HEALTH HAZARDS ASSOCIATED WITH SPRAY PAINTING AMONG WORKERS IN SMALL SCALE AUTO GARAGES IN EMBAKASI DIVISION, NAIROBI, KENYA

BY
Agnes K. Mwatu
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A Thesis Submitted in Partial Fulfillment of the requirements for the award of Degree of Master in Public Health (MPH) in the School of Health Sciences of Kenyatta University

OCTOBER 2011
DECLARATION

This thesis is my original work and has not been presented for a degree in any other University; however reference to other peoples’ work has been made with acknowledgement.

Signature………………………… Date..............................................

AGNES K. MWATU
Department of Community Health

SUPERVISORS
This thesis has been submitted with our approval as university supervisors

1. Signature........................................... Date..............................................

DR. AUGUSTINE AFULLO
Department of Health Systems Management
Kenya Methodist University

2. Signature............................................. Date..............................................

DR. MARGARET KERAKA
Department Environmental Health
Kenyatta University
DEDICATION

To my husband and children, for their support and encouragement throughout my study for this degree.
ACKNOWLEDGEMENT

I thank God, for life, for His all sufficient grace and for bringing me this far.

My gratitude and sincere appreciation goes to my supervisors; Dr. Augustine Afullo and Dr. Margaret Keraka for their commitment and guidance that has enabled me to accomplish this work.

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I thank my daughter for her encouragement and belief in me as I made this endeavor a success, my son Vic for challenging me to go on and finally to my friend Josephine, for seeing my potential and urging me to go back to school.
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DEFINITION OF TERMS

The definitions below shall apply only in the contexts that they are used in this research and not necessarily their usual medical or English dictionary definitions in normal use.

Substrate: Surface that comes into contact with paint during painting
Health professional: A qualified medical personnel in a health facility/pharmacy
Paint: Mixture of chemicals, such as pigments, extenders, solvents and other additives
Filler: Semi-solid paste applied on a substrate before painting
“Jua kali” garage: An informal auto body shop in Kenya
Asthma: Chronic lung disease that is characterized by wheezing of chest, tightness of chest, shortness of breath and coughing that usually occurs at night and early in the morning.
Risk: Effect of uncertainty on objectives (ISO 31000), whether positive or negative
Spray gun: An applicator resembling a gun for applying liquid substances (like paint) in mist form
Dermatitis: Skin inflammation that becomes itchy and may develop blisters
Spreader: A small hand held piece of plastic or metal for spreading Semi-solid materials like filler paste
Bronchitis: Inflammation of membranes lining bronchial tubes

Volatile Organic Compounds: Chemical compounds that can vaporize under normal (Standard) room temperature

(23±2°C)
<table>
<thead>
<tr>
<th>ACRONYMS</th>
<th>Description</th>
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<tbody>
<tr>
<td>AFR/RC:</td>
<td>African Regional Committee</td>
</tr>
<tr>
<td>ATSDR:</td>
<td>Agency for Toxic Substances and Disease Registry</td>
</tr>
<tr>
<td>CAA:</td>
<td>Clean Air Act</td>
</tr>
<tr>
<td>CCN:</td>
<td>City Council of Nairobi</td>
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<tr>
<td>CEPE:</td>
<td>American Association of Paint Manufacturers</td>
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<td>CLA:</td>
<td>Canadian Lung Association</td>
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<tr>
<td>DEAT:</td>
<td>Department of Environmental Affairs and Tourism</td>
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<td>DES/AFRO:</td>
<td>Occupational Health Services on Africa</td>
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<tr>
<td>DHHS:</td>
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<td>EC:</td>
<td>European Commission</td>
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<tr>
<td>EHP:</td>
<td>Environmental Health Programme</td>
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<td>GoK:</td>
<td>Government of Kenya</td>
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<td>HVLP:</td>
<td>High Volume Low Pressure</td>
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<tr>
<td>KEBS:</td>
<td>Kenya Bureau of Standards</td>
</tr>
<tr>
<td>KII:</td>
<td>Key Informant Individuals</td>
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</tbody>
</table>
KNBS: Kenya National Bureau of Statistics
NEMA: National Environmental Management Authority
NHSSP: National Health Sector Strategic Plan
NIOSH: National Institute of Occupational Safety and Health
NOHSC: National Occupational Health and Safety Commission
OHH: Occupational Health and Hygiene
OHSA: Occupational Health and Safety Administration Systems
OSHA: Occupational Safety and Health Act
PEL: Permissible Exposure Limits
PPA: Pollution Prevention Act
PPE: Personal Protective Equipment
SPSS: Statistical Package for Social Sciences
TDI: Toluene Diisocyanates
TLV: Threshold Limit Value
TWA: Time Weighted Average
U.S.A: United States of America
UN: United Nations
UN-HABITAT: United Nations Human Settlements Programme

VOC: Volatile Organic Compounds

WHA: World Health Association

WHO: World Health Organization

WHSC: Workers Health Service Centre
ABSTRACT

Most hazardous health effects of activities in small scale industries may not be apparent immediately, however they emerge much later in the life of the exposed individuals. One such small scale industrial activity, is spray painting in informal auto garages, popularly known in Kenya as “Jua Kali garages”. Although various disease symptoms may be associated with spray painting, respiratory and skin diseases are the major ones. The objective of this study therefore, was to establish occupational health hazards associated with spray painting in small scale auto garages in three selected locations of Embakasi division. To carry out the study, which took three months (June–August 2010), pre-tested questionnaires and checklists were administered to spray painters in the selected auto garages. Key informant individuals (KII) were interviewed to get details of disease symptoms and other issues to support the information captured by the questionnaires and checklists. A sample population of two hundred and seven spray painters was selected from small scale auto garages in the study area, their age ranged between 17-62 years, with 34% of the population being below 25 years. Half (51%) of the spray painters had been in this occupation for between 1-5 years. 65.3% of them had attained primary education, while the rest (34.7%) had secondary level of education. It was observed that, the main activities in the study garages were scraping off the old paints and spray painting. The two activities posed an exposure due to dust from old paints and over spray paint mists within the breathing zone of unprotected spray painters, and therefore data on asthmatic and bronchitis symptoms, and eye problems was collected, edited, coded and analyzed by using statistical package for social sciences (SPSS). Chi-square test of significance was used to measure association between the disease symptoms and exposure time, application methods, and amounts and types of paints. The analyzed data was presented using percentages, frequency tables and bar charts. Painters’ health seeking behaviours and presence of the disease symptoms associated with this occupation were also studied. Application methods had a significant relationship between asthmatic symptoms, \( \chi^2 = 18.72338; df = 2; p = 0.00009 \), but non between bronchitis symptoms \( \chi^2 = 0.055885; df = 2; p = 0.97246 \). Exposure time had no significant relationship between all disease symptoms in the study \( \chi^2 = 3.75855; df = 3; p = 0.28871 \), bronchitis; \( \chi^2 = 6.4773; df = 3; p = 0.09056 \) and eye problems; \( \chi^2 = 2.33641; df = 3; p = 0.50558 \). Types and amounts of paint also had no significant relationship between all diseases symptoms. According to the study, this was due to onset of the disease symptoms within a short duration of exposure. 85.7% and 67.3% of all the spray painters had bronchitis and asthmatic symptoms respectively, while 49.3% had eye problems. This indicated a high prevalence of disease symptoms associated with spray painting among the spray painters in the study area, who also had poor health seeking behaviours. Health hazard awareness creation among all stakeholders was recommended to ensure health and safety of workers and further research in the field, especially effectiveness of interventions.
CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

In rapidly developing countries, where labour is cheap and level of poverty is high, proper occupational hygiene and pollution control methods are often neglected at worksites (Gomes et al., 2001). It is worse for small factory workers where personal protective equipments are considered a luxury and rarely provided (Gomes et al., 2001). This is more common where profit margins are minimal like in small scale industries. The workers, being economically challenged accept adverse working conditions as part of their job. They do not demand hygiene measures and personal protective equipment from their employers and as result are exposed to physical and chemical pollutants (Gomes et al., 2001).

Small scale informal industries include, but not limited to, small scale auto garages which are situated along roadsides to service motor vehicles that breakdown on the roads and also in interiors of informal settlements (slums). The garage operators are low-income earners, with little or no basic education and limited knowledge of modern technology (KNBS., 2003). One of the major activities they undertake is spray painting of vehicles. This activity exposes them to paint hazards (DuPont., 2004). In Kenya, there is lack of sufficient safety information and safety magazines and/or pamphlets (Martin., 2006)
Basically paints are a mixture of pigments, solvents and other additives to enhance the performance of paint, like dryers and hardeners. Pigments and additives in paint do not dissolve completely but rather remain suspended throughout the systems to form emulsions and other paint mixtures (Turner., 1980). As most substances in paints are toxic to humans they are a health hazard to the users. The paint being a mixture of solvents, pigment and other additives, the spraying activities create paint mists that spread the volatile matters to the surrounding air. Depending on the type of the spray gun used, the pressure and the nebulizer, a high concentration of airborne contaminants is produced in vapors and is harmful to human health when inhaled (Turner., 1980). The solvent’s hazards are compounded by the fact that paints contain additives such as diisocyanates, lead and other heavy metals, which are known carcinogens and require a supply of clean air to the painter to disperse or minimize their contact (Turner., 1980).

Although different individuals have different sensitivity, reactivity and irritation levels to the chemicals, even at low concentrations, many solvents and solids in paints have specific threshold limit values (TLVs) [NIOSH., 1978]., thus different exposure values and guidelines require controlled exposure monitoring to establish the appropriate and effective protection methods (NIOSH., 1978). This calls for use of protective devices when handling paints.

Paint may also come into contact with the skin if not properly protected. Although skin contact may not be a major route of exposure, it may enhance the overall
body exposure. When the chemicals in the paint effectively permeate the skin, the harmful pigments and other additives may be dangerous, and present adverse health effects to the painter as well (Turner., 1980).

Many disease symptoms may be caused by spray painting, but the two primary occupational diseases associated with spray painting are painter’s asthma and dermatitis (DuPont., 2004). While neither of these two have significant data to determine their risk, there is enough evidence to warrant their concern (DuPont., 2004) because chemicals, solvents, pigments and other additives in paint that become airborne in spraying operation, makes it difficult to quantify the risks based on a specific hazard assessment, though career painters tend to be more predisposed to these diseases (DuPont., 2004). Apart from the chemicals in the paint, application methods, especially the spray gun and duration of exposure, also contribute to the overall health risk.

The selection of a spray gun by a user depends on the type of object to be sprayed, cost and the operation. They range from simple hand held equipment to complicated automated gadgets. Air-assisted spraying systems known as “Air mix” are claimed to drastically reduce the spray mist, usually associated with “normal-air” assisted spray guns and overall air consumption, according to National Institute of Safety and Health of United States of America (NIOSH., 1978). Many of these spray guns are ideally used in spray booths.
In small scale auto garages this may not be the case due to non use of spray booths. Where they are available, a system called “airless” spraying may be used. It is based on atomization of coatings at a pressure of 100 to 200 atmospheres (NIOSH, 1978). The materials are brought to this pressure by a hydraulic pump usually driven by compressed air. Less air is needed in this system than in the air-assisted type of spray gun, though at a higher pressure (NIOSH, 1978). Painter’s asthma and skin dermatitis being the primary diseases associated with spray-painting activities (DuPont, 2004), it confirms why good quality air around the painter is very important (NIOSH, DHHS, 1997). The study therefore, aimed at examining some occupational health hazards associated with automotive spray painting.

1.2 Problem Statement

Exposure to hazardous chemicals of auto paints in developing countries is common (Gomes et al., 2001). Hazardous chemical exposures were common experiences in United States of America in mid 1960s, and two years before OSHA (U.S.A) enactment of 1970, 14,000 workers died each year from work related hazards and another two million were disabled or harmed (Stender, 1970). That was as a result of negligent of employers, poverty, or lack of knowledge and job skills. Due to lack of regulation, supervision and application of standards by concerned authorities, the activities in small scale industries may be occupationally hazardous (Loewenson, 1998)
In Kenya there are indications that automotive spray painters in small scale auto garages are exposed to paint mists, mainly due to their open space work set up and lack of personal protective clothing. According to OSHA of Act of 2007 (Kenya) it is the duty of every work place occupier to make necessary arrangements for ensuring safety and absence of risks to health in connection with the use, handling and storage of articles and substances. The Act (OSHA., 2007) also stipulates that, it is the duty of every employee at all times to wear or use protective equipment or clothing provided by the employer for the purposes of preventing risks to his safety and health. In Kenya Small scale auto garage owners and employees have a duty to implement the above requirements but was clearly lacking. Further, it is known that the two primary occupational diseases associated with paint spray operations are asthma and dermatitis (DuPont, 2004). Dermatitis attacks the exposed skin where paint comes into contact. Asthma, which is prevalent among spray painters attacks the respiratory system and can be compounded by other existing respiratory diseases and conditions like smoking and existing allergies. This was clearly shown by the fact that, prevalence of respiratory diseases in urban areas of Kenya (asthma included), is 16.4% [KNBS (d)., 2003].

1.3 Justification of Study

The study can provide information that can strategically guide the policy formulation in control and prevention of occupational health hazards in spray
painting operations. The study results can provide an opportunity for other researchers to further into the topic.

The Ministry of Sanitation and Public Health, and other regulatory authorities like Directorate of Occupational Safety and Health and Kenya Bureau of Standards can use the results to set levels of different hazardous compounds in paints after considering the prevalence of disease symptoms associated with spray painting activities. The report could be used by relevant authorities to set occupational hygiene standards for automotive industries. The results are therefore useful to stakeholders in setting mitigation grounds in occupational health and industrial safety in paint and allied industries. Finally, the findings of the research are important for planning and policy formulation in auto paints and allied chemical industries and regulatory authorities.

The workers in paint industries can utilize the results of the study to make informed decisions concerning their occupation and prevention measures. Employers and factory owners could benefit from the study, in training their workers on occupational safety and health hazards inherent in paints and related products.
1.4 Broad Objective

The broad objective of the study was to determine occupational health hazards associated with automotive spray painting in selected small scale auto garages in Embakasi Division.

1.5 Specific Objectives

a) To establish how different types of application methods used affect health and safety of spray painters.

b) To determine the relationship between painters’ exposure time (length in occupation) in the selected small scale auto garages and, the disease symptoms associated with spray painting.

c) To determine the amounts and types of paints used and their occupational health hazards to spray painters.

d) To establish prevalence of spray painters’ disease symptoms associated with their spray painting occupation.

e) To establish health seeking behaviours of spray painters.
1.6 Research Questions

a) Do different types of application methods affect health and safety of spray painters?

b) Does period in spray painting occupation (exposure time) to auto paint affect spray painter’s health?

c) How do different amounts and types of paints affect occupational health of spray painters?

d) What are the occupational hazards associated with spray painting?

e) How do health-seeking behaviors affect health and safety of spray painters?

1.7 Significance of the Study

The study results are beneficial in formulation of policies on health promotion, preventive measures and safe painting procedures, which can be adopted by regulatory authorities and operators of small scale motor garages in the country. The study results are of great help to spray painters in small scale and large automotive enterprises for making informed decisions in selection and use of protective devises. The spray painters in small scale garages are expected to change their health seeking behaviours, if the relevant authorities use these findings to create health awareness among them.
1.8 Null Hypothesis

Spray painting activities in small scale informal automotive garages in Embakasi have no association with any occupational health hazards.

1.9 Scope of the Study

The study covered spray painting activities in small scale informal (Jua kali garages) automotive garages in the three selected locations of Embakasi Division in Nairobi City, namely Umoja, Kayole and Kariobangi South. The study took three months, between June to August 2010.

1.10 Limitations of the Study

The main limitation of this study is lack of clear legislation guidelines and close coordination of activities of small scale auto garages. The actual description of small scale auto garage or what constitutes the small scale auto garage was not clear. Lack of similar studies in the country was a limitation to this research; however data was available from research of other informal enterprises in the region like diatomite and salt mining in Kenya and Uganda respectively. Recall bias of respondents presented a challenge to the study but was greatly minimized by the collaborative information from key informant people in the study, namely health professionals and garage owners. Many respiratory disease have similar symptoms with spray painters’ diseases, however this was also minimized by
capturing the information about smoking habits and other existing among spray painters or their family history of chronic obstructive respiratory diseases like asthma and allergies.

1.11 Assumptions of the study

For the purpose of this study, it was assumed that any open and/or partially closed area where motor vehicle repair works, including spray painting where taking place was an informal auto garage. Another assumption was that all garages in the study area were using the same types and composition of the auto paints.
CHAPTER TWO: LITERATURE REVIEW

2.1 Overview of Health Hazards in Spray Painting Industry

Paint is loosely described as a colloid. The use of the word ‘colloid’ has been reserved for describing a mixture consisting of a dispersion of particles of one phase (solid, liquid, or gas) in a second continuous phase (solid, liquid, or gas) (Richard., 1992). The state of the continuous phase need not always be different from the dispersed phase (e.g. a liquid-liquid emulsion) but the interfacial properties of the two phases will certainly differ (Richard., 1992). The size of the dispersed colloidal matter may range from few nanometers up to tens of micrometers or so (Richard., 1992). People with no fore knowledge of paint technology may have a challenge in understanding the interactions of various phases of paint. This often happens to people who had never attended a formal learning for that particular technology but rather were inducted in the job (informal enterprise)

In general terms, paint is inevitably of heterogeneous composition, necessitating the requirement of colour and opacity (hiding power), a great variety of insoluble solids (pigments and extenders), a liquid medium to provide continuity of film and a volatile liquid (solvent) to assist in application (flow etc). The solvent evaporates to enable film to dry and form (NIOSH., 1978) and thus paint is mostly a two-phase system (solids dispersed in a liquid)
Many different types of raw materials are used in paint manufacture. Each type of raw material can bring about its own particular hazards, and the end products become poisonous internally (lungs, liver and other internal organs) or externally (eye and skin) harmful. Furthermore, there exists a possibility of two or more components combining to introduce a third hazard, either by reaction or by chemical interaction (NIOSH, 1978). Concern is often expressed about the potential health effects of volatile organic compounds (VOC) emission (Bower, 1994.)

In many countries there has been an upsurge of interest in recent years of the pollution potential arising from the use of solvent borne materials in industry. Traditionally those concerns have centered on the perception of odors by the general public around the users premises, and paint particle over spray affecting people’s property (Bower, 1994.)

While these issues remain important, the air pollutions debate has moved on to centre on the emission of volatile organic compounds (VOC). Arguably a greater concern however, is that VOCs are precursors of ozone depletion in the troposphere and it is this pollutant which most frequently approaches or exceeds levels at which deleterious (hazardous) effects on human health may be observed (Bower, 1994.)

The European Commission has seen the need to move further on this issue and is in the process of drafting guidelines concerning air emission of solvents from
industries. The scope of this draft is similar to that of United Kingdom (UK) legislation. The draft directive also envisages two routes to compliance; one based on abatement and the other on coating re-formulation (Karsa., 1995.). Currently many countries of the world have taken the second option of re-formulation of paint systems (Karsa and Davies., 1995).

The European Commission has recently adopted a proposal for a framework directive on Ambient Air Quality Assessment and Management. In its current form this would seek to set health based limit values and alerts for a range of pollutants. The aim is to attain ambient air concentrations that are under putative no-adverse-effect levels and provide information to the public (EC., 1994). In the United Kingdom the legislation strictly states that the control of emission should be done at the sources (Karsa and Davies., 1995).

The coating formulation should reduce the amount of solvents, which is the most potentially hazardous component of paint and improve on transfer effectiveness of coating i.e. reduce over spray (Mannouch., 1994). The drying process of paint is generally slow and therefore adding driers however accelerates it. These driers are compounds added to paints, based on oxidation curing resins; namely oils, varnishes, alkyds and modified alkyds (Boxal and Fraunhofer., 1977). The most widely used driers are napthanates of lead, cobalt and manganese. Other driers include zirconium and aluminum salts (Boxal et al., 1977).
Most of these driers are poisonous and can cause health hazards to human beings. Lead is an accumulative poison and a known carcinogen and therefore lead driers present in many paints can cause poisoning of the liver and other internal organs. Lead can be stored in bones of women and is transferable to a foetus of an expectant mother. Cobalt compounds cause testicular diseases in male painters (Bower et al., 1997).

Solvents are commonly used in manufacturing and laboratory processes. They are indispensable for many applications such as coatings (paints) and other chemical processes. Most solvents are known to upset the ecosystems and notably the Volatile Organic Compounds (VOC). Some solvents are known to cause cancer, are neurotoxins or can cause sterility in those individuals frequently exposed to them (Sherman et al., 1998). While contained use of these solvents would be acceptable from both an environmental and a health perspective, such operations are difficult to achieve and alternative solvents are currently being sought to minimize the problems inherent in their release to the environment (Sherman et al., 1998).

As the awareness and understanding of how solvents affect the environment and human health grow, so do the regulations that govern the use of these chemicals. One good example is the implementation of the Montreal Protocol, The Clean Air Act (CAA), and the Pollution Prevention Act (PPA) of 1990, which is a clear indication that many countries are becoming aware of increased use of organic
solvents in chemical processes (Sherman et al., 1998). The advances made in the search for ‘green’ replacements for traditional solvents are reviewed with reference to solvent alternatives for cleaning, coatings, and chemical reaction and separation processes (Sherman et al., 1998). Government agencies such as the Occupation Safety and Health Administrative of United States of America (OHSA) have installed measures to protect workers from solvent exposure. OHSA has implemented strict regulations called permissible exposure levels (PEL) for chemical concentrations for which one may be exposed without detrimental health effects. Although some solvents like benzene, have cumulative poisonous effects and can be harmful above certain concentrations in air, their foul smell may be enough to prevent their use for some purposes (Turner., 1980).

There is a concerted effort to move away from solvent–borne paints (Oil-based paint such as auto paint) due to their adverse effects on health and environment. In addition to this, the conventional polyurethane resins usually contain a high proportion of volatile organic solvents, normally between 40% and 60% by weight (Bittner and Ziegler., 2000). This has given way to more use of water borne polyurethane coatings due to the stringent controls on solvent emissions during the application process of solvent-borne paints mentioned above (Bittner and Ziegler., 2000). Although water based paints are more environmental “friendly”, there are several challenges in their use. One such challenge is the use of 2-butoxethanol chemical in water based paints. 2-butoxethanol is readily absorbed through the skin, and has been shown to damage the bone marrow, blood cells, kidneys and the
liver (Vincent et al., 1993). The dermal uptake of 2-butoxethanol increase in the presence of water and this should be considered in the health risk assessment of occupational dermal exposure to 2-butoxethanol where water based products are used (Kezic et al., 2002)

A good example of the campaigns against solvent emissions to environment was demonstrated by enactment of laws in first world countries to limit or put up maximum levels of emissions. In 1986 the German Clean Air Regulations, the so-called TA Luft, suggested limits on solvent emissions for industrial coatings (Bittner and Ziegler., 1995). Additionally CEPE, the European association of paint manufacturers suggests the reduction of solvent automotive refinishing paints. Last but not least, the Environmental Protection Agency of the United States of America established in 1965 by an act of congress entitled “The clean air act”, limited the solvent content of paints. (Bittner and Ziegler., 1995) this is the so-called VOC regulation of 1991.

According to the above regulation, the VOC content in reference to automotive coatings is limited to 250 and 350 g/l. Most of the regulations that are aimed at protecting the environment have a positive impact on human and animal health. One of the most stringent laws in this regard is the Montreal protocol which is mentioned earlier, which banned the manufacture and the use of stratospheric ozone depleting solvents (Boxal and Fraunhofer., 1977).
Paint contains two parts: the solid part and the solvent part. Both are harmful to humans and animals, and environmentally not friendly. The solid part contains pigments, extenders, fillers resins and minor additives, mostly organic and inorganic derivatives.

Organic and inorganic compounds in paint include but are not limited to;

a) *Silica:* Used in paint as a filler or extenders and is bound within the paint product. At times, the painter may sand and/or grind the substrate and this activity may release more dust containing silica particles in the air. When these particles are inhaled, they become trapped in the lungs. A condition known as silicosis may result (NIOSH., 1997).

b) *Chromium:* Chromium has many different forms including hexavalent chromium, a well-known carcinogen. Examples of paints pigments containing hexavalent chromium are zinc chromate and lead chromate, also known as chrome yellow and chrome green. The major health effects of hexavalent chromium are lung cancer. Hexavalent chromium can also irritate eyes, skin, nose and lungs.

According to the Agency for Toxic Substances and Disease Registry (ATSDR., 1989), the risk of developing lung cancer depends on the amount of chromium in the air, duration of exposure and the use of personal protective equipment (PPE)
c) *Lead*: It is classified as a toxic metal and cumulative poison. According to the American National Institute of Occupational Safety and Health (NIOSH, 1997) Lead exposure occurs when lead dust or fumes are inhaled while painting with lead-based paint. Low-level lead exposure may result in adverse pregnant outcomes such as gestation periods and fetal development. Elevated blood pressure has been observed in workers exposed to low levels of lead.

d) *Iron oxide*: Exposure to iron oxides may result to benign conditions in the lungs of workers, known as siderosis after six to ten years of continuous exposure (NIOSH, 1997).

e) *Isocyanates*: The major route of exposure is through inhalation of aerosols and vapour during the spraying of paints containing isocyanates. The most common paints containing Isocyanates are polyurethane paints and varnishes. Isocyanates are strong irritants to skin and can cause inflammation and dermatitis to the mucous membranes, gastro-intestinal and respiratory tracts (Dillon, 2000).

### 2.2 Health Hazards Associated With Spray Painting

It is estimated that every year over 1.1 million people worldwide die of occupational injuries and work-related diseases. In developing countries, the risks
that foster ill health are estimated to be 10 to 20 times higher than in developed countries (AFR/RC54/13 RE.1., 2004).

World over people are exposed to almost limitless risks to their health, including both communicable and non-communicable diseases. It is estimated that each year there are 160 million new cases and 1.1 million deaths associated with work-related diseases and injuries worldwide (AFR/RC54/13 RE.1., 2004).

A survey contacted by the WHO Regional Office in Africa showed lack of comprehensive occupational health services for workers in the region in spite of various WHA resolutions (DES/AFRO., 2001). In many African countries the economic impact of health and safety programs is obvious due to rampant poverty and poor performance of economies. The African Region is faced with a number of challenges. One such challenge is how to ensure that workers in the informal sector have adequate health education and are able to actively use such information (AFR/RC54/13 RE.1., 2004).

2.2.1 Asthmatic disease symptoms

Due to various pollutants in environment around informal sector workplaces, the air breathed in is contaminated with a range of hazardous chemicals. It is not surprising that the asthma rates have quadrupled over the past 20 years (WHSC., 2005).
Studies conducted in the United States of America and Japan showed that about five out of 15 per cent of adult asthma cases are work-related. Inhaling fumes, vapour, gases, dust, or other potentially harmful environmental substances while on the job causes many workers to experience a condition known as occupational asthma (WHSC., 2005)

Occupational asthma is triggered by certain environmental agents in the workplace, which act as allergens or irritants. When workers inhale these harmful agents the airways of the lungs become aggravated over time making them extra-sensitive/twitchy (hyper-responsive) and inflamed (red and swollen). Work exposures can also aggravate pre-existing asthma. This may be asthma that one had since childhood or pre-existing asthma of non-occupational origin (Lunt and White., 2005), hence spray painting is considered as an occupation with a high risk of respiratory impairment and asthma (Kogevinas et al., 1996). Regardless of the cause, early recognition and control of exposures to asthma-causing agents are essential. Left unchecked, breathing problems may become permanent and continuous treatment will be needed. Severe cases of asthma can be life-altering and even lead to death. In most cases the asthma-causing agent can be identified. Currently, there are over 250 substances of concern (WHSC., 2005). They may be proteins from laboratory animals, flour, plants, and latex or, chemicals such as Isocyanates (WHSC., 2005). Isocyanates are classified as one of the powerful asthma-causing agents according to WHSC., 2005, and one of essential constituent of auto paint.
2.2.2 Bronchitis disease symptoms

The harmful effects of isocyanates follow inhalation of free isocyanates groups in vapour, mists and particles or eye and skin contact with liquid or vapour isocyanates. Because of its inherent toxicity, higher volatility and widespread use, isocyanates, especially hexamethylene diisocyanate which is used as a paint hardener (ATSDR., 1998) and toluene diisocyanate (TDI) which is also a constituent of paint, presents the greatest overall hazard, and the exposure can occur at all stages of manufacture and use. Repeated exposure to isocyanates may result in chemical bronchitis among other symptoms ((NIOSH., 1978 and Charles et al., 1976))

2.2.3 Eye related problem

Eye protection is very vital, especially when one is working in an environment that is likely to be a source of injury or hazardous to eyes. Such an environment may be chemicals in auto paint containing chemicals like isocyanates. Exposure of isocyanate to eyes can result in eye irritation, temporary blurred vision and even cornea damage (Dillon., 2000). Furthermore, exposure to high concentration of isocyanate vapour or mist causes irritation to eyes, nose and throat. Symptoms include itchy, watery eyes, sensational burning in the eyes, fatigue and runny nose, among other symptoms (WSA., 2006).
2.2.4 Skin Dermatitis symptoms

Another common health hazard associated with spray painting is skin non-infective dermatitis, which can be caused by contact with chemicals. When the condition is due to contact with a substance at workplace it is called occupational or industrial dermatitis (Riddley and Channing., 1999).

In Kenya, there is lack of sufficient safety information (Martin., 2006), but with the enactment of OSHA of 2007, the health and safety of workers in Kenya, in future may change for better.
CHAPTER THREE: METHODS AND MATERIALS

3.1 Methodology

3.1.1 Study Design

The study design for the research was descriptive cross-sectional survey to evaluate prevalence of disease symptoms among spray painters from the selected locations of the study area. The study design is convenient because it is faster and evaluates prevalence of all the disease symptoms irrespective of time of onset. The shortcomings of this method are that, it can be a poor evaluator of the cause of the disease symptoms. The method is also convenient, especially where research resources are limited.

A preliminary survey was done to establish the number of spray painters in the study area, since such data did not exist. During the preliminary survey, it was found out that there were a total of two hundred and forty eight spray painters in the garages of the three selected locations.

3.1.2 Study Area

The study area covered three locations of Embakasi division in Nairobi; namely Umoja, Kayole and Kariobangi South. Embakasi division is one of the eight divisions of Nairobi Province and lies between latitudes and longitudes 1°14’S/36°52’E. It has recently been elevated to a district (GoK., 2008). Embakasi
division is situated in the eastern side of Nairobi city. It has an area of 208 km² and covering 30% of the total area of Nairobi city (GoK., 1999). Embakasi division is divided into eight locations; namely Dandora, Kariobangi South, Kayole, Umoja, Mukuru Kwa Njenga, Njiru, Embakasi and Ruai.

Embakasi division is an area inhabited mainly by low income people most of who rely on informal employment, including garages for motor vehicle mechanical repairs and spray painting work. Majority of these people live in many of informal settlements in the division like Soweto in Kayole (UN-Habitat., 2003).

The City Council of Nairobi is responsible for providing services such as health, primary education, refuse collection, water and sanitation, and fire protection services, among others (Hagerlund., 2006). Over the years, however, its service delivery capacity has deteriorated. The reasons for this include the fact that existing facilities were not planned to cater for the numbers of people now residing in the municipal areas. The technical and institutional capacity needed to increase the service coverage are lacking (Hagerlund., 2006). This situation applies to most areas of Nairobi province, including Embakasi division.

Embakasi division has fifty-nine health facilities, with a total catchment population of 458,298 people and 772,208 outpatients (NHSSP/GoK., 2007). There were nineteen health facilities in Kayole location, with a total catchment population of 144,630 and a total of 242,478 outpatients. Umoja location has eleven health facilities, with a total catchment population of 90,951 and a total of 124,316
outpatients who visit the health facilities in the location. Kariobangi south location has a catchment population of 25,731 people and no health facility in the location (NHSSP/GoK., 2007). The health facilities in the study locations are both public and private institutions. According to the study these facilities were receiving more outpatients than the total population residing in the study locations
FIGURE 3.1 MAP OF EMBAKASI DIVISION; SHOWING THE SHADED STUDY AREA

3.1.3 Study Population

The study population comprised of spray painters from the selected garages in the study area. Their main work in the small scale auto garages is removing of old paint and/or spray painting of different types of vehicles. All the spray painters in the study area were mainly young men (the study did not find any women in the occupation). The phenomena of young people, majority whom have not gone beyond primary level of education has been brought about by the youthful structure of Nairobi city population, where more than a half (56.5%) are below 25 years of age, (KNBS., 1999). The youthful structure of the population of Nairobi city has caused a high dependency ratio and is responsible for high unemployment rates and demand for education, housing, health, transport and other social amenities is high (KNBS., 1999).

The phenomenon of growth based on a society with high unemployment (jobless growth) is not sustainable and is contributing to the expansion of informal sector (DEAT., 1999). Approximately 2.5 million Kenyans are blacksmiths, roadside mechanics, carvers and petty traders (Habitat., 2001). All these occupations are informal. Available evidence in Kenya however shows that earnings in the informal sector are typically low and not enough to push people out of poverty (Odhiambo and Manda. 2003). The City Council of Nairobi is responsible for providing services such as health, education and sanitation among others. Over the
years however, these services have deteriorated, contributing to the mushrooming of informal settlements and lack of “proper jobs” (Heifer., 2006).

3.1.4 Study Variables

(i) Dependent variables

Dependent variables were asthmatic and bronchitis symptoms, eye problems and dermatitis.

(ii) Independent variable

Independent variables were length in spray painting occupation (exposure time), application methods, amounts and types of paint used, presence of disease symptoms associated with spray painting, and health seeking behaviours of spray painters.

3.1.5 Inclusion Criteria

All spray painters in the selected small scale auto garages in the study area, who were directly involved in spray painting activities and willing to fill in a questionnaire and/or be interviewed, were included in the study. Smoking habits among the spray painters was noted. Information on other pre-existing chronic obstructive respiratory diseases among the spray painters or their related family
members (parents and siblings) was considered, to minimize the confounding effects.

### 3.1.6 Exclusion Criteria

Workers in selected small scale auto garages who were not directly involved in spray painting and, spray painters who were not willing to fill in a questionnaire or be interviewed were excluded from the study.

### 3.1.7 Sampling Procedure

Three locations in Embakasi division; namely Umoja, Kayole and Kariobangi South were purposively selected due to their accessibility and high population density. There was a total of sixty two auto garages in the three locations (CCN., 2008), thirty eight in Umoja, fourteen in Kariobangi South and ten garages in Kayole. There was an average of four spray painters in each garage, which amounted to a total of two hundred and forty eight spray painters in the three locations (Table 3.1). Out of the above sample population (N) of two hundred and forty eight, two hundred and seven spray painters were randomly selected by a statistical method found in Fisher et al (1998) to form the sample size (n). This meant that, almost all spray painters in the selected garages in the study area were included in the study. The number of spray painters in the garages of the three locations were stratified according to the ratios of garages in the locations, in order to obtain a homogeneous sample (Kothari., 2004). Umoja location with 38
garages, 127 spray painters were selected from there, 47 spray painters were selected from Kariobangi South location which had 14 garage, and from Kayole location, with 10 garages and 33 spray painters. A pre-tested questionnaire was administered to each spray painter in the study by the researcher or the research assistant. Interviews were contacted on Key Informant Individuals to collaborate, elaborate and clarify the information given by the spray painters and, get any other professional information related to disease symptoms associated with spray painting. The checklists were used for observation of dermatitis symptoms on exposed body areas of spray painters

Table 3.1 Number of garages and spray painters in each location

<table>
<thead>
<tr>
<th>Locations</th>
<th>Number of garages in each location</th>
<th>Selected spray painters from each location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umoja</td>
<td>38</td>
<td>127</td>
</tr>
<tr>
<td>Kayole</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Kariobangi South</td>
<td>14</td>
<td>47</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>207</td>
</tr>
</tbody>
</table>

3.1.8 Sample Size Determination

The formula as used by Fisher et al (1998) was employed to calculate the sample size, as follows: $n = \frac{z^2pqD}{d^2}$
n = Desired minimal sample size

(Where population < 10000)

The prevalence of all respiratory diseases in Kenya urban areas is 16% (KNBS et al., 2004), therefore

\[ p = 0.16 \]

\( z = \) the standard normal deviation which is equal to 1.96 at 95% confidence level.

So, \( z^2 = 3.8416 \)

\( q = 1 - p, = 0.84 \)

D = desired effect =1

d = degree of accuracy (the level of statistical significance set) which in this case is 0.05,

\( d^2 = (0.05)^2 = 0.0025 \)

Thus,

\[ n = 1.96^2 \times 0.16 \times 0.84 \times 1/0.0025 = 206.5 \]

Therefore, 207 spray painters were selected.

A preliminary survey to establish the number of spray painters in the study area (This data did not exist before) in the small scale auto garages in the study area established that, each garage had an average of four spray painters. There were sixty two small scale auto garages in the three study locations, which resulted in a
total of two hundred and forty eight spray painters in the study area. Then; \( N = 248 \) (all the spray painters in the study area) and \( n = 207 \) (minimal sample size required), therefore: \( N/n = 248/207 = 1.198 \). This meant that, almost all spray painters in the study area were included in the study.

3.2 Data Collection Tools

3.2.1 Questionnaire

Data collection for asthmatic and bronchitis symptoms, and eye problems was done by use of pre-tested questionnaires. The questionnaires had eight diseases symptoms associated with exposure to auto spray painting. They were; dry cough, productive cough, breathlessness, wheezing of chest, sore throat, runny nose, irritating eyes. For the purposes of this study, and with help of health professionals and literature review, the above symptoms were grouped into three major areas. These groups were; dry cough and productive cough to make bronchitis symptoms (NIOSH., 1978, Charles et al., 1976). Sore throat, runny nose, breathlessness, and wheezing of chest to make asthmatic symptoms (Mobay., 1987) and irritating eyes problems.

3.2.2 Checklist

Checklists were used to collect data on dermatitis. This was done through observation of the condition of exposed skin of spray painters.
3.2.3 Interview Guides

Interview guides were used to collect data from Key Informant Individuals (KII). These were mainly health professionals (Appendix II), pharmacists (Appendix III), and garage owners (Appendix IV).

3.3 Data Quality Control

Pre-testing of research instruments was done before study data collection was carried out. It was applied to spray-painters in a large auto garages outside the study area who were exposed to occupational health hazards in auto paint. The aim of this was to check whether the research instrument will generate the required research data. Relevance of questions was checked during pre-testing of questionnaire to see whether the required information will be generated. In addition to the researcher, two research assistants were recruited and comprehensively trained to help administer the questionnaires, checklist and interview the key informant individuals. The language used for data collection and throughout the entire research was English, and where it was not possible, and for the purposes of clarifying some disease symptoms, Kiswahili language was used to supplement it, however all the responses were recorded in English. This was possible because the researcher and the assistants were well versed in the two languages.
3.4 Data Management and Analysis

The collected data was cleaned, stored, coded appropriately and edited to check for completeness of the filled questionnaires. Any response that was not in the questionnaire was recorded in verbatim and later decided where it best fits and whether it adds any value to the study before it was either added to the study or discarded. To ensure confidentiality of the information given by the respondents, no identity or names of individuals was used during data collection, coding and entry into the computer. The data was then entered into computer and analyzed using the Statistical Package for Social Sciences (SPSS).

The chi-square ($\chi^2$) test (using 95% confidence level) was calculated to test for statistical significance of association between painters’ length in occupation (exposure time), amounts and types of paint used, types of application methods used, and diseases symptoms associated with spray painting activities. Descriptive statistical analysis such as percentages and bar charts were also performed for socio-demographical and other social aspects such as presence of spray painters’ disease symptoms associated with the occupation and health seeking behaviors of spray painters. The results were considered significant when the p value was less than 0.05. The analyzed data and other generated information were presented in descriptive form, using contingency tables, frequency table, pie and bar charts.
3.5 Ethical Consideration

The study adhered to all ethical principles necessary for the study. The researcher sought permission from Kenyatta University Board of Postgraduate Studies, Ministry of Higher Education, through National Council of Science and Technology (Appendix VII) and The Office of The President (Appendix VIII); i.e. the local administration in the study area (District Commissioner’s Office). Informed consent was sought from respondents in the study and confidentiality of the information given was ensured in all steps of data collection, analysis and dissemination of final results.
CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Socio-demographic characteristics of study population

This first section of results dealt with socio-demographical characteristics of study population. It includes attributes such as gender, marital status, age distribution, level of education and employment information (Table 4.1)

The Age distribution of spray painters in the study ranged from 17 to 62 years, with a mean of 28 and mode of 25 years. About a half (50.5%) of the spray painters were in the age group of 25 – 34 years, 34% in the age group of 15 – 24 years with only 15.5% of the spray painters in the age of 35 years and above.

All spray painters in the study had attained either of the two levels of education, primary (65%) and secondary (35%) levels of education. More than a half (62%) of the spray painters were married, with a relatively small number (36%) being single, only 2% of them were separated/divorced (Table 4.1). According to garage owners, spray painters usually join employment when they relatively young (youngest spray painter was 17 years) after dropping or completing primary or secondary level of education (Table 4.1).

The spray painters interviewed in the study occupied different ranks in employment. Majority (84.5) of spray painters were ordinary workers, while the rest (14.5%) were either supervisors or garage owners. According to the study, the
spray painters worked for an average of five and half days per week for all types of work and an average of seven and a half hours per day for removal of old paints and, a minimum of three hours per day for spray painting. The main work of spray painters in small scale informal auto garages according to the study was removal of old paint from vehicles and re-spray painting (removal of old paint was part of painting preparation).

Spray painters in the study had been in the current employment for various durations of time, with a big number (45.7%) having worked for a period of one to five years and very few (15.6%) of the spray painters in their current employment having worked for over 10 years. Spray painters in the study did various types of work. More than a half (65.8%) were involved in removal of old paint together with re-spray painting, 30.7% did spray painting only and, 3.5% were involved in overseeing the removal and also spray painting activities (these were mainly garage owners). Table 4.1
Table 4.1 Socio-demographic characteristics of study population (n=200)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age in years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15 - 24</td>
<td>68</td>
<td>34.0</td>
</tr>
<tr>
<td></td>
<td>25 - 34</td>
<td>101</td>
<td>50.5</td>
</tr>
<tr>
<td></td>
<td>≥ 35</td>
<td>31</td>
<td>15.5</td>
</tr>
<tr>
<td><strong>Level of education</strong></td>
<td>Primary</td>
<td>130</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>70</td>
<td>35</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td>Single</td>
<td>72</td>
<td>36.0</td>
</tr>
<tr>
<td></td>
<td>Married</td>
<td>124</td>
<td>62.0</td>
</tr>
<tr>
<td></td>
<td>Divorced /separated</td>
<td>4</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Duration in current employment (years)</strong></td>
<td>≤ 1</td>
<td>11</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>1 – 5</td>
<td>91</td>
<td>45.5</td>
</tr>
<tr>
<td></td>
<td>6 - 10</td>
<td>66</td>
<td>33.0</td>
</tr>
<tr>
<td></td>
<td>≥ 11</td>
<td>31</td>
<td>15.5</td>
</tr>
<tr>
<td><strong>Position in current employment</strong></td>
<td>Ordinary worker</td>
<td>169</td>
<td>84.5</td>
</tr>
<tr>
<td></td>
<td>Supervisor</td>
<td>7</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Owner</td>
<td>24</td>
<td>12.0</td>
</tr>
<tr>
<td><strong>Main worker done by respondents</strong></td>
<td>Remove old paints and spray paint</td>
<td>131</td>
<td>65.5</td>
</tr>
<tr>
<td></td>
<td>Spray painting only</td>
<td>61</td>
<td>30.5</td>
</tr>
<tr>
<td></td>
<td>Supervising and spray painting</td>
<td>7</td>
<td>3.5</td>
</tr>
</tbody>
</table>
4.2 Different types of application methods used in the study.

Two methods of paint application were used in the study. These were spreader method and spray gun method. Spreader is a simple flat object (plastic or metal) used for spreading filler paste on the surface of a vehicle before spray painting is done. On the other hand, a spray gun is used to deliver paint in a mist form onto a vehicle or any other surface (substrate) being painted. More than a half (68%) of the spray painters used spray gun, while a small number (24%) used spreader or both types (8%) according to Table 4.2.

4.2.1 Relationship between different application methods and various disease symptoms

4.2.1.1 Methods of application and asthmatic symptoms

The results of test of significance, $\chi^2 = 18.72338; df = 2; p = 0.00009$, showed that p-value of 0.00009 is less than 0.05, and suggested that there was a significant relationship between methods of application and asthmatic symptoms suffered by spray painters (Table 4.2). This further suggested that, asthmatic symptoms suffered can significantly be associated with the method of application of paint. While every paint type used would cause asthmatic problems, it is significantly influenced by the method of application (spraying or spreading), which depends much on the type of paint. Thus change of method type can significantly alter the probability risk in the asthmatic conditions, however, the percentage difference of
responses, that is 95 (71.4%) out of 133 spray painters who used spray gun, compared to 34 (72.3%) out of 67 who used spreader only, may not serve well as indicators of the method with the stronger association due to large difference in the sample proportions, hence from the results it is not possible to point out which of the two methods is more likely to cause asthmatic symptoms (Table 4.2).

4.2.1.2 Methods of application and bronchitis symptoms

The results of test of significance of relationship between methods of application and bronchitis symptoms suffered by spray painters differ from those of asthmatic symptoms. The results, $\chi^2 = 0.055885; \text{df} = 2; p = 0.97246$, has a p-value greater than 0.05 which indicates that there is no significant relationship between methods of application and bronchitis symptoms suffered by spray painters. The results show that, whether one uses spreader or spray gun the effect of bronchitis symptoms does not change, according to the study (Table 4.2).

4.2.1.3 Methods of application and eye problems

The method of application had a significant influence on eye related problems according to the results, $\chi^2 = 9.3202; \text{df} = 2; p = 0.00947$, with a p-value less than 0.05. This suggested that, a change in the method of application would significantly alter the probability of this health risk (eye problems) associated with spray painting in the study area, however the study does not show between spreader and spray gun, which method is more risk to use.
### Table 4.2. Effects of application methods on various disease symptom associated with spray painting (n=200)

<table>
<thead>
<tr>
<th>Category variable</th>
<th>Response</th>
<th>CHi-square statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
<td>% Frequency</td>
</tr>
<tr>
<td>Asthmatic</td>
<td>Spray gun</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>Spreader</td>
<td>34</td>
</tr>
<tr>
<td>Bronchitis</td>
<td>Spray gun</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>Spreader</td>
<td>14</td>
</tr>
<tr>
<td>Eye problems</td>
<td>Spray gun</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Spreader</td>
<td>3</td>
</tr>
</tbody>
</table>
4.3 Painters’ exposure time (determined by duration of application and duration in occupation)

4.3.1 Relationship between exposure time (duration of work) and various ill health symptoms

The relationship between duration of work, which was the measure of length in occupation and, various health symptoms, is shown in Table 4.2 below. This was done for all types of diseases symptoms in the study. This formed the basis of effect of exposure time on various diseases symptoms associated with spray painting. According to the study, there was no statistical significant relationship between increase in exposure time and disease symptoms associated with spray painting despite the increase in proportion of spray painters suffering from disease symptoms associated with spray painting.

4.3.1.1 Relationship between exposure time and asthmatic symptoms

The proportion of spray painters suffering from asthmatic symptoms increased with the increase in the number of years of work from 45.5% to 76.7% (Table 4.2). This however did not outright indicate that the longer the duration of work, the higher the number of those who are at risk of suffering from the asthmatic symptoms. The results of test of significance of relationship showed that; $\chi^2 = 3.75855; \text{df} = 3; p = 0.28871$. The p-value, 0.28871 is greater than 0.05 and this clearly showed that, there was no statistical evidence of significant relationship
between the duration of work (number of years of work) and the asthmatic symptoms suffered by those working with spray paints in the study area. This implied that, once one is exposed to spray paint, regardless of length of exposure, there exists a risk of suffering from asthmatic symptoms associated with spray painting, and that one can not work for few years to minimize the risk.

4.3.1.2 Relationship between exposure time and Bronchitis symptoms.

The percentage of spray painters affected by bronchitis symptoms increased from 63.6% (≤ 1 years) to a maximum of 90.6% (6-10 years), however for ten years and above, the proportion (80%) of those affected by bronchitis symptoms reduced (Table 4.2). The number of those affected by bronchitis symptoms increased, but statistically there was no significant relationship between duration of work and bronchitis symptoms suffered by spray painters in the study, thus; \( \chi^2 = 6.4773; \text{df} = 3; p = 0.09056 \), had a p-value greater than 0.05.

Like in the case of the Asthmatic condition, there is no statistical evidence of significant relationship between the duration of work and the bronchitis symptoms suffered. This clearly shows that, the risk of developing bronchitis problems seems to be the same for those who serve less number of year and those who serve more. The difference may only be in the degree of severity which the null hypothesis does not talk about due to the nature of the data (qualitative data).
4.3.1.3 Relationship between exposure time and eye problems

The results of test of significance for eye problems yielded; $\chi^2 = 2.33641; df = 3; p = 0.50558$. The p-value is greater than 0.05, which indicated that there was no significant relationship between eye problems and duration of work.

Therefore, like in the cases of asthmatic and bronchitis conditions above, there was no statistical evidence of significant relationship between the duration of work and the eye problems suffered by spray painters. Thus, the risk of developing eye problems does not change whether one served for less number of years or more. It was concluded, therefore that, in the absence of preventive interventions, as was observed in the study, the spray painting occupation in the study area is a health risk to spray painters regardless of duration of time they served.
Table 4.3 Effects of exposure time (Duration of work) on various disease symptoms associated with spray painting (n=200)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Duration of work (years)</th>
<th>Response</th>
<th>Total number (n)</th>
<th>Chi-square statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>Asthmatic symptoms</td>
<td>≤ 1</td>
<td>5</td>
<td>45.5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1 – 5</td>
<td>59</td>
<td>65.6</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>6 – 10</td>
<td>44</td>
<td>68.8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>≥ 10</td>
<td>23</td>
<td>76.7</td>
<td>7</td>
</tr>
<tr>
<td>Bronchitis symptoms</td>
<td>≤ 1</td>
<td>7</td>
<td>63.6</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1 – 5</td>
<td>78</td>
<td>86.7</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>6 – 10</td>
<td>58</td>
<td>90.6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>≥ 10</td>
<td>24</td>
<td>80</td>
<td>6</td>
</tr>
<tr>
<td>Eye problems</td>
<td>≤ 1</td>
<td>5</td>
<td>45.5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1 – 5</td>
<td>40</td>
<td>44.4</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>6 – 10</td>
<td>32</td>
<td>50.8</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>≥ 10</td>
<td>18</td>
<td>60</td>
<td>12</td>
</tr>
</tbody>
</table>
4.4. Different types and amounts of paints applied by spray painters in the Study area.

4.4.1 Different types of paint applied by spray painters

Various types of paints were used for different purposes. They include filler paste, undercoat, auto-refinishing and clear varnish. In all the garages in the study, the spray painters were mixing auto-refinishing paint with clear varnish to minimize the work load and maximize on the income. For the purposes of this study, auto-refinishing paint and clear varnish was referred to as auto-refinishing paint. In an ideal case various types of paint are applied sequentially, with several coats of auto refinishing and clear varnish, but mostly in an informal garage this is not the case. The paints applied on vehicles in an informal garage depended on many factors such as cost and time, with cost being the major influencing factor, hence only two types of paint, filler paste and auto-refinishing paints with little under coat, if any, seems to be applied. Different amounts of paints are used in small scale auto garages in the study area. This study dealt primarily with the two major types of auto paints used in informal small scale garages in the study area, namely filler paste and auto-refinishing auto paints.
Table 4.4 various types of paint applied by spray painters (N=200)

<table>
<thead>
<tr>
<th>Paint type</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filler only</td>
<td>48</td>
<td>24.0</td>
</tr>
<tr>
<td>Filler and undercoat</td>
<td>16</td>
<td>8.0</td>
</tr>
<tr>
<td>Auto-refinishing &amp; clear varnish</td>
<td>136</td>
<td>68.0</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>

4.4.2 Relationship between types of paints and various health hazards

All the spray painters in the study agreed that, the increase in types of paint increased the number of those suffering from various health hazards according to the study (those who used the two types). This was also confirmed by garage owners from their many years of experience with different spray painters.

4.4.2.1 Types of paint and Asthmatic symptoms

According to the study, there was a significant relationship between asthmatic symptoms and types of paints; $\chi^2 = 18.72338; \text{df} = 2; p = 0.00009$. Thus, statistically, there is evidence that the asthmatic symptoms are significantly dependent on the paint type. That is, filler type and the auto-refinish types of paint do not have equal probability of asthma risks; one type of paint presents a higher risk than the other. Therefore, changing from one type to the other may
significantly alter the probability risk of suffering asthmatic conditions, however, from the percentages (73.5% filler and 71.4% auto-refinishing) Table 4.4, it can be stated that a slightly higher number of those using filler than those using auto-paint suffered from asthmatic symptoms.

4.4.2.2 Types of paint and bronchitis symptoms

The proportions of those exposed to auto-refinishing and filler, and suffering from bronchitis symptoms was 85.7% and 85.1% respectively (Table 4.5). The test of significance; $\chi^2 = 0.5585; df = 2; p = 0.97246$ had a p-value of 0.97246, which shows that, there is no evidence that the relationship between bronchitis symptoms and paint types was statistically significant. This meant that as far as the bronchitis symptoms are concerned, all paint types had risks of causing bronchitis symptoms. Thus one would not significantly alter the probability risk of experiencing the bronchitis problems by changing from one type of paint to another. This, however, was not the case with the asthmatic symptoms.

4.4.2.3 Types of paint and eye problem symptoms

The proportion of spray painters exposed to auto-refinishing and filler paste, and suffering from eye problems was 47.4% and 63.8% respectively (Table 4.5). The results of chi-square test of significance relationship; $\chi^2 = 9.32022; df = 2; p = 0.00947$ had a p-value less than 0.05, signifying that there is a relationship between types of paint and eye problems. From table 4.5, it was evident that, a
higher proportion of spray painters suffer from eye problems when exposed to filler than to auto-refinishing paint. This can only suggest that filler type of paint causes more eye problems than refinishing, and hence the significant difference between the causes by the two types of paint.

Table 4.5 Ill health effects of paint types on various disease symptoms (n=180)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type of paint</th>
<th>Response</th>
<th>Chi-square statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>Asthmatic</td>
<td>Filler</td>
<td>34</td>
<td>73.3</td>
</tr>
<tr>
<td></td>
<td>Auto-refinishing</td>
<td>95</td>
<td>71.4</td>
</tr>
<tr>
<td>Bronchitis</td>
<td>Filler</td>
<td>40</td>
<td>85.1</td>
</tr>
<tr>
<td></td>
<td>Auto-refinishing</td>
<td>114</td>
<td>85.7</td>
</tr>
<tr>
<td>Eye problems</td>
<td>Filler</td>
<td>30</td>
<td>63.8</td>
</tr>
<tr>
<td></td>
<td>Auto-refinishing</td>
<td>63</td>
<td>47.4</td>
</tr>
</tbody>
</table>
4.4.3. Different amounts of paint used by various spray painters

Spray painters in the study used an average of 14.8kg of filler and 37.4 liters of auto-refinishing paint per week. These were the two major paints frequently used in informal auto garages in the study area. Majority (81.2%) of spray painters used between one and twenty kilograms of filler, compared to 18.8% who used more than 21kg of filler per week, while about a half (52.4%) used more than thirty one liters of auto-refinishing paint.

Table 4.6 Different amounts of paint used by spray painters (n=200)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Amount of paint used</th>
<th>Frequency of use</th>
<th>Per cent (%)</th>
<th>Response number (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filler (kg)</td>
<td>1-20</td>
<td>39</td>
<td>81.2</td>
<td>n=48</td>
</tr>
<tr>
<td></td>
<td>≥ 21</td>
<td>9</td>
<td>18.2</td>
<td></td>
</tr>
<tr>
<td>Auto-refinishing, (liters)</td>
<td>1-30</td>
<td>50</td>
<td>47.6</td>
<td>n=105</td>
</tr>
<tr>
<td></td>
<td>≥ 31</td>
<td>55</td>
<td>52.4</td>
<td></td>
</tr>
</tbody>
</table>

4.4.4. Relationship between different amounts of Paint used and health hazards associated with spray painting

Relationship between different amounts of paint used by spray painters and various health hazards were studied. According to the study results, there was no significant relationship observed between health hazards associated with spray painting and various amounts of both filler and auto-refinishing paints.
4.4.4.1 Relationship between amounts of filler and health hazards

4.4.4.1.1 Amount of filler and asthmatic symptoms

The study showed that, when the quantity of filler used, increased, the proportion (%) of spray painters suffering from asthmatic symptoms increased from 71.1% to 77.8%. Although the proportions of the affected spray painters increased with the increases of amount of filler used, statistically this increase was not reflected in the results of the test of significance; $\chi^2 = 0.16448; \text{df} = 1; p = 0.68507$. This shows that, there is no significance relationship between the increase in amount of filler and asthmatic symptoms suffered by spray painters. This further suggests that, once a spray painter is exposed to filler paint, there is a risk of suffering from asthmatic symptoms irrespective of the amount.

4.4.4.1.2. Amount of filler and bronchitis symptoms

When the amount of filler paint used was increased (1-20, to over 20 kg), as shown in table 4.6 below, the proportion of spray painters suffering from bronchitis symptoms increased from 84.2% to 88.9%. Like in the case of asthmatic symptoms above, the increase in amount of filler did not have a significant relationship between bronchitis symptoms suffered by spray painters statistically ($\chi^2 = 0.12565; \text{df} = 1; p = 0.72299$). It was concluded that an exposure to any amount of filler paint may be a health risk in relation to bronchitis symptoms.
4.4.4.3 Amount of filler and eye problems

The increase in proportion (63.2% to 66.7%) of spray painters suffering from eye problems seemed to increase with the increase (1-20 to over 20 kg) in the amount of filler used (Table 4.6). This increase in proportions had no statistical significance as shown by the chi-square test of significance; $\chi^2 = 0.03880; \text{df} = 1; p = 0.84384$. This, like the other two cases above, of asthmatic and bronchitis symptoms, shows that the increase in filler paint used does not alter the risk of developing eye problems, and that any exposure to filler paint can cause eye problems.

4.4.4.2 Relationship between amounts of auto-refinishing paints and various diseases symptoms

Various amounts of auto-refinishing paint have health hazardous effect on respondents according to the study. Like the case of filler, no significant relationship was observed between health hazards associated with spray painting and auto-refinishing type of paint according to the study.

4.4.4.2.1 Auto-refinishing paint and asthmatic symptoms

The chi-square test of significant; $\chi^2 = 0.11577; \text{df} = 1; p = 0.73367$, had a $p$-value greater than 0.05. The results in Table 4.6 shows that, as the quantity of Auto-refinishing paint used increased, the proportion (%) of spray painters with
asthmatic symptoms increased from 73.5\% to 76.4\%. This increase is not statistically significant, ($\chi^2 = 0.11577; \text{df} = 1; p = 0.73367$).

Since the p-value of 0.73367 was greater than 0.05, it was concluded that there was no significant relationship between the amounts of auto-finishing paint used and the asthmatic symptoms. It further suggested that, even when the amounts of auto–refinishing paint used per week was increased; the risk of suffering from asthma symptoms remains the same.

### 4.4.4.2.2 Amount of auto-refinishing and bronchitis symptoms

The results of the study showed that 89.3\% of spray painter who used between one and thirty liters of auto refinishing paint suffered from bronchitis symptoms, while 84.5\% of those who used thirty one liters and above suffered from bronchitis symptoms. Although it appears that a majority (89.3\%) of spray painters who used between one and thirty liters of auto-refinishing suffer from bronchitis symptoms, when the amount was increased, less proportion of spray painters suffered from the symptoms. Statistically, it was found that there was no significant relationship between the increase in amount of auto-refinishing paints and the bronchitis symptoms suffered by the spray painters according to chi-square test of significant; $\chi^2 = 0.57519; \text{df} = 1; p = 0.44820$. This suggested that any individual exposed to auto-refinishing paint had a risk of suffering from bronchitis symptoms irrespective of the amount.
4.4.4.2.3 Amount of auto-finishing paints and Eye–problems

The same cases above in auto-refinishing and bronchitis symptoms, applied to eye problems, that there was no significant relationship between the increase in auto-refinishing paint and eye problems; $\chi^2 = 0.72161$; df $= 1$; $p = 0.39562$, which had a p-value greater than 0.05. It was concluded that any exposure to auto-refinishing paint carries a health risk to eyes of spray painters.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Amounts of paint used</th>
<th>Response</th>
<th>Response (n)</th>
<th>Chi-square statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequency   %</td>
<td>Frequency</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Asthmatic</td>
<td>Filler (kg)</td>
<td>1-20</td>
<td>27</td>
<td>71.1</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 21</td>
<td>7</td>
<td>77.8</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Auto-refinishing, (Liters)</td>
<td>1-30</td>
<td>36</td>
<td>73.5</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 31</td>
<td>42</td>
<td>76.4</td>
<td>13</td>
</tr>
<tr>
<td>Bronchitis</td>
<td>Filler (Kg)</td>
<td>1-20</td>
<td>32</td>
<td>84.2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 21</td>
<td>8</td>
<td>88.9</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Auto-refinishing, (Liters)</td>
<td>1-30</td>
<td>50</td>
<td>89.3</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 31</td>
<td>49</td>
<td>84.5</td>
<td>9</td>
</tr>
<tr>
<td>Eye problems</td>
<td>Filler (Kg)</td>
<td>1-20</td>
<td>24</td>
<td>63.2</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 21</td>
<td>6</td>
<td>66.7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Auto-refinishing, (Liters)</td>
<td>1-30</td>
<td>25</td>
<td>44.6</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 31</td>
<td>30</td>
<td>52.6</td>
<td>27</td>
</tr>
</tbody>
</table>
4.5 Presence of disease symptoms associated with spray painting

(Ill health symptoms suffered by spray painters and their link to paint exposure)

4.5.1 Different disease symptoms experienced by spray painters

The spray painters in the study were suffering from various disease symptoms associated with spray painting. The high prevalence of various disease symptoms among spray painters in the study was attributed to their occupation, i.e. spray painting activities. This was confirmed by health professionals in the health facilities where the spray painters were seeking medical treatment. This was likely true since majority (76%) of the spray painters were non-smokers and the same number (76%) of them had no family history of chronic obstructive respiratory disease. According to health professionals interviewed, many spray painters had multiple disease symptoms. Majority (85.7%) of the spray painters in the study confirmed to have experienced the bronchitis related symptoms, while a big number (67.3%) of them experienced asthmatic related symptoms. Eye problems (49.2%) were not as prevalent as asthmatic and bronchitis symptoms. According to the study results, bronchitis symptoms seemed to be more prevalent among spray painters in the study than any other diseases symptom studied (Figures 4.2, 4.3 and 4.4).
Figure 4.1 Percentage of spray painters suffering from asthmatic symptoms (n=200)

Figure 4.2 Percentage of spray painters suffering from bronchitis symptoms (n=200)
4.5.2 Various effects of diseases symptoms Suffered by spray painters

Various effects of disease symptoms had negative impact on the spray painters suffering from them. These were; increase in proportion of those suffering, duration of suffering and consequences of suffering.

4.5.2.1 Proportions of spray painters with various disease symptom

Different proportions of spray painters suffered from various disease symptoms (Figure 4.5). Majority (85.7%) suffered from bronchitis symptoms, followed by asthmatic (67.3%) and the least prevalent disease symptom was eye problems (49.2%).
4.5.2.2 Duration of suffering from the various disease symptoms

Different spray painters had suffered from various disease symptoms for different durations of time (Figure 4.6)

Different spray painters suffered from the disease symptoms associated with spray painting for various durations. A big number (46.5%) of spray painters confirmed that, they had experienced the above symptoms for a period of less than one year, 33.5% suffered for between one and two years, while 10% of spray painters suffered for between three and five, and the rest (10%) suffered for above five.
4.5.3 Consequences of various disease symptoms suffered by spray painters

4.5.3.1 Severity of disease symptoms to make physical activities difficult.

Various disease symptoms suffered by spray painters were so severe that they made physical activities difficult for different spray painters as shown in figure 4.7. Slightly more than a half (56.3%) of the spray painters said they had always or occasionally (sum of the two) had difficulty with physical activities while 43.7% rarely or never had any difficulty.
Figure 4.6 Severity of disease symptoms to make physical activities difficulty (n=178)

4.5.3.2 Time of severe suffering by the spray painters

Different spray painters suffered severely at different times of day or night (Table 4.8). Majority (74.7%) of the respondents said they experienced severe suffering from the bronchitis and asthmatic symptoms at night and early in the morning. Given that more than a half (56.3%) experienced difficulty in executing physical activities (strenuous work), and that the severity of these problems was at night and morning (74.7%), there was a likelihood of the symptoms causing serious implications on the economic and family obligations of the spray painters.
4.5.3.3 Severity to limit the work done (daily work)

At times, it was not only the physical activities that were hindered by the severity of the suffering, but also daily work of the spray painters was also limited (Figure 4.8). Slightly more than a half (54%) of spray painters said the severity of the disease symptoms limited their daily work, while 46% said the symptoms did not limit their daily work.

Figure 4.7 Severity to limit daily work done (n=178)
4.6 Health seeking behavior of the spray painters

The spray painters in the study had poor health seeking behaviors. Such behaviors included, failure to visit a health facility or consult a health professional when suffering from the disease symptoms associated with spray painting, self medication (buying medication over the counter without health professional’s prescription) according to pharmacists and health professionals/clinicians interviewed and, failure to adhere to health professionals instructions

A good example was 21.9% of spray painters who were advised to change their occupation completely but did not heed the advice. The reason they gave for not heeding the health professional’s advice, according to the study was that, if they changed their occupation they will be affected economically since they had no other skill to enable them earn a living.

4.6.1 Consultation with a health professional

Among the spray painters (n=187) suffering from diseases symptoms associated with spray painting, slightly more than a half (52.9%) said they did not consult a health professional for their health problems, but instead bought medicine over the counter, only 47.1% did consult a health professional when suffering from disease symptoms arising from spray painting activities. Apart from failure to consult a health professional when suffering from disease symptoms associated with spray painting, the spray painters in the study had other ill health behaviors such as lack
of wearing full personal protective equipment and wearing of old and tattered overcoats and safety shoes. Although majority (78.5%), wore overcoats and safety shoes, non of them had face masks, which prevents one from inhaling volatile organic solvents and other harmful organic compounds and, gloves which prevents the over spray paint mist from landing on the exposed skin. About a half (47.4%) of spray painters had torn and tattered protective clothing while about the same number (46.9%) of spray painters’ protective clothing were old but usable. Another condition that seems to escalate their exposure to health hazards is the fact that, all (100%) of the small scale auto garages in the study area were operated in open spaces with earthen floors (not cemented) full of dust. According to garage owners these earthen floors generated a lot of dust during dry seasons and mud during wet seasons. The dust was a nuisance to spray painters, and in many instance escalated some disease symptoms such as asthmatic symptoms, according to garage owners.

4.6.2 Advice from health professionals, on consultation

On consulting a health professional, different spray painters were given various advices (Table 4.9) based on their current health status. More than a half (58 %) of spray painters who consulted health professionals were advised to stop work temporarily or change their occupation, while 21.6% were advised to change their occupation completely. Based on the above proportions, this was a clear indication
of the severity, and probably the burden of the disease symptoms associated with spray painting among spray painters in the study area.

Table 4.8 Health seeking behaviors of spray painters and health professional’s advice N=

<table>
<thead>
<tr>
<th>Health seeking behaviour</th>
<th>Category</th>
<th>Frequency</th>
<th>Proportion (%)</th>
<th>Population involved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sick and consulted a health professional</td>
<td>88</td>
<td>44.0</td>
<td>n=200</td>
</tr>
<tr>
<td></td>
<td>Sick but did not consult a health professional</td>
<td>99</td>
<td>49.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Had no health problems</td>
<td>13</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>Health professionals advice</td>
<td>Change occupation</td>
<td>19</td>
<td>21.6</td>
<td>n=88</td>
</tr>
<tr>
<td></td>
<td>Stop work temporarily or Change occupation</td>
<td>51</td>
<td>58.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No specific advice</td>
<td>18</td>
<td>20.4</td>
<td></td>
</tr>
</tbody>
</table>
4.7 Discussion of results

4.7.1 Introduction to discussion

This section is a summary, interpretation and application of study results. The study brought out major links between exposure to, and disease symptoms associated with spray painting. Other factors known to be associated with respiratory disease symptoms such as cigarette smoking and family history of chronic obstructive respiratory diseases were considered along. This was to make sure that the disease symptoms suffered by spray painters are, most likely as a result of exposure to health hazard associated to their occupation and not other effects or at least to minimize compounding effects of external factors.

4.7.2 Socio-demographic characteristics of study population

Half (50.5%) of spray painters in the study were between 25 and 34 years of age (mean 28 years) with the youngest being 17 years. The Kenyan Occupational Health and Safety Act (OHSA) of 2007 states that, persons below eighteen years of age are not supposed to be engaged in employment, if the work is likely to harm their health and safety. According to Odhiambo and Manda (2003) many children from informal settlement areas drop out of school at an early age to seek employment due to poverty. This shows that, probably many of the spray painters in the study came from such areas, and that, a good number (36%) of spray painters are single is a confirmation that many spray painters enter employment at
a young age. None of the spray painters had gone beyond secondary level of education, with a big number (65%) having only reached primary level of education. Garage owners also agreed that, many people who seek employment in informal auto garages are young primary school drop outs, mainly from many informal settlements in Embakasi divisions. About a half (45%) of the spray painters in the study had worked for a period of between one and five and, only 15.5% had worked for period of ten years and above, signifying high employees turn over probably due to health hazards in the occupation. According to garage owners many of the newly employed spray painters have no formal training or job experience. When recruited, they start with minimum work of scraping old paint from vehicles in preparation for spray painting. With time and practice, they start spray painting of small patches of damaged vehicles, then progress to spray painting a whole vehicle. Majority (84.5%) of spray painters in the study are paid workers. This suggests that, garage owners are few (12%) among spray painters. Although a good number (30.5%) of spray painters did spray painting only, a big number (65.5%) combined spray painting, spreading of filler and removal of old paint from vehicles to maximize their earnings from their work. The study shows that, almost every spray painter worked for an average of five and a half days per week; however this depended on the availability of work, which on the other hand had no fixed schedule of reporting and leaving. Removing of old paint together with general preparation of a vehicle for repaint, took an average of seven and a half hours, while the actual spray painting took an approximately three hours per
vehicle. Scraping of old paint for an average of seven hours per day means that the spray painters, apart from being exposed to volatile organic solvents are also exposed to dust from the dried paint which contains a high concentrate of heavy metals like lead, cobalt and zirconium as driers (Boxal and Fraunhofer., 1977) and a host of other toxic heavy metals like chromium and cadmium which are constituents of paint pigments.

4.7.3 Application methods

Different applications methods are used for automotive spray painting. The choice of application method primarily depended on the object to be sprayed (Heitbrink et al., 1995). Apart from the object to be sprayed, the choice of application method also depended on the cost of application equipment, which is determined by the equipment efficiency and risk of exposure to paint overspray.

The study revealed that, all the garages visited were using compressed air conventional spray guns. The compressed air conventional spray gun has a spray technique deposition efficiency of 25-35%, while a high-volume; low-pressure (HVLP), also known as “airless” spray guns have an efficiency deposition of 65% (Heitbrink., et al 1996). It is also known that maximum deposition efficiencies for “airless” and electrostatic spray painting equipment are 65-70% and 80% respectively (Lansink et al., 1997). High-volume, low-pressure spray guns are more efficient than conventional spray guns. They can cause particulate overspray concentration to be reduced by a factor of two (compared to conventional spray
gun), while spray painting gun efficiency increases by 30% (Heitbrink et al., 1995). According to the study, these spray guns are more expensive than the later, and many informal garage owners may not afford them owing to their low earnings (Hagerlund., 2006). As spray painting gun efficiency increases, the painter uses less paint and there is more proportionate decrease in worker exposure (Heitbrink et al., 1995). If the garage owners were to change the spray guns from conventional types, probably this may bring the exposure down and reduce the amount of auto-refinishing paint used and, the health hazards associated with auto spray painting. Spreader application method is different from spray guns. It is small hand-held equipment (usually plastic or metal) for spreading filler paint on surfaces (substrate). The proportion of use of spreader method is 24%, compared to 68% of spray gun in the study area. Although the use of spray gun is more than three times that of spreader, in some instances of disease symptoms such asthma, more spray painters (73.8%) who use filler which is applied by spreader suffer from them than those who use auto-refinishing type of paint (71.4%). This probably is due to proximity of spreader to spray painter’s face (Breathing zone of spray painter) [Lansink et al., 1997].

4.7.3.1 Effects of application methods on spray painters

Application methods have a direct bearing on spray painters’ disease symptoms. Asthmatic symptoms are negatively affected by all application methods; \( \chi^2 = 18.72338; \text{df} = 2; p = 0.00009 \), suggesting that the asthmatic symptoms suffered
are dependent on the method of application used. Also for eye problems; \( \chi^2 = 9.32022; \) \( \text{df} = 2; \) \( p = 0.00947, \) indicates a significant relationship between eye problems and application method. In bronchitis case unlike asthma and eye problems, the results show that there is no significant influence of method of application. The results of test of significance for bronchitis symptoms; \( \chi^2 = 0.055885; \) \( \text{df} = 2; \) \( p = 0.97246, \) shows that there was no significance relationship between method of application and bronchitis symptoms. This suggests that spray painters can alter the risk of asthmatic symptoms and eye problems by changing from one application method to another. According to the spray painters in the study, these two symptoms (asthmatic, especially wheezing of chest and watery eyes) occur shortly after exposure indicating the effects/severity of volatile organic solvents on the target organs/areas. The type of spray guns (conventional compressed air type of spray gun) exclusively used in the informal auto garages in the study area seems to contribute more to the increased exposure.

The mass deposited on the painter from the resulting overspray is influenced by environmental factors such as droplet evaporation and air movement (Lansink et al., 1997) which have a direct effect on the transmission of overspray to worker’s body. Also worker-depended factors such as posture and worker’s orientation to the free stream of air flow will have an effect on emission of paint onto the skin and outer clothing (Lansink et al., 1997). The above statements, suggests that the volatility (VOCs) of paints have more effect on lungs, were exchange of gases take place rather than irritate the mucous membranes.
On the other hand, bronchitis symptoms affected the spreader users more than those using the spray gun. It seems like chemicals in filler were irritating the respiratory (bronchial membranes) mucous membrane and causing more dry and productive cough (bronchitis symptoms) than breathlessness and wheezing of chest (asthmatic symptoms). This is true because filler paste has less volatile organic solvents (VOC) compared to auto-refinishing, undercoat or clear varnish.

4.7.4 Exposure time (duration of work)

4.7.4.1 Effect of exposure time on diseases symptoms suffered by spray painters

The length of exposure had no significance relationship between the disease symptoms associated with spray painting, such as asthmatic symptoms; $\chi^2 = 3.75855; df = 3; p = 0.28871$, bronchitis symptoms; $\chi^2 = 6.4773; df = 3; p = 0.09056$ and eye problems; $\chi^2 = 2.33641; df = 3; p = 0.50558$. While this is true statistically, the proportions of spray painters suffering from disease symptoms increased with the number of years of work. The percentage of spray painters suffering from asthmatic symptoms increased from 45.5% for working for one year or less to, 65.6% for working between one to five years, 68.8% for six to ten, to a maximum of 76.7% for above ten years. For bronchitis, it was 63.6% for one year or less, and up to a maximum of 90.6% for between six to ten years, while for eye problems it was the same case, from 45.5% for one year or less to 60% for above ten years. From the study, it can be suggested that, since a big number
(45.5%, 63.6% and 45.5% for asthma, bronchitis and eye symptoms respectively) of spray painters suffer from disease symptoms associated with spray within the first year in their occupation, the long exposure time did not change the risk of suffering from disease symptoms associated with spray painting.

It is known that one of the main constituent of volatile organic solvent of auto paint was diisocyanates. Work exposure to diisocyanates causes chemical bronchitis among other symptoms (NIOSH., 1978 and Charles et al., 1976) Reports indicate that diisocyanates cause irritation to skin, mucous membranes, eyes, and respiratory tract (Mobay., 1987). Workers exposed to high concentrations of diisocyanates may result in what is called chemical bronchitis, chest tightness, nocturnal dyspnea (shortness of breath), pulmonary edema (fluid in the lungs) and reduced lung function (NIOSH., 1978, Charles et al 1976). It is also known that lung functions decrease with number of exposures (Turnling et al., 1990). Sensitization of isocyanate can happen even within days of exposure (Dillon., 200). According to the study, the spray painters had multiple symptoms of the disease associated with spray painting.

4.7.5 Different types and amounts of spray paints

Different types and amounts of paints were used by various spray painters in the study. A big number (68%) of spray painters used auto-refinishing and clear varnish compared to those who used other types of paint. This is so because several coats of auto-refinishing and clear varnish are required for the top coat
finish of any vehicle body. Spray painters in the small scale garages in the study were mixing auto-refinishing paint and clear varnish to minimize work and maximize the income and, hence for the purposes of this study both paints were referred to as auto-refinishing paint. About a half (52.4%) of spray painters used thirty one and above, liters of paint compared to 81.2% of spray painters who used between one and twenty kilograms of filler per day. On average the spray painters were using 14.8kgs of filler and 37.4 liters of auto-refinishing per day. This clearly shows that, more amounts of auto-refinishing paint were used compared to other paint types.

4.7.6 Presence of spray painters’ disease symptoms associated with auto spray painting

According to the study, there was evidence of presence of disease symptoms associated with spray painting. This was also confirmed by garage owners and health professional in the study area. Presence of disease symptoms associated with spray painting can be caused by many factors, both external such as poverty (Odhiambo and Manda., 2003) to political good will and other internal factors such as level of education, to lack of training in basics relevant skills in paint technology, lack of use of personal protective equipment and other infrastructures like enclosed buildings. The above factors notwithstanding, the actual exposure to health hazards in spray painting, according to the study may have been also caused
by different types of paints which accounted for a large proportion of disease symptoms.

Disease symptoms associated with spray painting among spray painters in the study seem to develop at a very low exposure for different types of paint. The increase in filler paint had no significant relationship to all the disease symptoms statistically; $\chi^2 = 0.16448$; df $= 1$; $p = 0.68507$; $\chi^2 = 0.12565$; df $= 1$; $p = 0.72299$ and $\chi^2 = 0.03880$; df $= 1$; $p = 0.84384$, for asthmatic and bronchitis symptoms, and eye problems respectively. The same case applied for auto-refinishing paint; $\chi^2 = 0.11577$; df $= 1$; $p = 0.73367$; $\chi^2 = 0.57519$; df $= 1$; $p = 0.44820$; $\chi^2 = 0.72161$; df $= 1$; $p = 0.39562$ for asthmatic and bronchitis symptoms, and eye problems respectively. Although statistically there was no relationship between increase in duration of work and disease symptoms, the proportions of those affected by the disease symptoms increased, both with number of years in occupation and amount of paint used. One good example is for auto-refinishing paint, where proportion of the affected spray painters increased from 73.3% for between one to thirty liters of paint used, to 76% when the paint was increased to above thirty liters.

Other factors like smoking habits and chronic obstructive respiratory diseases in related family members were also studied. The aim of this was to minimize the compounding effects of external factors. Majority (76%) of spray painters in the study were non-smokers, while the same proportion (76%) of spray painters did not have related family members (brothers, sisters and parents) with chronic
obstructive respiratory diseases like asthma and bronchitis. A big number (46%) of spray painters suffering from the disease symptoms had suffered for less than one year, while also the same (46%) proportion of them had worked for between one and five years. Another disease symptom associated with spray painting was dermatitis (Riddley and Channing., 1999). In the study, prevalent of this disease symptom was due to over spray paint landing on bare skin of spray painters and subsequent washing it off with volatile organic solvents, according to spray painters and health professionals in the study area.

The study safely concluded that, the spray painters suffering from the disease symptoms associated with spray painting had acquired the disease symptoms mainly from their occupation.

4.7.7 Health seeking behaviors of spray painters

Based on the study, about a half (52.9%) of spray painters (n=187) did not consult a health professional when suffering from the disease symptoms associated with auto spray painting. This was a clear indication that spray painters in small scale auto garages in the three study locations of Embakasi division had a poor health seeking behavior. From the study, it was clear that among the spray painters in the study there was a high prevalence of disease symptom associated with spray painting activities. This was enough reason for them spray seek prompt medical interventions. Given the fact that, they were poor income earners (Hagerlund., 2006), it was also good for them to seek prompt medical interventions to avoid
absenteeism from work and health deterioration. On contrary this was not the case because, apart from limited medical facilities in the study area, a big number (71.9%) of those who consulted health professionals did not heed the medical advices given to them. Such as advice included stopping work temporarily, using personal protective devices, to changing their occupation. According to health professional in the study area, the advices were based on severity and chronic nature of the disease symptoms. However they had reasons for not adhering to the medical advices, especially changing their occupation, owing to poor economy and lack of other skills to earn a living. Other unhealthy behaviours observed on spray painters were washing of paint soiled hands and any other exposed skin with volatile organic solvents, especially thinner type of solvent. This resulted in occupational dermatitis of hands, according to the health professionals in the health facilities in the study area.
CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study came up with conclusions based on the objectives of the research in the study area. They were as follows:

(a) The population at risk of ill health effects of spray paint exposure were young people (34% of the spray painters were below 25 years).

(b) Only one type of spray gun, compressed air type was in use in the small scale auto garages in the study area, which according to the study has a very low paint deposition efficiency and highest potential for exposure due to paint over spray it creates.

(c) It was observed that spray painters in the study were using little or no form of protection while engaged in spray painting activities and concluded that, this lack of protection was increasing exposure time (actual time in contact with auto paint), which increased the likelihood of contracting disease symptoms associated with spray painting.

(d) The increase in the amounts and types of paints used in the study contributed to overall exposure and subsequent development of various diseases symptoms associated with spray painting. This concluded that different types and amounts of paints used had a negative health effects on the spray painters.
The study confirmed the presence, and association between spray painting activities and, asthmatic symptoms, bronchitis symptoms, eye problems and dermatitis. It was therefore concluded that the high proportion of spray painters suffering from various disease symptoms associated with spray painting was due to presence of health hazards associated with spray painting occupation.

The study also revealed that spray painters in small scale informal auto garages in the three locations in Embakasi division had poor health seeking behaviors. According to the study, they rarely consulted a health professional or visit health facilities when suffering from the diseases symptoms associated with spray painting activities.

The Null Hypothesis that spray painting in small scale automotive garages is not associated with occupational health hazards is rejected. Finally it was concluded that spray painting in small scale auto garages in Kayole, Umoja and Kariobangi South locations of Embakasi Division is associated with health hazards.

### 5.2 Recommendations

#### 5.2.1 Recommendations for development partners

- Change of type of spray gun used, that is, compressed air type to other types such as high volume low pressure (HVLP) or electro-deposition spray gun which have less overspray (Heitbrink., 1995)
• Reduce exposure time by using interventions such as personal protective equipment properly and consistently, and also use of safe work procedures. The reduction of exposure time and amount of paint used will also reduce the burden of diseases associated with spray painting.

• Reduce the amount of paint used by using methods with high paint deposition efficiency such high volume low pressure (HVLP) and electro-deposition methods that use less paint for the same work.

• Spray painters to seek medical interventions immediately they see signs and/or symptoms of diseases associated with spray painting and follow health professional’s advice, and avoid self medication.

• Public awareness and preventive programs to be carried out in the workplaces where spray painting is done.

• Development of training manuals and programmes for spray painters and garages operators in small scale informal (jua kali) garages, to ensure some competence in the industry.

5.2.2 Recommendations for policy makers

• All concerned authorities such as; Ministry of Labour through Department of Occupational Health and Safety, Ministry of Environment and Mineral Resources, Ministry of Public Health and
sanitation, Ministry of Local Government, Ministry of Industrialization and relevant authorities like National Environmental Management Authority (NEMA), Kenya Bureau of Standards (KEBS) and other relevant local authorities to come up with a policy for short, medium and long term preventive and sustainable interventions in the sector.

- Periodical monitoring and evaluation of health of all the workers in the auto garages and paint industries, as these health hazards cuts across all the stages of manufacture, storage and handling, and end use of the auto paint and allied chemicals (Ontario Ministry of Labour., 1987).

- Health care providers to be sensitized and equipped with knowledge and diagnostic facilities to appropriately attend to the increasing health hazards medically.

- Inter-disciplinary approach to be used to bring together all concerned authorities towards achieving:

  (i) Social development, by protecting particularly the young people, who are the majority in the industry and are integral part of the future intellectual, social and economical resource, by developing standards and other regulatory procedures for the industry

  (ii) Promote sustainability by protecting all vulnerable groups.

  (iii) Meeting pressing health and environmental challenges in the industry.
(iv) Developing appropriate human and social resources

(v) Finally revitalizing the community

5.2.3 Recommendations for further research

The research was very comprehensively done and brought out many issues that could not be exhaustively tackled at this stage due to limitations in the study, however they are recommended for future research. They include, but not limited to the following areas:

i) Comparison study of efficacy of different application methods, especially spray guns used in small scale auto garages.

ii) Effectiveness of interventions (such as PPEs) in controlling exposure time and amounts of paint used in small scale auto garages.

iii) In-depth study of the disease symptoms associated with auto spray painting in relation to various amounts and types of automotive paints using “case control study” methods.

iv) Full scale impact assessment of the diseases associated with spray painting on the individuals working in, but not necessarily sprays painters, and visitors to the auto garages. This can be termed as effect of “passive” spray painting
REFERENCES


Department for Environmental Affairs and Tourism (DEAT) [1999]. National State of Environmental Report; Pretoria, South Africa.


APPENDIX I

LIST OF COMMON CHEMICALS IN PAINTS AND THEIR THRESHOLD LIMIT VALUES (TLVs)

<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>TLV (Threshold Limit Values)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead as Pb (fumes, dust etc)</td>
<td>0.15 mg/m³</td>
</tr>
<tr>
<td>Mercury (all forms except alloys)</td>
<td>0.05 mg/m³</td>
</tr>
<tr>
<td>Alloy compounds of mercury</td>
<td>0.001 ppm, 0.01 mg/m³</td>
</tr>
<tr>
<td>Nickel</td>
<td>1 mg/m³</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.2 mg/m³</td>
</tr>
<tr>
<td>Hydrogen Selenide</td>
<td>0.05 ppm, 0.2 mg/m³</td>
</tr>
<tr>
<td>Manganese</td>
<td>5 mg/m³</td>
</tr>
<tr>
<td>Molybdenum \ Soluble compounds</td>
<td>5 mg/m³ \ 10 mg/m³</td>
</tr>
<tr>
<td>Chromium (chromic acids)</td>
<td>0.1 mg/m³</td>
</tr>
<tr>
<td>Zinc Chromate</td>
<td>0.1 mg/m³</td>
</tr>
<tr>
<td>Copper fumes \ Copper dust, mist</td>
<td>0.2 mg/m³ \ 1 mg/m³</td>
</tr>
<tr>
<td>Tin (SnO₂, SnH₄ \ Sn₆ \ Oxalate)</td>
<td>2 mg/m³ \ 0.1 mg/m³ \ 10 mg/m³, 30 ppm</td>
</tr>
<tr>
<td>Titanium dioxide</td>
<td>10 mg/m³</td>
</tr>
<tr>
<td>Substance</td>
<td>Concentration</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Zirconium</td>
<td>5 mg/m³</td>
</tr>
<tr>
<td>Diisocyanate</td>
<td>0.02 ppm</td>
</tr>
</tbody>
</table>

Adopted from: Environmental Health Department; Peters, (1970)
APPENDIX II

KEY INFORMANT INTERVIEW GUIDE TO PHARMACISTS

Introduction

My name is Agnes Mwatu; I am a student at Kenyatta University, school of Health Sciences. I am undertaking a Master degree in Public Health. I’m carrying out a research on health hazards associated with spray painting in small scale informal (Jua kali) auto garages in Embakasi division. To be authorized to carry out research in this area, I have a research permit (Research Permit No. NCST/RRI/12/1/MAS/80, issued on 05/05/2010), a letter from National Council of Science and Technology (Appendix VII) and an introductory letter from District Commissioner, Embakasi District (Appendix VIII) [All these documents are produced and shown to the pharmacist]

I would like to ask you questions about auto spray painters in this area who purchase drugs in your pharmacy. The interview will take fifteen to twenty five minutes.

Interview questions

1. Identification of auto spray painters

   (a) Among the people who purchase drugs in your pharmacy, are there some who identify themselves as auto spray painters?
(b) Of the medications they purchase, are there some which have not been prescribed by a health professional?

(c) Of the medication they purchase over the counter, do they consult you (the pharmacist) or they decide on their own the type of medication to purchase?

(d) When they do consult the pharmacist, do they disclose how long they have been suffering?

2. Types of disease symptoms

(a) What are the common disease symptoms do the spray painters above complain of?

(b) After they purchase the medication over the counter or consult the pharmacist and purchase the medication, do they come back again with the similar symptoms or complain?

(c) If (b) above is true, what advice do you give them?
APPENDIX III

KEY INFORMANT INTERVIEW GUIDE TO HEALTH PROFESSIONALS
(OR CLINICAL OFFICERS).

Introduction

My name is Agnes Mwatu; I am a student at Kenyatta University, School of Health Sciences. I am undertaking a Master degree in Public Health. I’m carrying out a research on health hazards associated with spray painting in small scale informal (Jua kali) auto garages in Embakasi division. To be authorized to carry out research in this area, I have a research permit (Research Permit No. NCST/RRI/12/1/MAS/80, issued on 05/05/2010), a letter from National Council of Science and Technology (Appendix VII), and an introductory letter from District Commissioner, Embakasi District (Appendix VIII) [All these documents are produced and shown to the health professional or clinical officer]

I would like to ask you questions about auto spray painters who seek medical services in this hospital (or clinic). The questions mainly will be about health seeking behavior, common disease symptoms among automotive spray painters from this area and advice and /or referrals they are given. The interview will take fifteen to twenty five minutes.
Interview questions

1. Among the patients you treat in this hospital/clinic, are there some who identify themselves as automotive spray painters?

2. What are the common disease symptoms do they complain about, or signs do you observe/diagnose?

3. After taking their medical history and duration in their occupation, when do these symptoms seems to have started?

4. Do you associate their disease symptom to their occupation?

5. Have you discussed with them or advised them on personal protection equipment use while carrying out their work?

6. After treatment, do they come back, once or severally with the same complaint?

7. Due to severity and/or chronic nature of their disease symptoms, have you advised them to stop their work temporarily or change their occupation?

8. For those you advice to stop work temporarily, what is their condition after this period?

9. What further advice or referrals do you give to them, especially those severely affected and/chronically ill?
APPENDIX IV

KEY INFORMANT INTERVIEW GUIDE TO GARAGE OWNERS

Introduction

My name is Agnes Mwatu; I am a student at Kenyatta University, school of Health Sciences. I am undertaking a Master degree in Public Health. I’m carrying out a research on health hazards associated with spray painting in small scale informal (Jua kali) auto garages in Embakasi division. To be authorized to carry out this research, I have a research permit (Research Permit No. NCST/RRI/12/1/MAS/80), issued on 05/05/2010), a letter from National Council of Science and Technology (Appendix VII) and an introductory letter from District Commissioner, Embakasi District (Appendix VIII) [All these documents are produced and shown to the garage owner]

I would like to interview you about your workers’ health challenges associated with their occupation, particularly absenteeism due to sickness, turnover of spray painters due sickness and especially respiratory and dermatitis diseases that seem to arise from their spray painting activities. You can also give any other information about their health that you may be able and willing to share. The interview will take about fifteen to twenty five minutes
Interview questions

1. Workers’ ill health record and effect of spray painting activities

(a) After how many years (approximate) of spray painting work do spray painters start experiencing disease symptoms in this questionnaire (I read the list of disease symptoms from the questionnaire)?

(b) Do you have spray painters in your garage who constantly become sick after spray painting activities?

(c) Are there spray painters in your garage who become too ill to carry out their daily work after spray painting for continues period of time?

(d) Are the disease symptoms, to best of your knowledge similar to the ones in the questionnaire?

2. Personal protective equipment and health hazards associated with auto spray painting

(a) Do you link their ill health to their occupation?

(b) What advice do you give them about personal protection, and what are their reaction and behavior towards personal protective equipment?

(c) In your own opinion, do you think personal protective equipment is effective when used properly?
3. Absenteeism due to ill health and employees turnover

(a) Approximately, how many days do spray painters miss work after continues spray painting for a week (A week is an absolute time and any period of time could have been chosen)?

(b) Are there spray painters in your garage who become too ill to carry out their daily work after spray painting for continues period of time?

(c) Are there spray painters in your garage who leave work due to ill health associated with their occupation?
APPENDIX V

PROPORTION OF DISEASE SYMPTOMS SUFFERED BY SPRAY PAINTERS IN THE STUDY

![Pie chart showing the proportion of disease symptoms suffered by spray painters in the study.](image)
APPENDIX VI

PROPORTION OF SPRAY PAINTERS SUFFERING FROM DIFFERENT DISEASE SYMPTOMS IN THE STUDY

![Graph showing the proportion of spray painters suffering from different disease symptoms.](image-url)
APPENDIX VII

AUTHORITY FROM MINISTRY OF EDUCATION

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telephones: SCIENCE TECHNO, Nairobi
Telephone: 254-020-243499, 2213182
254-020-310571, 2213122
Fax: 254-020-3223125, 318245, 318249
When replying please quote

Our Ref: NCST/RR/1/12/1/MAS/80/4

Agnes Mwatu
Kenyatta University
P. O. Box 43844
NAIROBI

Date: 6th May 2010

Dear Madam,

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on “Health Hazards associated with spray painting among Workers in Small Scale Auto Garages in Embakasi Division, Nairobi, Kenya.” I am pleased to inform you that you have been authorized to undertake research in Embakasi District for a period ending 30th August, 2010.

You are advised to report to the Provincial Director of Public Health Nairobi Province, District Commissioner Embakasi District, before embarking on the research project.

On completion of the research, you are expected to submit two copies of the research report/thesis to our office.

P. N. NYAKUNDI
FOR: SECRETARY/CEO

Copy to:

Provincial Director of Public Health
Nairobi Province

District Commissioner
Embakasi District
APPENDIX VIII

AUTHORITY FROM OFFICE OF THE PRESIDENT

OFFICE OF THE PRESIDENT
PROVINCIAL ADMINISTRATION

Telegrams: ......................
Telephone: Nairobi 340454,341666
When replying please quote

Ref: EMB/EDU.10/7/8

DISTRICT COMMISSIONER
EMBAKASI DISTRICT
P.O. BOX 30124-00100
NAIROBI

12th May, 2010

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION
AGNES MWATU

The above mentioned who is a student from Kenyatta University has been authorized to carry out a research on "Health Hazards Associated with spray painting among workers in small scale Auto Garages in Embakasi District."

Any assistance accorded to her is highly appreciated.

PK MBUGI
DISTRICT COMMISSIONER
EMBAKASI DISTRICT
APPENDIX IX

QUESTIONNAIRE

The purpose of this questionnaire is to collect data on occupational health and safety for spray painters in small-scale motor garages. This is part of my Masters of Science (MSc) degree course in Public Health (MPH) at Kenyatta University. The information collected, when documented and analyzed will help the current auto spray painters and the relevant authorities to make informed decisions. I am therefore requesting, you to fill this questionnaire as honestly and factually as possible.

Please select the appropriate statement by ticking (√)

SECTION A: DEMOGRAPHIC INFORMATION

1. Sex of the respondent:
   a) Male    b) Female

2. Marital status:
   a) Single b) Married c) Separated

3. Age in years…………….…

4. Level of education:
   a) Informal education b) Primary c) Secondary d) Tertiary (middle level colleges and university)
SECTION B: EMPLOYMENT INFORMATION

1. Duration in current employment in years:

   i) ......................... Months ii) .............. Years

   (If less than 5 years, specify where else have you been working before)

   (i) ..........................................................

   (ii) ..........................................................

2. What is your position in the employment?

   a) Employer/Owner

   b) Supervisor/Foreman

   c) Unpaid family worker

   d) Paid worker

3. What is your main work activity?

   a) Removing old paint from cars and painting

   b) Spray painting only

   c) Supervising the old paint removal and the spray-painting

4. How many days per week on average do you work....................

5. On average how many hours do you work per day? (E.g. if one day you work
   for 10 hrs and the other for 4 hrs, the average is 7 hrs)

   i) For old paint removal.................................
ii) For spray painting…………………………

iii) Other painting work (Brush and Roller methods, etc)…………………..

SECTION C: AMOUNT OF PAINT USED

1. What is the main type of paint used?

   a) Fillers   b) Undercoat   c) Auto refinishing (top coat) (d) Clear vanish

2. What different types of automobile do you work on?

   a) All vehicles   b) Cars   c) Cars and all matatus   d) Lorries

   e) Others (specify)…………………………………………………..

3. How much paint is used per week on average in litres?

   i) Fillers: .................................

   ii) Undercoat: ..............................

   iii) Auto refinishing (topcoat) ..........

   iv) Clear varnish ............................

SECTION D: APPLICATION METHODS USED

1. What application methods do you use?

   (i) Manual a) Rollers only b) Spray guns only c) Brushes d) any combination of the three
Methods above

(ii) Motorized a) Rollers b) Spray guns c) Any other method

(iii) All the two types of methods above

Note: If spray guns are used, are they air-assisted type, airless type or any other type?

Please specify..........................

(iv) Any other type of application method, specify..................

SECTION E: ILL HEALTH SYMPTOMS SUFFERED DUE TO PAINT EXPOSURE

The questions in this section unless otherwise specified, apply to ill-health symptoms experienced due to exposure within the past 12 months.

1. Have you experienced any of the following health problems in the last 12 months?
   (tick more than one if applicable)

   a) Dry cough  b) productive cough  c) breathlessness  d) wheezing of the chest  e) Sore throated  f) runny nose  g) irritating eyes

2. Do you often cough for 3 consecutive months?

   a) Yes  b) No
3. How many times have you suffered from coughing after painting exposure in the past 12 months………………………………….?

4. Do you ever suffer from wheezing chest after strenuous experience or work?
   a) Yes   b) No

5. Has your wheezing been severe to limit your speech?
   a) Yes   b) No

6. How often do you experience the symptoms stated in No. above?
   a) Always   b) Occasionally   c) Rarely   d) Never

7. For how many years/months have you suffered from the symptoms in No. 1 above?
   a) Months………..   b) ………..Years

8. At what time are your symptoms more severe?
   a) At night   b) at work   c) in the morning   d) at various time during the day

9. How often do your symptoms make physical activity difficult?
   a) Always b) Occasionally   c) Rarely   d) never

10. Has suffering from the above symptoms, limited your work activities?
    a) Yes   b) No

11. Have you consulted a health professional about the above problems?
    a) Yes   b) No
12. If you consulted a health professional, did the health professional suggest that you change your occupation?
   a) Yes  b) No

13. Did the health professional suggest that you stop your work temporarily?
   a) Yes  b) No

14. If No. 13 above is yes, has your condition improved after a temporary stop?
   a) Yes  b) No

15. Have you taken any medication for your problem?
   a) Yes  b) No

16. Was the medication prescribed by a health professional?
   a) Yes  b) No

17. Do you smoke?
   a) Yes  b) No

18. If No. 17 above is yes, how would you rate your smoking?
   a) Light  b) medium  c) heavy

19. Has any one else in your workplace suffered from the same symptoms?
   a) Yes  b) No

20. Does any one else in your family (who is not spray painting occupation) suffer from the same symptoms?
21. In your own opinion, do you associate your ill health to your occupation?
   a) Yes   b) No

22. If yes, explain how you associate it…………………………… ………..

23. If you associate your ill health to your work environment layout and safety, what changes would you recommend?

SECTION F: WORK LAYOUT AND SAFETY MEASURES USED

1. Where do you out carry your work activity?
   a) In an open space (outside)
   b) Indoors
   c) Use a spray booth
   d) Any other (specify)…………………………..

2. Do you use any personal protective equipment (e.g. masks and gloves)?
   a) Yes   b) No

3. When you use the personal protective equipment, does it make any difference in the symptoms mentioned in section E (1)

4. From number 3 above, how would you rate personal protective equipment?
   a) Very effective
   b) Effective
c) Not very effective

d) Very poor

e) No different at all

OBSERVATIONAL CHECKLIST

1. Wearing of personal protective equipment.
   a) Yes  b) No

2. State how many of them (e.g. gloves, overcoat, safety shoes, headgear any other) .................................................................

3. State of personal protective equipment (e.g. new, old but in good state and clean, torn and in tartars, either of the above but not covering all the exposed areas of the body, etc) .................................................................

3. Presence of dermatitis (inflammation and sores) on the exposed areas of the body
   a) Yes  b) No