☐ 3-Both ☐

Reproductive History:(for married)

16-Date of marriage:…….

17-Consanguity : 1- First kin ☐ 2-Second kin ☐ 3-Not related ☐

18-Date of the first pregnancy or conception:…….

19-Date of birth of the first live child:…….

20-Did you have any abortion? 1-Yes☐ 2- No ☐

21-Did you have Children deaths just before delivery? 1-Yes☐ 2- No ☐

22-Did you have any treatment for reproduction? 1-Yes ☐ 2-No ☐

23- If the previous answer is yes, do you know the reason for infertility or inability to reproduction? 1-Yes ☐ 2- No ☐

24- If the previous answer is yes, is the reason for non-producing associated with the fertility of the husband?
1-Yes ☐ 2-No ☐

25-Children nursing: 1-Breast feeding ☐ 2- Bottle feeding ☐ 3-Both ☐

26- If it is breast feeding, for how long?.....month

Congenital malformation History:

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

28- If the previous answer is yes, are those malformation apparent and clearly manifested?
1-Yes 2-No ☐ ☐

29-Did any of your children died right after birth without knowing the reason?
1-Yes ☐ 2-No ☐

Cancer History:

30-Do you have had any cancer disease? 1-Yes ☐ 2- No ☐

31- If the previous answer is yes,

a- what was the date of having the disease?.....

b-Place of diagnosis of the disease: 1-Palestine ☐ 2- Outside Palestine ☐

c-Type of cancer: 1-Blood(Leukemia) ☐ 2-Other ☐

d-Did you have any treatment for the cancer disease? 1-Yes ☐ 2-No ☐

32-Did any of your first kin relatives had any cancer disease? 1-Yes ☐ 2-No ☐

33-If the previous answer is yes, was he living in the same area where you live?
1-Yes☐ 2-No ☐

34- If the previous answer is yes, since when?.....

35- Did any of your first kin relatives died from cancer disease? 1-Yes ☐ 2-No ☐

36- If the previous answer is yes, was he living in the same area where you live?
1-Yes☐ 2-No ☐

37- If the previous answer is yes? a-what is the date of the disease?.....
b-What is the date of death?.....

38-Do you use insecticides or any other similar chemicals? 1- Yes ☐ 2- No ☐

39-Do you work in insecticides or any other similar chemicals industry?
1-Yes ☐ 2- No☐

Diabetic History:

40-Have you ever had diabetes? 1-Yes ☐ 2- No ☐

41- If the previous answer is yes,
a-What was your age when you have had diabetes?.....
b- What was your first treatment for diabetes?
1- Diet ☐ 2- Tablets ☐ 3-Insulin ☐ 4-All ☐

42- Do any of your first kin relatives have diabetes? 1- Yes ☐ 2-No☐

43- If the previous answer is yes, was he living in the same area where you live?
1-Yes☐ 2-No ☐

44-If the previous answer is yes, since when?.....

45- what is the date of the disease?.....

46-Do you do the blood sugar tests? 1-Yes ☐ 2-No☐

Respiratory Disease History:

47-Do you suffer of any of respiratory diseases? 1-Yes ☐ 2- No☐

48- If the previous answer is yes, is the respiratory disease is:
1-Bronchial Asthma☐ 2-Chronic Bronchitis ☐ 3-Emphysema ☐

49- what is the date of the disease?.....

50-Where you had been diagnosed ?
1-Clinic☐ 2-Hospital ☐ 3-Private physician ☐

51- Did you had been admitted to hospital for respiratory disease treatment?
1-Yes ☐ 2-No ☐

52- Did any of your first kin relatives have the same symptoms or disease?
1-Yes ☐ 2-No ☐

53- If the previous answer is yes, was he living in the same area where you live?
1-Yes☐ 2-No ☐

54- If the previous answer is yes, since when?.....

55- what is the date of the disease?.....

56-Do you complained of Dyspnoea on exertion? 1-Yes ☐ 2-No☐

Annex 1

بسم الله الرحمن الرحيم

إستبيان حول وصف ومقارنة الأعراض المرضية الناتجة عن التعرض للمواد الناتجة عن حرق المخلفات الصلبة في معسكر جباليا وبيت فوريك في فلسطين.

عزيزي المشارك/ة
السلام عليكم ورحمة الله وبركاته وبعد.....

شكرا لك لمشاركتك في هده الدراسة حيث تم اختيارك لأنك تحقق المعايير المطلوبة للمشاركة.

أفيدكم باننى احد طلاب الدراسات العليا بكلية الصحة العامة بجامعة القدس وأقوم حاليا بهده الدراسة ضمن متطلبات الحصول على شهادة الماجستير في برنامج الصحة العامة/صحة البيئة ، جامعة القدس ، فلسطين.

الغرض من هده الدراسة هو وصف ومقارنة الأعراض المرضية الناتجة عن التعرض للمواد الناتجة عن حرق المخلفات الصلبة في معسكر جباليا وبيت فوريك في فلسطين.

أرجو منكم التكرم بالمشاركة في تعبئة الاستبيان المرفق بالمعلومات المطلوبة والتي تشكل عنصرا مهما في نجاح البحث ولك حرية الاختيار في المشاركة أو الانسحاب في اى وقت علما بان جميع المعلومات المتحصل عليها سوف يتم تحليلها بصورتها الإجمالية وستعامل بسرية تامة وعلى أن تستخدم لغرض البحث العلمي فقط وسوف تنشر النتائج بصورة جماعية.

مع علمنا المسبق بحجم المسئوليات المناطة بكم والتي تستحوذ على جل وقتكم ، إلا أن مشاركتكم في هذه الدراسة سيكون لها الأثر البالغ على النتائج المتحصل عليها ، مع تقديري لتعاونكم المتوقع في تعبئة الاستبيان والذي لن يأخذ أكثر من 15 دقيقة من وقتكم الثمين .

شاكرين لكم مسبقا كريم تعاونكم معي وتقبلوا تحياتي.

ملاحظة : أرجو الاتصال بالباحث للاستفسار عن اى معلومات تتعلق بالاستبيان

- الباحث: سليم رمضان
- بريد اليكتروني : Salimramadan1@hotmail.com
- جوال: 0599407895

Annex 2

الاستبانة

عنوان الدراسة: العلاقة بين التعرض الناتج عن حرق المخلفات الصلبة و الأعراض المرضية و التأثيرات الصحية السلبية الناتجة عنه في بيت فوريك و معسكر جباليا – فلسطين

برجاء الإجابة على الأسئلة التالية:

المعلومات الشخصية:

1-الجنس: 1- ذكر ☐ 2- أنثى☐

2-تاريخ الميلاد:.....

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

4- الدخل الشهري:..... دينار أردني

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

6- مستوى التعليم: 1- أمي ☐ 2-ابتدائي☐ 3- إعدادي ☐
4-ثانوي ☐ 5-جامعي ☐ 6-دراسات عليا☐

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

8- مكان الإقامة الدائم : 1- معسكر جباليا ☐ 2-بيت فوريك ☐

9- تاريخ السكن في مكان الإقامة الدائم منذ:.....

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

11- هل أنت مدخن: 1-نعم☐ 2- لا ☐

إذا كانت الإجابة نعم، هل تدخن؟

1- سجائر عدد السجائر يوميا .....

2-غليون عدد المرات يوميا.....

3-نارجيلة عدد المرات يوميا.....

4-عدد السنين التي مارست بها التدخين..... سنة.

السيرة الغذائية:

12- هل تعتمد في وجباتك على أغذية؟ 1-كثيرة الدهون ☐ 2- قليلة الدهون ☐

3- اسماك ☐ 4-لحوم ☐ 5- خضروات ☐ 6- غير محدد ☐

13- هل تعرف او تسال عن مصدر طعامك الذي تتناوله؟ 1- نعم ☐ 2- لا☐

14- هل مصدر طعامك من إنتاج نفس منطقة السكن؟ 1- نعم ☐ 2-لا ☐

15-هل تعتمد في غذائك على طعام؟ 1-طازج☐ 2-مجمد ☐ 3-كلاهما☐

السيرة الإنجابية: (للمتزوجين/ات)

16- تاريخ الزواج: .....

17-درجة القرابة: 1- قريب/ة من الدرجة الأولى ☐ 2-من العائلة☐ 3-غريب☐

18- تاريخ أول حمل:.....

19- تاريخ إنجاب أول طفل ولد حيا:.....

20-هل حدث إجهاض؟ 1- نعم ☐ 2- لا☐

21- هل مات لكم أطفال قبل الولادة؟ 1-نعم ☐ 2-لا ☐

22- هل تعالجت للإنجاب؟ 1-نعم ☐ 2- لا ☐

23-إذا كانت الإجابة السابقة نعم هل سبب عدم الإنجاب معروف لديكم؟ 1-نعم ☐ 2- لا☐

24- إذا كانت الإجابة السابقة نعم هل سبب عدم الإنجاب يتعلق بخصوبة الزوج؟ 1- نعم ☐ 2- لا ☐

25 - رضاعة أطفالكم: 1-رضاعة طبيعية من الأم ☐ 2- رضاعة صناعية ☐ 3-كلاهما ☐

26- فترة رضاعة أطفالكم إذا كانت رضاعة طبيعية هي:..... شهر

التشوهات الخلقية:

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

28- إذا كانت الإجابة السابقة نعم هل التشوهات ظاهرة؟ 1-نعم ☐ 2- لا ☐

29-هل توفي أي من أطفالكم بعد الولادة دون معرفة السبب؟ 1- نعم ☐ 2-لا ☐

سيرة الإصابة بالسرطان:

30- هل أصبت بمرض السرطان؟ 1- نعم☐ ☐ 2-لا

31- إذا كانت الإجابة نعم

1- ما هو تاريخ الإصابة؟.....

2- مكان التشخيص : 1-فلسطين ☐ 2- خارج فلسطين ☐

3- نوع السرطان : 1- سرطان الدم☐ 2-غير ذلك☐

4-هل تمت معالجتك بخصوص السرطان؟ 1-نعم ☐ 2- لا ☐

32-هل أي من أقاربك من الدرجة الأولى أصيب بالسرطان؟ 1-نعم ☐ 2- لا☐

33-إذا كانت الإجابة نعم هل هو من سكان نفس المنطقة المحيطة بسكنك؟ 1- نعم☐ 2-لا☐

34- إذا كان من سكان نفس المنطقة المحيطة بسكنك ما هو تاريخ سكنه؟ .....

35- هل توفي أي من أقاربك من الدرجة الأولى نتيجة مرضه بالسرطان؟ 1- نعم ☐ 2-لا☐

36-إذا كانت الإجابة السابقة نعم هل هو من سكان نفس المكان؟ 1- نعم ☐ 2-لا ☐

37-إذا كانت الإجابة السابقة نعم ؟ 1- تاريخ الإصابة..... 2- ما هو تاريخ الوفاة؟.....

38- هل تستخدم المبيدات الحشرية او أي مواد أخرى كيميائية مشابهة؟ 1- نعم☐ 2-لا ☐

39- هل تعمل في صناعة المبيدات الحشرية او أي مواد أخرى كيميائية مشابهة؟ 1-نعم ☐ 2-لا ☐

سيرة الإصابة بداء السكري:

40- هل أصبت بداء السكري؟ 1- نعم ☐ 2-لا ☐

41- إذا كانت الإجابة السابقة نعم

1- ما عمرك عندما أصبت بالسكري؟.....

2-بداية علاجك للسكري هل كانت؟

1-حمية ☐ 2- حبوب ☐ 3-أنسولين ☐ 4- الكل ☐

42- هل أي من أقاربك من الدرجة الأولى مصاب بداء السكري؟ 1-نعم ☐ 2- لا ☐

43-إذا كانت الإجابة نعم هل هو من سكان نفس المنطقة المحيطة بسكنك؟ 1- نعم ☐ 2-لا☐

44- إذا كان من سكان نفس المنطقة المحيطة بسكنك ما هو تاريخ سكنه؟.....

45- ما هو تاريخ إصابته بداء السكري؟.....

46- هل تقوم بعمل الفحوصات الخاصة بالسكر في الدم؟ 1- نعم☐ 2- لا☐

سيرة الأمراض الصدرية:

47-هل تعاني من أية أمراض صدرية؟ 1-نعم ☐ 2-لا ☐

48-إذا كانت الإجابة السابقة نعم هل المرض هو :

1- ربو شعبي ☐ 2- التهاب الشعب الهوائية المزمن ☐ 3-انتفاخ الرئتين ☐

49-ما هو تاريخ الإصابة؟.....

50- مكان تشخيص المرض هل هو: 1-عيادة طبية ☐ 2- مستشفى ☐ 3- طبيب خاص ☐

51-هل أدخلت للمستشفى للعلاج من أية أمراض تتعلق بالجهاز التنفسي ؟ 1- نعم ☐ 2-لا ☐

52-هل أي من أقاربك من الدرجة الأولى يعاني من نفس الأمراض؟ 1- نعم ☐ 2- لا ☐

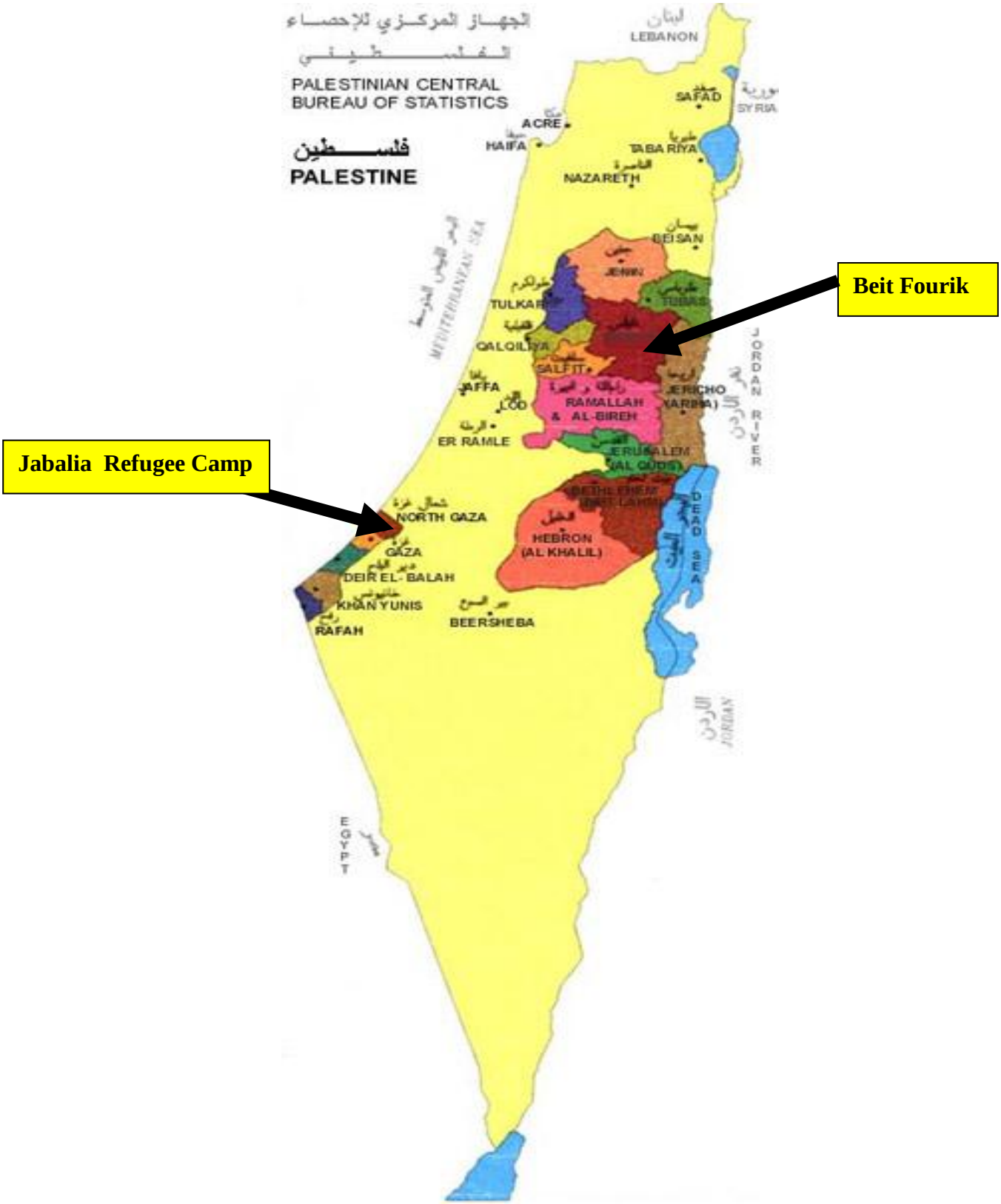
53-إذا كانت الإجابة نعم هل هو من سكان نفس المنطقة المحيطة بسكنك؟ 1- نعم ☐ 2-لا ☐

54-إذا كان من سكان نفس المنطقة المحيطة بسكنك ما هو تاريخ سكنه ؟.....

55-ما هو تاريخ إصابته ؟.....

56- هل تعاني من صعوبة في التنفس او لهثه عند بذل هي مجهود بدني؟ 1-نعم ☐ 2-لا ☐

Annex 3


PALESTINIAN CENTRAL BUREAU OF STATISTICS
فلسطين
PALESTINE
LEBANON
SYRIA
SAFAD
ACRE
HAIFA
TABARIYA
NAZARETH
BEISAN
JENIN
TULKARM
TUBAS
QALQILYA
SALFIT
JERICHO
JORDAN RIVER
JAFFA
LOD
RAMALLAH & AL-BIREH
ER RAMLE
JERUSALEM (AL QUDS)
BETHLEHEM
HEBRON (AL KHALIL)
DEAD SEA
NORTH GAZA
GAZA
DEIR EL-BALAH
KHAN YUNIS
RAFAH
BEERSHEBA
EGYPT
JORDAN
Beit Fourik
Jabalia Refugee Camp

Annex 4

Beit Fourik and Random landfill (1)

Beit Fourik and Random landfill (2)

Beit Fourik and Random landfill (3)

Annex 5

Palestinian National Authority
Ministry of Health
Helsinki Committee

السلطة الوطنية الفلسطينية
وزارة الصحة
لجنة هلسنكي

التاريخ: 2009/12/7

Name:

الاسم : سليم رمضان

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

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:-

Relationships between Burning of Solid Wastes and the Development of Clinical Signs of Adverse Health Effects in Beit Fourik and Jabalia Camp-Palestine

In its meeting on December 2009

و ذلك في جلستها المنعقدة لشهر 12 2009

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.

Al-Quds University
Jerusalem
School of Public Health

جامعة القدس
القدس
كلية الصحة العامة

Annex 6

27/9/2009

الأخ/د. محمد المقادمة المحترم
مدير دائرة الصحة–وكالة الغوث
تحية طيبة وبعد،،،

الموضوع: مساعدة الطالب سليم عيد رمضان

يقوم الطالب المذكور بأعلاه بإجراء بحث بعنوان :

"Relationships between Burning of Solid Wastes and the Development of Clinical Signs of Adverse Health Effects in Beit Fourik and Jabalia Camp-Palestine"

كمتطلب للحصول على درجة الماجستير في الصحة العامة–مسار صحة بيئة و عليه نرجو التكرم بالموافقة السماح للطالب بمغادرة القطاع لإجراء عينة البحث حيث أنه سيقوم بجمع البيانات بنفسه وأي معلومات مستجدة تخص البحث .
علماً بأن المعلومات ستكون متوفرة لدى الباحث و الجامعة فقط.

و اقبلوا فائق التحية و الاحترام،،،

د. بسام أبو حمد
منسق عام برامج الصحة العامة

نسخة:
- الملف

Jerusalem Branch/Telefax 02-24799234
Gaza Branch/telefax 08-2884422-2884411
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فرع القدس/تلفاكس 02-2799234
فرع غزة/تلفاكس 08-2884422-2884411
ص.ب/51000-القدس

Annex 7

29/09/2009

Jabalia Health Center

UNRWA

To: Dr. **Mohammad El-Maqadma**

C.F.H.P./Gaza

Subject: **Traveling to the West Bank to complete the master thesis.**

Sir,

I would like to thank you for your support and encouragement to expand my knowledge specially in the health field.

As you know sir, my Thesis title is:

Relationships between Burning of Solid Wastes and the Development of Clinical Signs of Adverse Health Effects in Biet Fourik and Jabalia Camp, Palestine

Part of data will be collected from Biet Fourik (Nablus governorate-West Bank). So I am seeking your no objection and help in getting the necessary permission for traveling to the West Bank from the 10th of oct. 2009 to the 15th of nov 2009.

Thank very much

Dr. Salim Ramadan

Jabalia Health Center

Al-Quds University
Jerusalem
School of Public Health

جامعة القدس
القدس
كلية الصحة العامة

Annex 8

2009/10/10

الأخ العقيد /رشيد حمدان المحترم
مدير شرطة محافظة نابلس
تحية طيبة وبعد،،،

الموضوع: مساعدة الطالب سليم عيد رمضان

يقوم الطالب المذكور بأعلاه بإجراء بحث بعنوان:

"Relationships between Burning of Solid Wastes and the Development of Clinical Signs of Adverse Health Effects in Beit Fourik and Jabalia Camp-Palestine"

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علماً بأن المعلومات ستكون متوفرة لدى الباحث و الجامعة فقط.

و اقبلوا فائق التحية و الاحترام،،،

د. بسام أبو حمد
منسق عام برامج الصحة العامة

نسخة:
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Jerusalem
School of Public Health

جامعة القدس
القدس
كلية الصحة العامة

Annex 9

27/9/2009

الأخ النقيب/ سامر الدر يدي المحترم
رئيس مركز شرطة بيت فوريك
تحية طيبة وبعد،،،

الموضوع: مساعدة الطالب سليم عيد رمضان

يقوم الطالب المذكور بأعلاه بإجراء بحث بعنوان :

"Relationships between Burning of Solid Wastes and the Development of Clinical Signs of Adverse Health Effects in Beit Fourik and Jabalia Camp-Palestine"

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علماً بأن المعلومات ستكون متوفرة لدى الباحث و الجامعة فقط.

و اقبلوا فائق التحية و الاحترام،،،

د. بسام أبو حمد
منسق عام برامج الصحة العامة

نسخة:
- الملف

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School of Public Health

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القدس
كلية الصحة العامة

Annex 10

27/9/2009

الأخ/عاطف حنني المحترم
رئيس بلدية بيت فوريك
تحية طيبة وبعد،،،

الموضوع: مساعدة الطالب سليم عيد رمضان

يقوم الطالب المذكور بأعلاه بإجراء بحث بعنوان :

"Relationships between Burning of Solid Wastes and the Development of Clinical Signs of Adverse Health Effects in Beit Fourik and Jabalia Camp-Palestine"

كمتطلب للحصول على درجة الماجستير في الصحة العامة-مسار صحة بيئة و عليه نرجو التكرم للإيعاز لمن ترونه مناسب لتسهيل مهمة الطالب في جمع البيانات اللازمة وذلك بتزويده بالخرائط التي تخص بلدة بيت فوريك حيث انه سيتم أخذ عينة من سكان المنطقة لإجراء البحث .
علماً بأن المعلومات ستكون متوفرة لدى الباحث و الجامعة فقط .

و اقبلوا فائق التحية و الاحترام،،،

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القدس
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Annex 11

27/9/2009

الأخ الدكتور/ يوسف أبو صفية المحترم
وزير جودة البيئة
تحية طيبة وبعد،،،

الموضوع: مساعدة الطالب سليم عيد رمضان

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علماً بأن المعلومات ستكون متوفرة لدى الباحث و الجامعة فقط.

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Annex 12

Global Perspective on Generated Solid Waste Quantities

	Low Income Country	Meddle Income Country	High Income Country
Mixed urban waste large city (Kg/ Capita / Day)	0.50 - 0.75	0.55 - 0.95	0.75 - 1.80
Mixed urban waste medium city (Kg/Capita / Day)	0.35 - 0.65	0.45 - 0.75	0.65 - 1.50
Residential waste only (Kg/Capita / Day)	0.25 - 0.45	0.35 - 0.65	0.55 - 1.00

Notes:

1-Country categorization by income is based on 1992 GNP data from the 1994 World Development Report published by the World Bank. Waste data based on a wet, "as received", condition (i.e., not oven dried).

2-For purposes of this table, a medium city has 100,000 to 500,000 residents, and a large city has above 500,000 residents.

3-Urban waste includes residential, commercial, industrial and institutional waste, as well as street sweepings and yard waste. Construction/demolition debris is not included.

Source: (Cointreau-Levine, S. 2006).

Annex 13

Global Perspective on Urban Solid Waste Characteristics

Composition of raw waste (by wet weight):	Low Income Country	Meddle Income Country	High Income Country
Vegetable/Putrescible%	40 - 85	20 - 65	20 - 50
Paper and Carton %	1 - 10	15 - 40	15 - 40
Plastic %	1 - 5	2 - 6	2 - 10
Metal %	1 - 5	1 - 5	3 - 13
Glass %	1 - 10	1 - 10	4 - 10
Rubber%	1 - 5	1 - 5	2 - 10
Fines % (sand, ash)	15 - 50	15 - 40	5 - 20
Moisture	40 - 80	40 - 60	20 - 30
Density in truck Kg/m^3	250 - 500	170 - 330	100 - 170
Lower heating Kcal/Kg	800 - 1100	1000 - 1300	1500 - 2700

Table Notes:

1-Country categorization by income is based on the 1992 GNP data from the 1994 World Development Report published by the World Bank. Waste data based on a wet, "as received", condition (i.e., not oven dried).

2-Compaction trucks achieve load densities of 400 to 500 kg/m^3 in both developing and industrialized countries, based on their hydraulic mechanism designs. Higher densities, of up to 650 kg/m^3, could result from high soil and water contents levels common in the wastes of some countries.

3-For self-sustained incineration, a year-round minimum greater than 1300 kcal/kg lower calorific value (that is, as received) is needed. For waste-to-energy plants, 2200 kcal/kg is the minimum calorific value desired.

4-Some Eastern European cities within middle income countries have marginally suitable levels calorific value for incineration of 1300 to 1600 kcal/kg.

Source: (Cointreau-Levine, S. 2006).

Annex 14

Global Perspective on Solid Waste Management Costs Versus Income

	Low income country	Middle income country	High income country
Average waste generation	0.2 m.t./cap/year	0.3 m.t./cap/year	0.6 m.t./cap/year
Average income from GNP	370 $/cap/year	2,400 $/cap/year	22,000$ /cap/year
Collection Cost	10 - 30 $/m.t.	30 - 70 $/m.t.	70 - 120 $/m.t.
Transfer Cost	3 - 8 $/ m.t.	5 - 15 $/m.t.	15 - 20 $/m.t.
Sanitary Landfill Cost	3 - 10 $/ m.t.	8 - 15 $/m.t.	20 - 50 $/m.t.
Total cost without transfer	13 - 40 $/ m.t.	38 - 85 $/m.t.	90 - 170 $/m.t.
Total cost with transfer	16 - 48 $ /m.t.	43 - 100 $/m.t.	105 - 190$ /m.t.
Cost as % of income	0.7 - 2.6 %	0.5 - 1.3 %	0.2 - 0.5 %.

Table Notes:

1-Income based on 1992 Gross National Product data from the World Development Report 1994 published by the World Bank.

2-Costs are for owning, operation, maintenance, and debt service in 1995, assuming no equipment provision through grants.

3-If sanitary landfill can be located with an economic haul distance which allows direct haul in collection vehicles, the cost of transfer can be avoided. An economic haul time for a small truck carrying 2 to 6 tones commonly is within 30 minutes one-way from the collection area to the unloading point. Depending on traffic conditions, 30 minute one-way would be 15 to 30 kilometers one-way. Larger trucks can readily haul for 30 to 50 kilometers one-way.

4-$/m.t. means US Dollars per metric tone, and $/cap/yr means US Dollars per capita per year.

Source: (Cointreau-Levine, S. 2006)

Annex 15

Toxicity Rating-Oral Human Dose

Class	Dose	For Average Adult
Practically non-toxic	>15 g/kg	More than a quart
Slightly toxic	5-15 g/kg	Between a pint and quart
Moderately toxic	0.5-5 g/kg	Between an ounce and a pint
Very toxic	50-500 mg/kg	Between a teaspoonful and an ounce
Extremely toxic	5-50 mg/kg	Between a drop and a teaspoonful
Super toxic	<5 mg/kg	A taste (< 7 drops)

Cited from Lecture 1: Principles of Environmental Toxicology (El-Sousi 2008).

N.B.: Quart = 964 cm^3 approximately one liter

Pint = Half a quart

Ounce = 29.6 cm^3

Teaspoonful = 5cm^3

(Abu Safieh Y, 2009)

Annex 16

Spectrum of Toxic Dose

Agent	LD_{50} (mg/kg)
Ethanol	10,000
NaCl	4,000
Ferrous sulfate	1,500
Morphine sulfate	900
Phenobarbitol	150
DDT	100
Picrotoxin	5
Strychnine sulfate	2
Nicotine	1
d-Tubocurarine	0.5
Tetrodotoxin	0.1
Dioxin (TCDD)	0.001
Botulinus toxin	0.00001

Cited from Lecture 1: Principles of Environmental Toxicology (El-Sousi, 2008).

Annex 17

Toxic Equivalency Factor for PCDDs and PCDFs Recommended by the World Health Organization (Van Den Berg M., et al, 1998)

Congener	TEF
TCDD	1
1,2,3,7,8-PeCDD	1
2,3,7,8-substituted HxCDDs	0.1
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.0001
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
2,3,7,8-substituted HxCDFs	0.1
2,3,7,8-substituted HpCDF	0.01
OCDF	0.0001

ملخص الرسالة

العلاقة بين حرق النفايات الصلبة و حدوث العلامات الصحية السلبية في كل من معسكر جباليا و بلدة بيت فوريك – فلسطين

إن هذه الدراسة حول العلاقة بين حرق النفايات الصلبة و التأثيرات السلبية الضارة على صحة الإنسان قد تمت في عام 2009 ميلادية في كل من بلوك 3 من مخيم جباليا للاجئين الواقع في قطاع غزة و بلدة بيت فوريك الواقعة في الضفة الغربية. كان حجم العينة التي تم اختيارها بالطريقة العشوائية المنتظمة 375 شخص، 20% من عدد العينة كان من مخيم جباليا أما الباقي فقد تم تقسيمه بالتساوي على أربعة مناطق في بيت فوريك. وكان الهدف من هذه الدراسة هو تقييم الضرر الصحي الناتج عن التعرض للغازات و المواد الناتجة عن حرق النفايات الصلبة على عينة البحث التي تم اختيارها عشوائيا في المناطق التي تم تحديدها سابقا، وتتضمن التأثير السرطاني و التأثير على الخصوبة عند الرجال و معدل الجنس و التشوهات الخلقية و تأثيرها على داء السكري وكذلك التأثير على الجهاز التنفسي. لتأدية هذا الغرض صممت دراسة وصفية مقارنة لتطبيق البحث و جمع البيانات. لقد تم توزيع استبيان باللغة العربية على العينة و كانت نسبة الاستجابة 94.4% (354 من 375) وكانت نسبة 99.4% من المستجيبين إجاباتهم مقبولة. ولتحليل البيانات لقد استخدم الباحث البرنامج الإحصائي للعلوم الاجتماعية SPSS. أما بالنسبة لنتائج البحث فكانت نتائج المصابين بالسرطان في عينة البحث 3.6% أكثر من معدل فلسطين الذي كان 0.05% وكانت العيوب الخلقية 10.0% أكثر من معدل الحالات في الدولة المجاورة مصر التي كان معدلها 3.16%، وكان 66.7% من حالات العيوب الخلقية ظاهرا و ما نسبته 33.3% عيوب غير مرئية. وأما بالنسبة لداء السكري فكانت نسبه 10.6% من العينة مصابين بداء السكري معدل العمر 42.30 سنة و هذه أيضا أعلى من نسبة فلسطين المقدرة 9.0%. وكان 15.2% من العينة مصابين بأمراض الجهاز التنفسي 48.0% منهم ربو شعبي و 46.0% التهاب الشعب الهوائية المزمن و 6.0% انتفاخ الرئتين. أما بالنسبة للخصوبة فكان معدل حجم الأسرة العام 6.51 في عينة البحث، وكانت في مخيم جباليا 7.13 أعلى من معدل الأسرة في غزة 6.5 و كانت في بيت فوريك 6.33 أعلى من معدلها بالضفة الغربية 5.5. وأظهرت نتائج الدراسة إن نسبة الجنس قد اختلفت في مناطق الدراسة مما يشير إلى زيادة نسبة الإناث وتدني نسبة الذكور، فكانت نسبة الجنس في مناطق الدراسة 100.6 ذكر لكل 100 أنثى في حين كانت في فلسطين 103 ذكر لكل 100 أنثى. و كان من أهم توصيات الدراسة العمل على إغلاق جميع مكبات النفايات العشوائية، و منع حرق النفايات الصلبة في الهواء الطلق وتشجيع عمليات إعادة التصنيع و إعادة الاستخدام وتقليل النفايات من المصدر.