An-Najah National University

Faculty of Graduate Studies

Evaluation of Darkroom Disease Symptoms among Radiographers in the West Bank Hospitals, Palestine.

By

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This Thesis is submitted in partial Fulfillment of the Requirements for the Degree of Master in Public Health, Faculty of Graduate Studies, An-Najah National University, Nablus, Palestine.

2013

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Dedication

I dedicate this dissertation to the soul of my beloved late father; Mahmoud, may GOD let him rest in mercy and peace and to my mother …

To my darling wife; Hanan,

To my cherished daughter; Noor,

To my precious sons; Baraa', Malik and Anas,

To my well-regarded sisters and brothers, and

To those who treasured Palestine as a home land.

Yaser Mahmoud Anis Nazzal

Acknowledgments

Thank you GOD for the opportunity to learn…

First and foremost, I would like to offer all the praises and glory to our GOD Almighty. His inspiring words and steadfast love and mercy are lamps and lights to my path that guide me from the conception until the giving of birth to this study.

To complete a research like this, several minds are essential. But God sent people who have been very helpful and instrumental in the accomplishment of this study. I am forever grateful to those people who have supported and encouraged me along the way.

I would like to express my sincere gratitude to my supervisor, Dr. Hamzeh AL Zabadi for his faith in me, his unwavering support, wisdom, and great guidance throughout this study. Thank him for coordinating and walking me through the process and offered a lot of opportunities and achievements in my personal and professional life and who taught me the importance of perseverance and patience to accomplish target goals in my life.

I would like to express my heartfelt appreciation to my teachers in the Public Health program at the University of An-Najah for teaching me Public Health. Thank them for making me better in different ways.

Several colleagues made special contributions to this work and the researcher gratefully acknowledges their assistance. To all my colleagues in the health profession. My sincere gratitude goes to people who lent a helping hand to me in data collection.

My thanks also would go to the members of the Palestinian Medical Imaging Association (PMIA) for their participation and cooperation. Many thanks to the nurses Association. I would like also to thank all participants in this study, thank you a lot for the precious time you gave me.

My full love goes to all my sisters and brothers for their support, love and permanent caring, their encouragement was my motivation.

Finally, I must gratefully acknowledge the help and support of my gorgeous wife, Hanan, whom I owe my deepest gratitude for caring, patience and inspiring; you were a pillar of strength and comfort, also my children, Baraa', Malik, Anas and Noor, who have encouraged me to write, study, even though it has resulted in them undertaking additional family responsibilities.

إقـــــرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Evaluation of Darkroom Disease Symptoms among Radiographers in the West Bank Hospitals, Palestine.

اقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء ما تمت الإشـــارة إليه حيثما ورد، وأن هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name: **اسم الطالب:**

Signature: **التوقيع:**

Date: **التاريخ:**

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List of Abbreviations

CI	Confidence Interval
GS	Gaza Strip
IRB	Institutional Review Board
PMIA	Palestinian Medical Imaging Association
ppm	parts per million
SO_2	Sulphur dioxide
TLV	Threshold Limit Value
U.K	United Kingdom
WHO	World Health Organization
BSR	British Society of Radiographers

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Abstract

Background: Radiographers are exposed to certain chemicals when using chemical solutions which might lead to some health adverse effects. Nevertheless, radiographers report many unexplained work related symptoms attributed to "darkroom disease symptoms". The aim of the present study was to assess the prevalence of occupationally-related darkroom disease symptoms among male radiographers compared to male nurses in West Bank hospitals.

Materials and Methods: A cross sectional study was conducted on a non-random purposive sample of male radiographers and nurses using a previously validated and standardized face-to-face questionnaire. The study was conducted in the governmental and non-governmental hospitals in the West Bank. Those with physician diagnosed asthma before starting their current occupation were excluded.

Results: We were able to recruit 572 male participants from both groups. The radiographers were 330 subjects (57.7% of all population) while nurses were 242 (42.3% of all population). Data analysis showed both groups aged between (36-43) years old (28%). There were no statistically significant

differences between radiographers and nurses regarding age and marital status (P values > 0.05). Furthermore, the differences in the reported prevalence of symptoms among radiographers showed a statistically significant higher proportion for each reported symptom compared to nurses (P-values=0.001). The most significant symptoms measured in the radiographers were headache (75.8%), sneezing/nose itchy (70.9%), irritation of throat (69.1%), and chemical taste (61.2%).

In multivariate linear regression analysis, monthly income was a significant predictor for the mean number of symptoms with a positive association among radiographers [P-value, B (95%CI)] [0.001, 2.35 (0.96-3.74)]. Furthermore, living in a village [0.03, 1.15 (0.12-2.19)], reporting living in an industrial area (yes) [0.03, 5.63 (3.39-7.86)]. Regarding occupational factors, staying more than 30 minutes in the darkroom per shift was associated with a significant increase in the mean number of reported symptoms [0.001, 3.28 (2.06-4.51)]. However, the availability of a ventilating machine in the darkroom showed a strong negative association with the mean number of reported symptoms [0.001, -1.98 (-3.05- -0.91)].

Conclusions: Radiographers showed an increase in the prevalence of certain symptoms representing the darkroom disease. Developing clear diagnostic criteria, educating radiology workers about potential hazards and prevention techniques should form a crucial constituent of their training.

We recommend further future studies in the Palestinian hospital X-rays departments in order to correlate the reported symptoms with the exposed chemicals more appropriately. We also recommend following radiographic workers in the future to provide further understanding to the role played by darkrooms and their chemicals in the etiology of these symptoms.

Chapter One
Introduction

1.1 Background

Chemicals have become part of life. In the workplace, if not properly used, they might endanger health and poison the environment **(Kolarzyk et al., 2000)**. Extensive use of x-ray processing chemistry on a world-wide basis has raised professional concerns regarding darkroom disease symptoms that are reported by medical imaging personnel and experienced when being exposed to film processing chemicals **(Glass, 1997; Genton, 1999; Sanches, 1999)**.

Darkroom disease symptoms are a variety of chemical reactions reported by medical imaging personnel. Symptoms include; headaches, skin rashes, shortness of breath, mouth ulcers, unusual heart rhythms, painful joints, runny/stuffy nose and nausea **(Spicer et al., 1986).**

X-rays could create a latent image on the film surface by reducing the silver halide crystals to elemental silver then the image is amplified and stabilized during the development process using agents such as hydroquinone. The image is fixed by agents, which dissolve and remove the unused silver halides **(Carlton and Adler, 2001).** Automated x-ray film processing machines achieve short development times by using elevated temperatures (28-35°C), by including glutaraldehyde as a hardening agent within the developer solution, and by actively drying the fixed and washed film with heated air **(Hewitt, 1993).**

This process of radiographic film development might therefore induce potential exposures to hydroquinone, glutaraldehyde, formaldehyde, glycols, acetic acid, sodium sulphite, sulfur dioxide (SO_2), ammonium chloride, silver compounds and other chemicals **(Teschke et al., 2000)**. Exposure to glutaraldehyde has been believed to be the main responsible factor for the increased risk of darkroom disease symptoms **(Leacy and Brennan, 2002)**.

During manual film processing, cleaning of the internal components of the film processor or during the normal processing procedures, radiographers might be exposed to the above mentioned chemicals through either direct or indirect skin contact, fumes inhalation or via ingestion. Therefore, this exposure in such an occupational setting is complex and implies multiple chemicals. Consequently, it is not appropriate to assess the exposure to a single chemical as the outcomes could be related to the overall synergistic and pharmacokinetics interactions between these chemicals in the human body. Worldwide, few studies have been conducted on the radiographers in order to clarify the link between their exposures and the workplace related symptoms **(Chessor and Svirchev, 1997)**.

The darkroom disease symptoms are similar to those of individuals exposed to sulphur dioxide fumes in the mining and allied occupations **(Smith et al., 1977; Rom et al., 1986; Kolarzyk et al., 2000)**. Until 1997, no known studies on radiographers had clarified a link between their exposures and these symptoms. Later on, studies on the radiographic

personnel conducted to assess the occupational risks of the fumes had revealed that most of those workers were not fully-aware of such risks **(Spicer et al., 1986: Genton, 1998)**.

1.2 Study justification and problem statement

Radiographers are exposed on a daily-basis to multiple chemicals in their workplace settings. Dependently, the occupational environment for the radiographic personnel might involve unsafe and unhealthy exposures. They could in turn experience a significant health hazard which is represented at the end by the darkroom disease symptoms among other occupationally-related diseases. In Palestine, there is no known legislation that covers the risks of occupationally-related diseases resulted from this type of health hazard, neither are there any available data on morbidity rates that evaluate the prevalence of darkroom disease symptoms in the x-ray processing rooms. As an expected outcome, this study will identify the main adverse health outcomes and this would aid in assisting the authorities responsible for controlling occupational hazards to make necessary decisions for implementation of effective protocols on handling hazardous chemicals, and developing the darkroom health and safety checklist to be used in the Palestinian radiology departments. It would further help in creating awareness about occupational hazards posed by processing chemicals among the radiographic workers and among the Palestinian population as well. Also, the results of this study will improve our understanding in a way that might help overcome the limitations of environmental exposure assessment in such a very complex occupational setting. This study will increase our knowledge regarding total exposure to complex mixtures of toxic chemicals along different pathways (lung, skin

and gastrointestinal routes of exposure) and their associated adverse health effects.

1.3 Goal of the study

To decrease the morbidity of darkroom disease among the radiographers in the Palestinian hospitals.

1.4 Aim of the study

To assess the prevalence of occupationally-related darkroom disease symptoms among the radiographers (exposed group) compared to the nurses (non-exposed group) in the West Bank hospitals in order to implement preventive measures for the control of this occupationally-related disease.

1.5 Objectives of the study

1.5.1 General objective:

To study if the exposed radiographers present prevalence of darkroom disease symptoms compared to the control group (hospitals' nurses).

1.5.2 Specific objectives

1. To study the relationship between darkroom disease symptoms and some occupational factors and darkroom design conditions (e.g., years of experience, daily worked hours, period of stay in darkroom per shift and availability of ventilating machine, availability of a window and double door) among radiographers.

2. To examine the association between darkroom disease symptoms and other independent variables like socio-demographic factors, smoking history and other exposure variables (e.g., living in an industrial area) among radiographers.

1.6 Thesis overview

The thesis consists of five chapters. Chapter 1, “Introduction”, includes the background information for this particular area of research. Chapter 2 “Literature review”, reviews the relevant literature. Chapter 3, “Materials and methods”, describes the study setting, population and sample. Also it describes the tools for data collection and analysis. Chapter 4, “Results”, presents the study results. While chapter 5, “Discussion”, evaluates our study findings and results. It also gathers information from all the results and presents future insights for further work and research. Finally, the study questionnaire with other different appendices at the end of this thesis, provide summaries related to this work which were essential parts of it including permissions to conduct the study.

1.7 Summary

This introductory chapter provided a synopsis about the importance of assessing the prevalence of occupationally-related darkroom disease symptoms among the medical imaging personnel (radiographers; exposed group) compared to the nurses (non-exposed group) in the Palestinian hospitals in the West Bank. This chapter included background information

about the significance and justification of the study. The overall goal, aim, general and specific objectives were also stated. It also described in a general overview the thesis's chapters and contents.

Chapter Two

Literature review

2.1 Introduction

Staffs in radiology departments are exposed to processing chemical fumes, but there are no accessible statistics on morbidity and mortality in Palestine neither are there regulations in place to ensure that regular measurements are done on the fume levels of the processing chemistry. However, each department should have protocols on handling of hazardous chemicals to reduce the potential of constantly increasing work-related diseases associated with exposure to fumes.

This chapter reviews national and international studies conducted in the area of assessment of the prevalence of occupationally-related darkroom disease symptoms and their associated workplace factors among the radiographers. A comprehensive search was employed to cover theoretical and research work related to the study concepts. Also, this chapter outlines the risks associated with the use of processing chemistry, darkroom disease and the importance of health and safety measures related to this issue. It then highlights the literature related to symptoms associated with the darkroom disease.

2.2 Hazards in processing chemicals in the darkrooms

Handling out chemistry is a vital part of an x-ray department. The risks of x-ray processing chemistry have been brought to the face in many developed countries **(Spicer and Gordon, 1994)**. Side-effects of gases put the personnel at risk in poorly ventilated areas. One example of these gases is sulfur dioxide. Chemicals can go through the body by the person inhaling or swallowing the substance and/or by skin contact. All three routes of exposure are apparent in diagnostic imaging departments **(NIOSH Pocket Guide, 2005)**. Therefore, staff working in darkrooms handle chemicals, breathe in the chemistry fumes and handle hardcopies of radiographs (x-rays). The risks of chemical exposures are not isolated to darkroom personnel but include any person who comes directly or indirectly into contact with the processing chemistry and/or its spin-off fumes which travel in the air and therefore can be inhaled by persons in nearness to darkrooms, or even in nearby rooms, wards, and waiting areas. Persons at high risks are those who spend long periods in diagnostic imaging departments **(Teschke et al., 2000)**.

2.3 Previous studies on darkroom disease characterization

2.3.1 Local studies:

A study that investigated possible effects of film processing in darkroom on respiratory functions and hematological and biochemical parameters of radiographers as compared to a control group of physiotherapists was

conducted in Gaza, Palestine in 2008. Seventy-six (76) medical radiographers and ninety-one (91) physiotherapists responded to participate in the study. This study revealed significant and worse deviations in health status of medical imaging technologists (health complains, spirometric measurements, platelets count, serum Immunoglobulin E) as compared to control group. All other health complains showed higher percentages in radiographic personnel as compared to physiotherapists. Also significant correlations were reported between the evaluation variables of health status and years of experience of radiographers and number of weekly processing hours at darkrooms. Unawareness of medical radiographers, poor structural designs together with operational deficiencies of ventilation were foremost factors of radiography departments. The most predominant health complain addressed by the medical radiographers were discomfort breathing in closed/smoky/dusty rooms (98.7%), recurrent headache (78.9%), difficulties in nose breathing (73.3%), wake up symptoms (68.4%), intermittent sleep (65.8%), eye symptoms (65.8%) and sneezing during working hours (63.2%). The majority of radiographers (82.9%) mentioned the inapplicability of safety measures in darkrooms, deficiency of quality control measures for darkroom processing (80.3%), lack of effective departmental ventilation system (73.7%), lack of special darkroom ventilation system (78.9%); absence of local exhaust for waste fumes (90.8%) **(Al Ajerami and Sirdah, 2008)**.

2.3.2 International studies:

Sulphur dioxide (SO_2) is one of the most important compositions and is known as an acid gas. It reacts with water to form sulphurous acid which may react further to form sulphuric acid. These acids are formed when SO_2 comes into contact with moist membranes in the eyes or respiratory tract after inhalation leading to irritation characteristics **(Teschke et al., 2000; NIOSH Pocket Guide, 2005)**.

SO_2 is an irritant of the upper respiratory tract and eyes. Conjunctivitis, corneal burns, and corneal opacity may occur from direct contact with high concentrations of SO_2. Death from respiratory arrest may occur from acute over-exposure, while survivors may develop bronchitis, bronchopneumonia and fibrosing obliterative bronchiolitis. Radiographic personnel involved in developing and fixing films have a potential exposure to processing chemicals including sensitizers and irritants, such as glutaraldehyde, formaldehyde, SO_2, and acetic acid **(Gordon, 1985; Scobbie et al., 1996; Teschke et al., 2000)**.

The reagents in the developer and fixer solutions according to various manufacturers' specifications are listed in Table 2.1 **(Eastman Kodak, 1993)**.

Table 2.1: Reagents in developer and fixer solutions

Developer	Fixer
Acetic acid	Acetic acid, Aluminum chloride
Carbonates (potassium, sodium)	Aluminum sulphate
Glutaraldehyde (sometimes as bi-sodium sulphite)	Ammonium
Glycols (diethylene, triethylene)	Thiosulphate
Hydroquinone	Boric acid
5-nitroindazole	Citric acid
1-phenyl-3-pyramzolidone	Gluconic acid
Potassium acetate	Sodium acetate
Potassium hydroxide	Sodium bisulphite
Potassium sulphite	Sodium sulphite
Sodium sulphite	Sodium thiosulphite

Darkroom disease (DD) is a term used to describe unexpected multiple symptoms attributed by radiographic personnel to their work environment **(Tarlo et al., 2004)**. According to Smedley et al. **(Smedley et al.,1996)** symptoms recorded include:

- Headaches,
- Shortness of breath,
- Lip sores/mouth ulcers,
- Unusual numbness of extremities,
- Unusual heart beating,
- Irritation of the throat,
- Runny/stuffy nose and nausea.

Initial information on darkroom disease was brought to the attention of radiology workers due to the work of Majorie Gordon, a New Zealand radiographer who was forced to give up her clinical career in 1983 because

she became severely sensitized to x-ray processing chemicals. Her main symptoms were tachycardia, hoarseness and extreme fatigue. While visiting Agfa Gevaert plant in Belgium, she learned that if the factory workers suffered any signs of respiratory illness they were immediately transferred away from chemical sources. Gordon devoted herself to raising awareness about the safety use of processing chemicals **(Genton, 1998).**

Gordon study highlighted the potential threat to the health of radiology workers constantly exposed to x-ray processing chemicals and reported chest findings in three radiographers and one radiologist, including chest pain with loss of consciousness, arrhythmia, tachycardia and recurring chest infections and lymphoma **(Gordon, 1987).**

Besides, Fisher (1981) published the first report of allergic contact dermatitis in a radiologist and a technician due to handling films containing glutaraldehyde. Quite the opposite to the above arguments, Frielander et al., (1982) performed an epidemiological investigation of a 1964 cohort of 478 photographic processors in nine East Kodak Colour Print and Processing Laboratories in the United States of America. The findings of the study showed no significant excess mortality, sickness-absence or cancer incidence in people working in the processing laboratories. However, in 1986, Kipen et al., researched the respiratory abnormalities among three photographic developers who were responsible for processing the x-ray films and who spent approximately five hours in these laboratories, one had worked for two years in a cardiac catheterization

laboratory and who experienced headaches, tiredness, nasal hyper secretion, sore throat, nausea and two episodes of severe left chest pain. Recognizing the individual irritant potential of acetic acid, SO_2, formaldehyde and hydroquinone, the authors suggested that although the air levels of each individual chemical might be below the threshold limit value (TLV), the impact of exposure to combinations may result in adverse effects at levels that would be endurable if exposure were only to a single compound.

Furthermore, Norback, 1988, compared a group of 39 workers exposed to glutaraldehyde compared to an unexposed group of 68 workers. The study revealed irritative skin and airway effects and headache occurring at glutaraldehyde exposure levels that were far below the present Swedish short term occupational exposure limit of 0.05 ppm. Norback advised that those with a history of rhinitis, asthma and allergic dermatitis should avoid contact with the solution or vapor.

The British Society of Radiographers (1991), carried out a survey on 2,804 of their respondents. Nearly, 39% of respondents reporting the following symptoms in descending order of frequency, headaches, sore throat/hoarseness, unexpected fatigue, sore eyes, chemical taste, sinus problems/nasal discharge, persistent cold-like symptoms, catarrh, painful joints, mouth ulcers, skin rash and chest pain/breathing difficulties.

Tarlo et al. (2004) reported similar symptoms for their survey. They indicated the following symptoms as most commonly reported in order of frequency; headache, nasal symptoms, eye symptoms and sore throat. Smedley et al., (1996) in the United Kingdom (UK), examined the health surveillance of employees exposed to respiratory sensitizing agents including x-ray departments. They found that many departments had no written policies and that only a minority of departments had made arrangements for communicating the collective results of screening to employees. In another study, Smedley et al., (1996) determined the prevalence of symptoms among radiology workers compared with a control group of physiotherapists. They found work-related symptoms suggesting irritation of the eyes and upper airways to be more common in the radiology workers than physiotherapists and that follow-up assessment would be required to assess the prevalence of occupational asthma in the radiology workers.

Dimich et al. (2003) pointed out through a mailout questionnaire survey and a small subset underwent spirometry and methacholine challenge testing that radiographers had a higher prevalence of most symptoms, with an extreme odds ratio of 11:4 for chemical taste. The percentage of radiographers with non-specific bronchial hyperresponsiveness was 3 times higher than that of physiotherapists, although the comparison was not

statistically significant. Reporting inadequate ventilation, frequently detecting the odor of X-ray processing chemicals and cleaning up spills within the past 12 months were highly associated with most of the symptoms. Conclusions suggested that differences in the prevalence of symptoms represent a complex process, both in exposure and response to the many components found in radiographic processing chemicals. Objective testing of health outcomes and more refined exposure measurements are recommended to further investigate occupational health problems of radiographers.

Non-controlled studies performed in New Zealand and the UK in the year 2000 reported a high incidence of a large number of symptoms within radiographers. The authors of these investigations proposed that these symptoms resulted from exposure to X-ray processing chemicals and the associated fumes. Forty percent of radiographers (n=295) and 40% of physiotherapists (n=250) working in 34% of Irish hospitals (n=31) were asked if they experienced any of the 15 symptoms described in darkroom disease. The results demonstrated that radiographers had a significantly higher incidence than physiotherapists for only two of the symptoms--bad taste ($P< 0.0001$) and sore eyes ($P< 0.001$). These higher incidences were confined to three of the 31 hospitals surveyed. Physiotherapists expressed a higher incidence for sore throats ($P< 0.01$) and nasal discharge ($P< 0.01$).

These results clearly demonstrate that radiographers are no more symptomatic than a group of hospital staff not exposed to processing chemicals.

Liss et al., in their study conducted in 2003, determined the prevalence of asthma and work related respiratory symptoms among radiographic personnel compared with physiotherapists, and identified work related factors in the darkroom environment that are associated with these outcomes. They undertook a questionnaire mail survey of the radiographic personnel and physiotherapists in Ontario, Canada, to ascertain the prevalence of physician diagnosed asthma and information on exposure factors such as ventilation conditions, processor leaks, cleanup activities, and use of personal protective equipment. The prevalence of new onset asthma (since starting in the profession) was greater among never smoking radiographers than physiotherapists (6.4% Vs 3.95%). Among the radiographers, respiratory symptoms were associated with a number of workplace and exposure factors likely to generate aerosol or chemical exposures such as processors not having local ventilation, adjusted OR 2.0 (1.4 to 3.0). Conclusions suggested an increase of work related asthma and respiratory symptoms shown to denote asthma among radiographers, which is consistent with previous surveys previously mentioned in this chapter.

The mechanism is not known but appears to be linked with workplace factors and may involve a role for irritant exposures.

Teschke et al. (2002), in a study in British Columbia, Canada, radiographers' personal exposures to glutaraldehyde (a constituent of the developer chemistry), acetic acid (a constituent of the fixer chemistry), and sulfur dioxide (present in both developer and fixer solutions) were measured. Local exhaust ventilation of the processing machines and use of silver recovery units lowered exposures, whereas the number of films processed per machine and the time spent near the machines increased exposures. Private clinics were less likely to have local exhaust ventilation and silver recovery units. Their radiographers spent more time in the processor areas and processed more films per machine. Developments in digital imaging technology are making available options that do not involve wet-processing of photographic film and therefore could eliminate the use of developer and fixer chemicals altogether.

In a descriptive-analytical study done in Iran (2007), Kakooei et al., aimed to measure fixer and developer components levels inside wet x-ray processing areas in a developing country and comparing data with those in developed countries. The results showed that the Iranian radiographers full-shift exposures are generally lower than the American Conference of Governmental Industrial Hygienists (ACGIH) recommended levels.

Identification of these key exposure determinants is useful in targeting exposure evaluation and controls to reduce developer and fixer chemicals exposures in the radiology departments.

Tarlo et al. (2004), determined in their mail survey study the prevalence of symptom clusters similar to other unexplained syndromes among the radiographers as compared with physiotherapists in Ontario, Canada, and identifies associated work-related factors. Symptom cluster includes abnormal tiredness as well as work-related headaches, and symptoms suggestive of eye, nasal, and throat irritation. Criteria for darkroom disease were met by 7.8% of 1,483 radiographers and 1.8% of 1,545 the physiotherapists [odds ratio, OR 4.8 (confidence interval, CI 3.1-7.5); ($P < 0.0001$)]. Both professions demonstrated significant associations between responses reflecting psychosocial stressors and darkroom disease. Those with this symptom cluster were more likely to report additional symptoms than those without, and the radiographers with darkroom disease symptoms reported significantly more workplace chemical exposures. Results suggest overload symptoms consistent with darkroom disease among radiographers versus physiotherapist, and there were associations among those meeting the definition of darkroom disease with self-reported irritant exposures and psychosocial stress factors. Leacy and Bernnan, (2002), in a controlled comparing study, questioned the link of the darkroom disease symptoms

with processing chemicals with the aim to investigate if the hospital environment is a contributing factor for the darkroom disease symptoms. Fifty percent of radiographers from two Dublin hospitals were compared with 50% of private practice physiotherapists working in the same geographical areas of Dublin. Respondents were asked to identify, by means of a questionnaire, any of 15 darkroom disease symptoms from which they suffer and any factors that may relate to this symptom prevalence. Results demonstrated that radiographers had suffered more from bad taste (P=0.0124), sinusitis (P=0.0008) and catarrh (P=0.0477) compared with physiotherapists. For these symptoms, certain high-risk groups have been identified in this work such as those with respiratory disorders and smokers. The results suggested that radiographers and private practice physiotherapists, with the exception of the three significant symptoms, suffer to the same extent, and the need for further work involving larger numbers of radiographers to confirm current findings. Baylis et al., (2000), in their retrospective cohort design used an interviewer administered questionnaire to determine the occurrence of symptoms associated with darkroom disease (headache, sore throat/hoarseness, unexpected fatigue, sore eyes, chemical taste in the mouth, sinus problems/nasal discharge, painful joints, oral ulcers, skin rash, chest pain/ breathing difficulty and arrhythmia/tachycardia) in

radiographers in Trinidad and Tobago when compared with an age and gender matched control group which consisted of a convenient sample of a clerical staff. A total of 104 participants of equal numbers of radiographers and the control group were interviewed. Results denoted that there was a significantly higher occurrence of sinus problems/nasal discharge (p=0.0018), sore throat/ hoarseness (p=0.0001) unexpected fatigue (p=0.0066), chemical taste (p=0.0008), irregular heartbeat (p=0.02), and skin rash (p=0.0273) among radiographers and concluded that radiographers in Trinidad and Tobago exhibit symptoms associated with darkroom disease.

Gary et al. (2001), conducted a questionnaire survey to ascertain, among the radiographers as compared with a control group of physiotherapists, the prevalence of asthma, respiratory and other symptoms and chemical sensitivities. Responses were analyzed among 862 radiographers and 621 physiotherapists who never smoked. New asthma since starting work was higher among radiographers (7.6% vs. 4.7%). Respiratory symptoms were higher among radiographers: associations with work-related symptoms were stronger. Radiographers reported more frequently having symptoms (possibly associated with "darkroom disease"), including sore throat OR 1.8 (1.1-2.8), headache 1.9 (1.5-2.4), numbness of hands 2.1 (1.3-3.3), and chemical taste 6.7 (3.3-13.7). These findings suggest that the etiology for

new onset asthma and symptoms among radiographers may be work-related, but do not indicate that those working in darkrooms are more likely to have responses consistent with chemical sensitivities.

2.4 Safety measures for the darkroom hazards

While the hazards of processing chemistry are well documented in the literature and, given the importance that the WHO places on safety in the working environment, safety defensive measures are however not operative in darkrooms in Palestine. There is a lack of information of darkroom disease amongst Palestinian radiographers. Perhaps this is because most of the studies were done in developed countries. Hewitt. (1993) denoted that the most common problem was lack of understanding of risk associated with chemical exposures, and slow and often-inappropriate responses to reported problems such as poor ventilation or no extractor fans and protective clothing in the darkroom. According to Teschke et al., (2002), preventative measures include adequate ventilation, use of protective gear when handling chemicals, a safe and healthy environment with ongoing monitoring practices.

Therefore, we can conclude that the potential hazards and preventative measures should be an essential part of the radiographers' duty in the workplace. For example, a functioning health and safety committee that

conducts regular inspections of processing areas could be of importance to each imaging department. Consequently, much emphasis has been placed on reducing the hazards associated with the processing chemicals by the WHO and collaborative role-players, such as International labor organization and National Institute for Occupational Safety and Health. Manufacturers of chemicals have been constantly searching for less toxic alternatives, lower temperatures are employed for developing and fixer processes **(Eastman Kodak, 1993).** Chemical packaging and departmental warning notices increasingly detail the dangers of specific chemicals and the necessary treatment following excessive exposure, more regulations is apparent, such as control of substance hazardous to health regulations in the U.K. **(Brennan et al., 1996)**. More effective ventilation and extraction systems are being employed as well as propagation of studies monitoring the levels of chemical fumes in individual imaging departments is evident in most of the developed countries **(Genton, 1998; Teschke et al., 2003; Tarlo et al., 2004)**.

Eastman Kodak (1993), published several articles in response to alleged adverse health effects. They created worst-case scenarios by disconnecting room ventilation and processor exhaust ducts, but found that measured air concentrations remained below permissible exposure limits. They concluded that when used properly, Kodak x-ray processing chemicals

should not present a health or safety risk, but noted that some employees may have specific medical conditions, such as asthma or other respiratory diseases, that may require special consideration **(Genton, 1998).**

In terms of exposure to harmful chemicals, darkroom workers normally receive no training in the proper use of chemicals **(Bunting, 1987).** The greatest danger to darkroom workers is through the inhalation of powders or vapors. Individuals looking for information about safety issues in the darkroom will be disappointed. The lack of information is another reason why so many believe that the darkroom poses no danger.

Another problem is that darkroom workers are very likely to deal with premixed packaged chemicals. In addition, darkroom workers spend most of their time in the dark which could increases the risk of mistakes, accidents and acute exposure to those workers**.**

2.5 Risk management

The key to working safely with photo-processing chemicals is to understand the potential health hazards of exposure and to manage the risk to an acceptable level. Recognition and control of potential hazards begins with reading and understanding product labels and safety data sheets.

Avoiding skin contact is an important goal in darkroom safety. Neoprene gloves are particularly useful in reducing skin contact, especially in mixing

areas where more concentrated solutions are encountered. Gloves should be of sufficient thickness to prevent tears and leaks, and should be inspected and cleaned frequently-preferably thorough washing of the outer and inner surfaces with a non-alkaline hand cleaner. In addition to gloves, tongs may also be used to prevent skin contact. A protective apron, smock or lab coat should be worn in the darkroom, and frequent laundering of work clothing is desirable. Protective goggles also should be used, especially in areas where concentrated photochemicals are handled **(Kipen and Lerman, 1986)**.

If photo-processing chemicals contact the skin, the affected area should be flushed as rapidly as possible with copious amounts of water. Because materials such as developers are alkaline, washing with a non-alkaline hand cleaner (pH of 5.0 to 5.5) may aid in reducing the potential to develop dermatitis. Clothing should be changed immediately if there is any contamination with chemicals, and spills or splashes should be immediately cleaned up. Hand-washing facilities and provisions for rinsing the eyes are particularly important in the mixing and processing areas. If concentrated or glacial acetic acid is used, emergency shower facilities should be available **(Kipen and Lerman, 1986).**

Adequate ventilation is also a key factor to safety in the darkroom. The amount of ventilation required varies according to room conditions and processing chemicals. The exhaust air should be discharged outside the

building to avoid redistributing potential air contaminants. Special procedures such as toning (which involves the replacement of silver by silver sulphide, selenium or other metals), intensifying (which involves making parts of the image darker by the use of chemicals such as potassium dichromate or potassium chlorochromate) and mixing operations (where concentrated solutions or powders are handled) may require supplementary local exhaust ventilation or respiratory protection **(Kipen and Lerman, 1986)**.

Johnston and Killion in their study which was conducted in (2006), viewed the problems associated with the darkroom disease and revealed high symptomatic prevalence in radiographic personnel. The study proposed the use of stages of change model developed by James Prochaska to change attitudes among radiographers in individual departments to improve workplace safety and the use of an established health education/disease prevention model to change the attitudes of radiographers toward chemical threats.

Administrators report that implementing a safety program to address the above mentioned ailments would considerably increase a department or hospital budget. However, administrators also report that the cost of litigation, loss of productivity, and compensation outweighs the cost of a safety program. To help avoid these costs, the stages of change model is

suggested to help create a program to protect and inform the radiographers. The ultimate goal is to reduce lost production caused by missed work, lower litigation and compensation costs, and keep employees safe. With today's shortages and legal costs, an effective safety program will benefit a healthcare facility financially and protect it legally.

2.6 Summary

The above literature review offers a hasty look at the complex subject of darkroom disease. Many challenges remain, including the understanding of the biomechanics of commonly reported symptoms. As noted by Glass (1997), the problems are known globally and known to general practitioners or hospitals management or user, but it is a long process educating everyone. Even if the problems are known internationally, there is an enormous transaction to be done in developing countries in order to educate radiographic personnel.

Chapter Three

Materials and Methods

3.1 Background

This chapter entails the methodology of the study. It includes the methodological approach, research design and sample size, selection of the study population and methods of data collection. Consideration is also

given to the methods of data analysis. Ethical and administrative issues were also described in this chapter including permission for conducting the study and invitation to participants.

3.2 Study design

A cross sectional study was conducted on a sample of radiographers (exposed group) and nurses (non-exposed group).

3.3 Study population

The study population involved subjects recruited from the two professional health team members; the radiographers (exposed group; n=330) and the hospital's nurses (non-exposed group; n=242) selected from the chosen Palestinian governmental and non-governmental hospitals listed in table 3.1. As most of the medical imaging personnel are males, only male nurses were included in the study to avoid bias from gender differences. Therefore, both study populations were selected from the same occupational setting and from similar demographic category and had worked in the field since at least one year and agreed to participate. However, those with physician diagnosed asthma before their current occupation were excluded, as asthma symptoms could interfere with the study outcomes (i.e. darkroom disease symptoms).

Table 3.1: The study selected hospitals stratified by governorate, sector (governmental and non-governmental).

Governorate	Governmental hospitals	Non-governmental hospitals
Ramallah	Al-Mujamaa' Al-Tibi	Red Crescent society; Arab Medical Care; Al-Mustaqbal
Jenin	Martyer Dr. Khalil Suleiman	Al-Razi; Patient Friend Society
Tulkarm	Thabit Thabit	Al-Zakat; Red Crescent Society
Nablus	Rafedia; Al-Watani	Al-Injili; Al-Ittihad; Al-**A**rabi Al-Takhasussi
Qalqilya	Darwish Nazzal	Al-Aqsa
Salfit	Salfit	None
Jericho	Jericho	None
Bethlehm	Alhussein	None
Hebron	A'alia	Alahli

3.4 Study sample size

There are nearly (518) radiographers who currently (at the time of study) work in the x-ray departments all over the Palestinian hospitals in the West bank. Out of them, 471 are males (PMIA, 2012). A sample size of about 330 radiographers of all those met the selection criteria responded to participate. Similarly, the male nurses (n=242) responded by the same sampling method (non-random purposive sampling) from the same hospitals assuring that the selection criteria are fit and nearly equal number of male nurses and radiographers are selected from each hospital (although this was not always the case where we have selected larger number of nurses as non-exposed group due to their higher availability as health professional workers in the Palestinian hospitals). We think that the possible reasons which could have contributed to a lower number of radiographers are scheduling of the radiographic examinations, scheduling of the work shifts and vacation leave.

Based on the study type I error (α) that has been estimated up to 5% for the study and a power expectation of 80%, a sample size of 250 in each group will be sufficiently large enough to highlight the expected differences (10%) between the two study groups.

3.5 Study settings

The study was conducted in the x-ray departments in the governmental and non-governmental hospitals in the West Bank. The study was conducted within the period that extended from January 2012 to the end of March 2012.

The selected hospitals stratified by governorate and non-governmental sectors are shown in table 3.1 above. The above mentioned hospitals were chosen primarily because they have a large number of radiographers that work in these facilities in Palestine and therefore we believe that they are representative of the most Palestinian hospitals in the West Bank. Another reason is that they are accessible to the researcher.

3.6 Operational definitions

It is not within the scope of this study to define detailed means of prevention or to attempt to describe the underlying biomechanisms of DD as these important topics merit comprehensive representation.

Darkroom: A darkroom is a room that can be made completely dark to allow the processing of light sensitive photographic materials, including photographic film and photographic paper. Darkrooms have been created and used since the inception of photography in the early 19th century. Darkrooms have many various manifestations; from the initial development to the creation of prints, the darkroom process allows complete control over the medium **(http://en.wikipedia.org/wiki/Darkroom).**

Darkroom Disease (DD): Is a term used to describe an illness affecting radiology workers. It is caused by exposure to x-ray processing chemistry though the biomechanisms of this allergic-type illness**,** and, while this illness continues to pose certain diagnostic challenges, it has been linked with exposure to processing chemicals. Darkroom Disease is somewhat of a misnomer because those who do not employ a darkroom *per se*, remain exposed to automatic processor and storage tank emissions, to processing chemistry leaks, and to skin contact and off-gassing from processed film **(Genton, 1998).**

Radiology workers: This term is employed to encompass technologists, darkroom technicians rather than radiologists, and office staff who have all reported this occupational illness.

Developer and Fixer: Radiography uses two chemicals in the processing of light sensitive materials. The first chemical is called Developer. The developer detects changes in the silver salt in the emulsion of the film or paper and turns those that have been struck by light into metallic silver. The second chemical is Fixer. It fixes the film or paper so that it is no longer sensitive to light. It will dissolve the unexposed silver salt from the light sensitive emulsion while leaving the metallic silver intact. Fixer will, however, bleach the metallic silver if left in contact for a long enough period of time. Finally we wash the emulsion to remove the dissolved unexposed silver salt as well as all the fixer residue.

Film processing: Film processing is a multi-stage process involving developing, fixing, washing and replenishment. In development, the exposed grains are preferentially reduced to black metallic silver. In fixing the remaining unexposed grains are dissolved so that they can be removed from the emulsion by washing. Replenishment ensures that chemical balance is maintained with usage of the processing solutions **(http://www.e-radiography.net/radtech/f/film.htm)**.

Former smokers: Adults who have smoked at least 100 cigarettes in their lifetime, but say they currently do not smoke or quit smoking.

Nonsmokers: Adults who currently do not smoke cigarettes, including both former smokers and never smokers.

Current smokers: Adults who have smoked 100 cigarettes in their lifetime and currently smoke cigarettes every day (daily) or some days (nondaily) **(US Centers for Disease Control and Prevention, 2010)**.

Age: The age of patient (in completed years at the time of registration at health provider).

Gender: Male or female of the participant.

Marital status: In the term of legal status at the time of registration at health provider, divided into four scales; single, married, widower and divorced.

Place of residence: Place in which participant live (city, village and refugee camp).

Headache: A pain in the head being above the eyes or the ears, behind the head (occipital), or in the back of the upper neck **(MedicineNet, 2013).**

Nausea: The sensation that there is a need to vomit. It is a stomach queasiness. Nausea can be acute and short-lived, or it can be prolonged **(MedicineNet, 2013).**

Runny nose: "Stuffy nose" is a term often used to refer to obstruction to the flow of air in and out of the nose, while "runny nose" refers to a discharge (fluid) coming from the nasal passages **(MedicineNet, 2013).**

Abdominal pain: Is pain that is felt in the abdomen comes from organs within the abdomen or organs adjacent to the abdomen **(MedicineNet, 2013).**

Ringing in the ears: Together with other abnormal ear noises, ear ringing is medically called tinnitus. It is a symptom of a problem, not a disease. Tinnitus is commonly described as a ringing in the ears, but some people also hear it as a roaring, clicking, hissing or buzzing. It may be soft or loud, and it might affect both of your ears or only one. For some people, it's a minor annoyance. For others, it can interfere with sleep and grow to be a source of mental and emotional anguish **(MedicineNet, 2013).**

Palpitation: Palpitations are unpleasant sensations of irregular and/or forceful beating of the heart and can occur without heart disease or as a result of abnormal heart rhythms (arrhythmias). Some patients have palpitations associated with abnormal heartbeats that can require medications or other medical treatments **(MedicineNet, 2013).**

Industrial area: Areas allocated for industry within a town-planning scheme or environmental plan. The range of industries accommodated in a plan may include: light industry, service industry, general industry, hazardous, noxious or offensive industry, waterfront industry, extractive industry or even quarries. Standards are usually defined for industrial areas

relating to access and roads, drainage, car parking, landscaping, buffer zones, noise levels, and air and water pollution **(www.eionet.europa.eu/gemet/concept/4213).**

Sore throat: (Pharyngitis) Pain in the throat. Breathing through the mouth dries the throat and makes it feel sore.. A sore throat that lasts for more than 2 weeks can be a sign of a serious illness, such as throat cancer or AIDS **(MedicineNet, 2013).**

Skin rash: Refers to the inflammation of the skin tissues that is characterized by change in the color and/or texture of the skin. It may or may not be associated with itching sensation. A rash is a general term that encompasses all the inflammatory skin reaction occurring as a response to various conditions or substances/agents that irritate the skin tissues.

3.7 Ethical and administrative procedures

The study proposal was approved by the Institutional Review Board (IRB) (Annex A) and the scientific research committee of the Public Health Department as well as the Faculty of Graduate Studies Scientific Research Board at An-Najah National University. A permission to conduct the study in the hospitals' x-ray departments was obtained from the Palestinian Ministry of Health (MoH) for the governmental hospitals and from the hospital's managers for the non-governmental hospitals (UNRWA and

private) through sending official letters from An-Najah National University to these sectors (Annex B). An official permission had been given to the researcher in order to visit the hospitals to distribute the questionnaires and to facilitate data collection procedures. Accordingly, the researcher had visited the targeted institutions before beginning of the study in order to get to know the place and to explain the research purpose.

A verbal explanation as well as a written explanatory letter (which was written in English language and then translated to Arabic language) for all participants was attached to each questionnaire which explained the aim, importance, confidentiality and anonymity of the information with optional participation (voluntary). For those who met the selection criteria and agreed to participate, a written and signed informed consent was obtained from each participant (Annexes C and D). A standard clarification to all participants was made when needed.

3.8 Data collection

This study was designed to collect data in order to determine the prevalence of the darkroom disease symptoms among the radiographic personnel in the x-ray departments of the governmental and the non-governmental hospitals in the West Bank, Palestine.

3.9 Study tool

Data were collected by using a standardized and a previously-validated face-to-face administered questionnaire which was written in English to elicit information about darkroom disease symptoms. The questionnaire had been adapted with permission from Damases (2006) (Annex E)). The approval was granted through the reply letter by email correspondence (available upon request). The researcher secured to use the questionnaire in measuring darkroom disease symptoms.

The researcher (himself) had visited all provinces and hospitals in the West Bank where there is a governmental hospital in each city, and then he visited also the nongovernmental hospitals in that city. Coordination with hospitals' managements has been set through sending a letter from An-Najah National University. The researcher first visited the governmental x-rays departments in Ministry of Health (MoH), and interviewed the male radiographers available at that time who met the inclusion criteria (non-random purposive) and where able to agree to participate and sign the consent form. The interview was in private with each radiographer and in a face-to-face where the researcher himself filled the questionnaires with the participants assuring that every question is answered and clear. After conducting x-ray departmental questionnaires, the researcher completed individually face-to-face interviews with the available male nurses in the nursing wards at that time taking into consideration even numbers with

radiographers (although this was not always the case; where the researcher had sometimes recruited more nurses).

The questionnaire included questions dealing with the study independent and dependant variables. It included:

1) Socio-demographic factors and exposure to some factors that might influence health such as smoking status and habits.

2) Exposure to external factors such as living near to industrial areas and sharing home with people who smoke.

3) A self-reported list of symptoms of darkroom disease such as; headache, nausea, runny nose, irritation of throat, unexpected fatigue, ringing in the ears, lip sores, mouth sores, heart beating abnormally, unusual numb arms and legs, skin rash, abdominal pain, blurred vision, dizziness, runny eyes, night sweat, palpitation, urination, chemical taste and finally sneezing or nose itchy (not including common cold).

4) Questions for radiology workers only covered the availability of services and services conditions such as; performing daily radiographic images in a single working shift; duration time spent in the darkroom in a single working shift; availability of windows, availability of more than one door

and ventilating machine in the darkroom. Also if there was an exhaust to transmit the fumes outside the darkroom.

3.10 Pilot study

Data were collected by using a standardized and a previously-validated questionnaire of darkroom disease symptoms that had been adapted with permission from Damases (2006) (see Annex E). The questionnaire was piloted before using in the field and on the Palestinian population. Indeed, ten radiographers and ten nurses (who work in the male wards in Jenin hospitals) were asked to fill in the questionnaires in order to examine its clarity and comprehensiveness for the Palestinian population. As a result of this pre-test (pilot testing), no major changes were found to be necessary on the questionnaire. However, minor modifications were judged necessary to improve the questionnaire clarity and presentation of questions for the local Palestinian conditions. The data gathered from the pilot study were not included in the main study.

3.11 Data analysis

All data were managed and analyzed using the statistical software package SPSS (Statistical Package for the Social Sciences) version 16 **(SPSS Inc., Chicago, IL, USA 2007).** Chi-square test for trends was carried out to analyze the differences between the dependant variable and the qualitative

independent variables and in regard to the percentages of the reported symptoms. Students-t test and ANOVA were used to test the mean differences of the continuous dependant variable (number of symptoms) among different categorical independent variables. Multivariate linear regression analysis adjusted for possible confounders was developed to assess the associated occupational factors with the mean number of symptoms among radiographers (out of 20 studied symptoms). P-value less than 0.05 was always considered significant. In the questionnaire, there were 20 questions about symptoms, and the answers' categories for each question were (yes, no). These questions were used to develop new variables with scorings. Each score is the sum answer "yes" for each of the 20 symptoms' questions. Therefore, the score ranged from 0-20. This new variable was then analyzed as continuous variable in the analysis.

3.12 Summary

In this chapter, study methods and materials have been described including study settings, design, pilot study, study population and sample size, data collection and statistical data analysis. Moreover, ethical and administrative issues were also been described.

Chapter Four

Results

4.1 Introduction

This chapter introduces the survey results including the characteristics of the respondents and the average percentages of the responses for each item in the questionnaire.

4.2 Characteristics of the study population

In this study, we were able to recruit 572 participants from both groups (radiographers and male nurses). The radiographers were 330 subjects who represent nearly 57.7% of all population. However, the male nurses were 242 in this study representing nearly 42.3% of all population in both groups. The distribution of the study population is shown in table 4.1 below.

Table 4.1: Description of the study subjects

Variable	Total N (%)*=572	Current occupation n (%)*		*P*-Value
		Radiographers n (%)*	Nurses n (%)*	
Age				
20-27years	106 (18.5)	60 (18.2)	46 (19)	
28-35 years	154 (26.9)	88 (26.7)	66 (27.3)	0.092
36-43 years	160 (28)	92 (27.9)	68 (28.1)	
44-51 years	124 (21.7)	80 (24.2)	44 (18.2)	
>51 years	28 (4.9)	10 (3)	18 (7.4)	
Marital status				
Single	152 (26.6)	86 (26.1)	66 (27.3)	0.942
Married	410 (71.7)	238 (72.1)	172 (71.1)	
Widower	10 (1.7)	6 (1.8)	4 (1.6)	
Educational level				
Diploma	236 (41.3)	104 (31.5)	132 (54.5)	
Bachelor	316 (55.2)	216 (65.5)	100 (41.3)	**0.000****
Master	14 (2.4)	8 (2.4)	6 (2.5)	
PhD	6 (1)	2 (0.6)	4 (1.7)	
Monthly net income				
1500-2000NIS	84 (14.7)	36 (10.9)	48 (19.8)	**0.005****
2001-2500NIS	382 (66.8)	236 (71.5)	146 (60.3)	
2501-3000NIS	106 (18.5)	58 (17.6)	48 (19.8)	
Residence place				
City	210 (36.7)	124 (37.6)	86 (35.5)	
Village	268 (46.9)	164 (49.7)	104 (43)	**0.018****
Refugee camp	94 (16.4)	42 (12.7)	52 (21.5)	
Type of hospital				
Non-Governmental	302 (52.8)	160 (48.5)	142 (58.7)	**0.016****
Governmental	270 (47.2)	170 (51.5)	100 (41.3)	
Duration in current occupation				
1-5years	218 (38.1)	126 (38.2)	92 (38)	**0.001****
6-10years	126 (22)	64 (19.4)	62 (25.6)	
11-15years	128 (22.4)	74 (22.4)	54 (22.3)	
>15years	100 (17.5)	66 (20)	34 (14)	
Daily working hours				
<8 hours	120 (21)	88 (26.7)	32 (13.2)	
8 hours	394 (68.9)	222 (67.3)	172 (71.1)	**0.000****
> 8hours	58 (10.1)	20 (6)	38 (15.7)	

*Data are expressed as number (percent) of each group.

**Statistically significant ($p < 0.05$).

As shown in the table 4.1 above, the sample was initially described on the variable “Age”. Respondents were asked to choose from the most appropriate category “20-27 years,” “28-35 years,” “36-43 years,” “44-51 years,” and “ older than 51 years”. The largest number of respondents among radiographers indicated their age as between "36 and 43" years

(n=92; 27.9%), while the largest respondents among nurses was also between "36 and 43 years" (n=68; 28.1%). The least group between radiographers was above 51 years old (n=10; 3%) while the least between nurses was above 51 years old (n=18; 7.4%) as well. The age was not statistically significant between the two study groups.

On marital status category**,** respondents were additionally described on the variable “Marital Status.” The majority of the subjects among radiographers (n=238; 72.1%) reported that they were married. One-hundred seventy two nurses (n=172; 71.1%) indicated that they were married. Six radiographers (n=6; 1.8%) indicated they were widowed and (n=4; 1.6%) of responding nurses indicated they were also widowed. No significant differences were found between the study groups regarding marital status.

Regarding the highest level of education completed by the respondents, the largest group (n=216; 65.5%) reported completion of a Bachelor degree among radiographers, while one-hundred (n=100; 41.3%) from nurses also indicated having the Bachelor degree. The second largest group among radiographers (n=104; 31.5%) reported the achievement of Diploma as the highest level of education completed, and (n=132; 54.5%) from nurses indicated having Diploma degree. Two respondents (n=2; 0.6%) reported a Doctorate degree as the highest level of education completed among

radiographers. From nurses (n=4; 1.7%) reported the attainment of Doctorate degree. A significant relationship was found between the study groups in regard to the educational level. The other remaining factors showed statistically significant differences between the two study groups (for more details, see table 4.1 above).

We have also plotted the living district and living in industrial area variables as bar charts. These bar-charts are shown in figures 4.1, 4.2 and below.

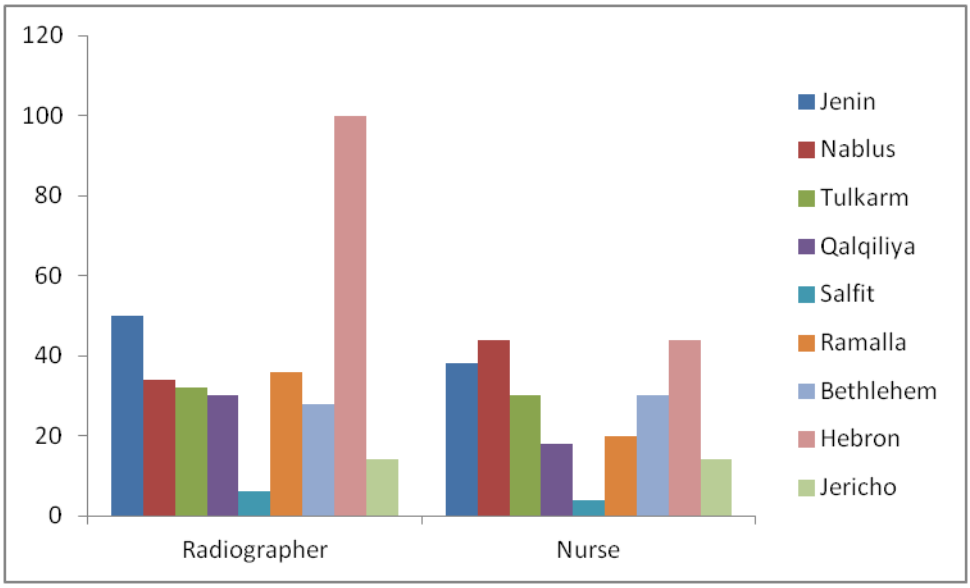

Figure 4.1: Distribution of radiographers and nurses by district.

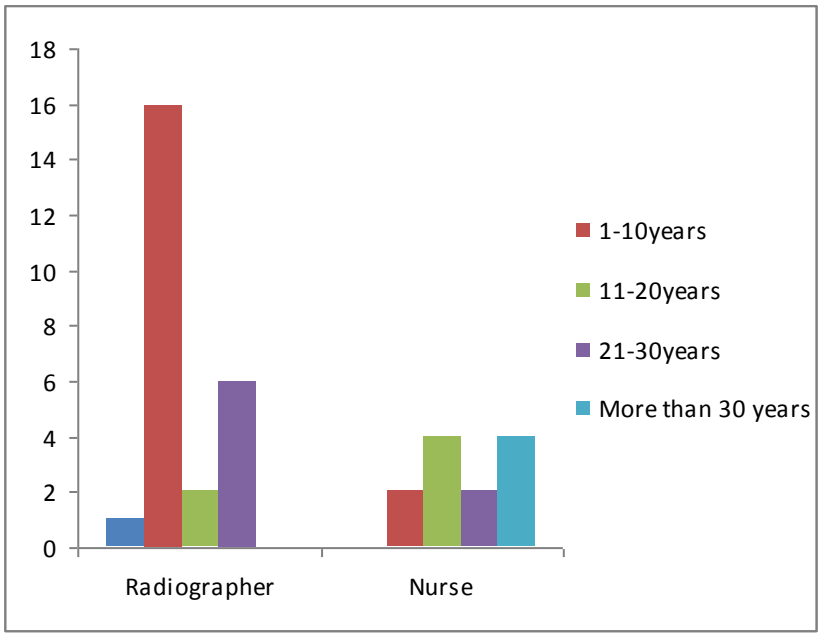

Figure 4.2: Distribution of radiographers and nurses by time spent in living in industrial area.

4.3 Exposure to internal and external factors

This section summarizes the respondents self-reporting of some interesting internal and external factors that could be related to darkroom disease's symptoms. Table 4.2 below shows these variables and their distributions among each study group with the chi-square statistical significance test.

Table 4.2: Exposure to the internal and external factors that could be related to darkroom disease's symptoms.

Variable	Radiographers n (%)*	Nurses n (%)*	Chi-square *P*-value
Do you live in an industrial area?			
Yes	66 (20)	18 (7.4)	
No	264 (80)	224 (92.6)	**0.000****
Do you share your home with people who smoke?			
Yes	72 (21.8)	46 (19)	
No	258 (78.2)	196 (81)	0.412
Smoking status			
Current smoker	86 (26.1)	80 (33.1)	
Ex-smoker	24 (7.3)	14 (5.8)	0.176
Non-smoker	220 (66.7)	148 (61.2)	

*Data is expressed as number (percent) of each group.
**Statistically significant ($p < 0.05$).

As shown in the table 4.2 above, participants were also asked to offer information concerning their neighborhood residence. Twenty percent of radiographers respondents (n=66; 20%) reported that they reside in an industrial area, while (n=264; 80%) indicated they do not live in such areas. Eighteen respondents of nurses (n=18; 7.4%) inhabit in an industrial areas, while (n=224; 92.6%) mentioned they don't live in such areas. There was a significant relationship between current occupation of respondents and neighborhood locality.

Moreover, respondents were also demanded to decide and state with reference to the sharing home with people who are smoking. The minority of the survey subjects from radiographers denoted they have been sharing home with people who smoke (n=72; 21.8%), whereas two-hundred fifty eight (n=258; 78.2%) radiographers denied sharing home with people who

smoke. Forty-six (n=46; 19%) from nurses stated they have been living with people who smoke while the greater part of them (n=196; 43.2%) reported not sharing home with people who smoke.

There was no significant relationship between current occupation of respondents and sharing home with people who smoke neither there was a significant difference regarding smoking status (for more details, see table 4.2 above).

4.4 Evaluation of darkroom disease's symptoms among radiographers and nurses.

We have evaluated the darkroom disease's symptoms as the main study objective. Table 4.3 below shows the self-reported frequency (percent) of darkroom disease's symptoms among the two study groups (radiographers and nurses) with the proportional value of radiographers compared to nurses.

Table 4.3: The self-reported frequency (percent) of darkroom disease's symptoms among radiographers and nurses.

Symptom*	Radiographers n (%)*	Nurses n (%)*	Proportion radiographers/ nurses	Chi-square *P*-value
Headache	250 (75.8)	142 (58.7)	1.760	**0.000****
Nausea	170 (51.5)	36 (14.9)	4.72	**0.000****
Runny nose	208 (63)	38 (15.7)	5.47	**0.000****
Irritation of throat	228 (69.1)	50 (20.7)	4.56	**0.000****
Unexpected fatigue	216 (65.5)	88 (36.4)	2.45	**0.000****
Ringing in the ears	184 (55.8)	38 (15.7)	4.84	**0.000****
Lip sores	136 (41.2)	42 (17.4)	3.23	**0.000****
Mouth sores	142 (43)	26 (10.7)	5.46	**0.000****
Heart beating abnormally	116 (35.2)	38 (15.7)	3.05	**0.000****
Unusual numb arms and legs	162 (49.1)	60 (24.8)	2.7	**0.000****
Skin rash	196 (59.4)	26 (10.7)	7.53	**0.000****
Abdominal pain	160 (48.5)	64 (26.4)	2.5	**0.000****
Blurred vision	136 (41.2)	42 (17.4)	3.23	**0.000****
Dizziness	154 (46.7)	52 (21.5)	2.96	**0.000****
Runny eyes	146 (44.2)	34 (14)	4.29	**0.000****
Night sweat	98 (29.7)	18 (7.4)	5.44	**0.000****
Palpitation	102 (30.9)	28 (11.6)	3.64	**0.000****
Urination pain	106 (32.1)	34 (14)	3.11	**0.000****
Chemical taste	202 (61.2)	0 (0)	-------	**0.000****
Sneezing/nose itchy	234 (70.9)	40 (16.5)	5.85	**0.000****

*Data are expressed as number (percent) of each positive answer (yes) to each symptom. The non presented data equals the negative answer (No).
**Statistically significant ($p < 0.05$).

As shown in the table 4.3 above, the differences in the reported proportion of symptoms among radiographers showed a statistically significant higher proportion for each reported symptom compared to the nurses (P-values=0.001; see table 4.3) for all the reported symptoms. Proportionally, radiographers suffer from headache (for example) more than one and a half times (1.760) than nurses (see table 4.3 above for the remaining symptoms).

The specific health symptoms of the radiographers and nurses are mentioned in table (4.3). The most predominant health symptoms in descending order of frequency, addressed by radiographers were: headache (75.8%), sneezing/nose itchy (70.9%), irritation of throat (69.1%), unexpected fatigue (65.5%), runny nose (63%), chemical taste (61.2%), skin rash (59.4%), ringing in the ears (55.8%), nausea (51.5%), unusual numb arms and legs (49.1%), abdominal pain (48.5%), dizziness (46.7%), runny eyes (44.2%), mouth sores (43%), lip sores (41.2%), blurred vision (41.2%), heart beating abnormally (35.2%), %), urination pain (32.1%), palpitation (30.9%) and finally night sweat (29.7%).

4.5 The frequency of reported symptoms among radiographers

In this section, we have evaluated the reported symptoms (yes answer only) among radiographers on daily, weekly, monthly and yearly basis as asked in the questionnaire. Table 4.4 below shows the frequency of the self-reported symptoms among radiographers depending on this categorization.

Table 4.4: The frequency of reported symptoms (yes answer) among radiographers based on daily, weekly, monthly and yearly categorization.

Symptom	Radiographers					p-value
	N (%) for yes*	Daily n (%)	Weekly n (%)	Monthly n (%)	Yearly n (%)	
Headache	250 (75.8)	10 (4)	80 (32)	134 (53.6)	26(10.4)	**0.000**
Nausea	170 (51.5)	4 (2.4)	84 (49.4)	80 (47.1)	2 (1.2)	**0.000**
Runny nose	208 (63)	14 (6.7)	30 (14.4)	154 (74)	10 (4.8)	**0.000**
Irritation of throat	228 (96.1)	4 (1.8)	60 (26.3)	156 (68.4)	8 (3.5)	**0.000**
Unexpected fatigue	216 (56.5)	40(18.5)	66 (30.6)	100 (46.3)	10 (4.6)	**0.000**
Ringing in the ears	184 (55.8)	4(2.2)	32 (17.4)	126 (68.5)	22 (12)	**0.000**
Lip sores	136 (41.2)	0 (0)	22 (16.2)	72 (52.9)	42 (30.9)	**0.000**
Mouth sores	142 (43)	6 (4.2)	28 (19.7)	60 (42.3)	48 (33.8)	**0.000**
Heart beating abnormally	116 (35.2)	6 (5.2)	28 (24.1)	70 (60.3)	12 (10.3)	**0.000**
Unusual numb arms and legs	162 (49.1)	18 (11.1)	46 (28.4)	90(55.6)	8 (4.9)	**0.000**
Skin rash	196 (59.4)	2 (1.0)	12 (6.1)	68 (34.7)	114 (58.2)	**0.000**
Abdominal pain	160 (48.5)	10 (6.3)	22 (13.8)	100 (62.5)	28 (17.5)	**0.000**
Blurred vision	136 (41.2)	8 (5.9)	46 (33.8)	76 (55.9)	6 (4.4)	**0.000**
Dizziness	154 (46.7)	4 (2.6)	30 (26)	96 (62.3)	14 (9.1)	**0.000**
Runny eyes	146 (44.2)	18 (12.3)	46 (31.5)	74 (50.7)	8 (5.5)	**0.000**
Night sweat	98 (29.7)	4 (4.1)	28 (28.6)	60 (61.2)	6(6.1)	**0.000**
Palpitation	102 (30.9)	4 (3.9)	28 (27.5)	70 (68.6)	0 (0)	**0.000**
Urination pain	106 (32.1)	8 (7.5)	30 (28.3)	60 (56.6)	8 (7.5)	**0.000**
Chemical taste	202 (61.2)	14 (6.9)	78 (38.6)	96 (47.5)	14 (6.9)	**0.000**
Sneezing/nose itchy	234 (70.9)	20 (8.5)	72 (30,8)	136 (58.1)	6 (2.6)	**0.000**

*Data are expressed as number (percent) of each positive answer (yes) for each symptom. The non--presented data equals the negative answer (No).

As shown in table 4.4 above, it was found that (75.8%) of radiographers have headaches most of them on monthly basis (53.6%). Findings regarding the nausea episodes denoted that (51.5%) of radiographers had suffered from nausea most of them on weekly basis (49.4%). The general trends show that the majority of the reported symptoms among

radiographers were experienced in a monthly basis (see table 4.4 for more details on the frequency categorization of the reported symptoms).

4.6 Evaluation of the occupational conditions for radiographers

Table 4.5 below shows some of the occupational conditions for the radiographers. The frequency of radiographers and the number of symptoms among each different category of an occupational condition are shown below.

Table 4.5: Occupational condition variables by number (percent) of subjects and number (percent) of total reported symptoms (3346) among radiographers (n=330).

Working condition variables	Radiographers n (%)*	Number of symptoms among radiographers No. (%)[!]	p-values
How many radiographic images do you perform every day?			
1-5 images	28 (8.5)	290 (8.7)	**0.001***
6-10 images	10 (3)	30 (0.9)	
11-15 images	84 (25.5)	756 (22.6)	
>15 images	208 (63)	2270 (67.8)	
The time spent in the darkroom during the working shift?			
1-30 minutes	104 (31.5)	1002 (29.9)	**0.011***
31-60 minutes	72 (21.8)	660 (19.7)	
61-90 minutes	100 (30.3)	1048 (31.3)	
> 90 minutes	54 (16.4)	636 (19)	
Is there a window in the darkroom?			
Yes	38 (11.5)	444 (13.3)	**0.038***
No	292 (88.5)	2902 (86.7)	
Does the darkroom have more than one door where you work?			
Yes	76 (23)	890 (26.6)	**0.007***
No	254 (77)	2456 (73.4)	
Is there a ventilating machine in the dark room where you work?			
Yes	174 (52.7)	1566 (46.8)	**0.000***
No	156 (47.3)	1780 (53.2)	
Is there an exhaust to transmit the fumes outside the darkroom?			
Yes	84 (25.5)	898 (26.8)	**0.041***
No	246 (74.5)	2448 (73.2)	

*Data is expressed as number (percent) for each variable's category.[!] Number of symptoms (percent from the total number of symptoms reported among radiographers; 3346).

As shown in table 4.5 above, the majority (63%) of the radiographers reported performing more than 15 images per day. However, a slight minority (n=10; 3%) reported performing (6-10) radiographic images a day. The higher number of performed images per day the higher number of symptoms reported. On the other hand, nearly 104 (31.5%) gave an account of spending (1-30) minutes in the darkroom during the working shift, while the minority (16.4%) stated of spending more than 90 minutes per working

shift. The vast majority of radiographers (n=292; 88.5%) reported not having windows in the darkrooms, while the minority (n=38; 11.5%) reported the availability of such windows in the darkrooms. Regarding having alternative door in the darkroom, most of the radiographers (n=254; 77%) indicated not having alternative door in the darkroom, while only 23% confirmed having additional door in the darkroom. However, 47.3% of the radiographers reported not having ventilating machines in the darkrooms where they work, whilst 74.5% notified not having an exhaust to transmit the fumes and odors outside the darkroom.

Radiographers were more likely to report symptom clusters associated with working factors expected to reflect greater workplace chemical exposures and symptoms (Table 4.5); less local exhaust of machines, less frequent adequate ventilation in the processing area, intense load of images done daily, elongated time spent in the darkroom, low accessibility of a window and an extra door in the darkroom. It is of notion that radiographers reported more concerns about working conditions which were associated frequently with darkroom disease symptom clusters, e.g. medical radiographers who practiced more than 15 images daily were more vulnerable to have the sum majority of all reported symptoms (67.8%; table 4.5 above). Unavailability (88.5%) of a window in the darkroom gave also an indicator to more symptomatic disease (86.7%; table 4.5).

4.7 Association of the mean number of symptoms with other variables among radiographers

We have conducted a one-Way ANOVA analysis for all questionnaire variables (those with two and those with more than two categories (table 4.6 below)). However, variables that where more than two categories and showed significant associations in this stage of analysis with the mean number of symptoms (out of 20 total symptoms) were categorized again into two categories and re-tested for significance using the same ANOVA analysis (Annex F). The variable "number of working hours" was also categorized into two categories (Annex F) although it was not significant before categorization because we expected a possible association with the dependant variable (mean number of symptoms). Indeed, all that were significant on more than two categories remained also significant after re-categorization into two categories (see table 4.6 and Annex F). This process of re-categorization of some variables where done due to the large number of variables that showed a significant association with the mean number of symptoms in the bivariate analysis. Therefore, and for the purpose of developing not an overloaded multivariate linear regression model, we have categorized the variables with more than two categories into two categories. Then, we have calculated the mean number of symptoms (out of 20 total symptoms) among each variable category in the radiographers'

subjects in order to predict the variables that could be associated with the mean number of symptoms among those subjects (radiographers).

Variables entered in the final multivariate regression model were those with a significant P value of less than or equal 0.05. However, the variables "number of working hours-less than or equal 8 hrs and more than 8 hrs; is there a window in the darkroom-no/yes; and is there an exhaust in the darkroom-no/yes" were also entered in the final model although they were not significant in the first stage of analysis due to their possible effects and associations with the model dependant variable "number of symptoms among radiographers" after adjusting for other variables.

The final multivariate linear regression model with all possible predictors is shown in the table 4.7.

Table 4.6: One-way ANOVA analysis for the association of the mean number of symptoms (yes) among radiographers' (N=330) with other independent variables.

Variable	N	Mean	SD	ANOVA P-value
Age				
20-27years	60	8.23	6.461	**0.015****
28-35 years	88	9.86	6.224	
36-43 years	92	10.50	5.779	
44-51 years	80	10.95	5.575	
>51 years	10	14.20	6.512	
Marital status				
Single	86	9.26	6.722	0.130
Married	238	10.53	5.865	
Widower	6	7.33	2.066	
Educational level				
Diploma	104	10.88	5.908	0.06
Bachelor	216	9.93	6.049	
Master	8	8.75	7.686	
PhD	2	0	00	
Monthly net income				
1500-2000 NIS	36	10.56	6.797	**0.003****
2001-2500 NIS	236	9.50	5.804	
2501-3000 NIS	58	12.48	6.227	
Residence place				
City	124	8.98	6.693	**0.017****
Village	164	11.04	5.733	
Refugee camp	42	10.05	4.933	
Living district				
Jenin	50	8.8	5.006	**0.000****
Nablus	34	6.88	5.504	
Tulkarem	32	8.25	5.489	
Qalqilia	30	9.00	6.281	
Salfit	6	11.67	5.391	
Rammallah	36	9.06	4.465	
Bethlehem	28	7.50	3.921	
Hebron	100	14.48	6.004	
Jericho	14	6.00	2.000	
Hospital type				
Governmental	170	10.51	6.172	0.260
Nongovernmental	160	9.75	5.976	

Table 4.6 cont'd:

Years of experience				
1-5 years	126	13	5.865	
6-10 years	64	9.19	6.023	
				0.000**
11-15 years	74	10.19	5.573	
>15 years	66	12	6.276	
Daily worked hours				
<8 hours	88	10.59	6.648	
8 hours	222	9.86	5.775	0.429
> 8 hours	20	11.30	6.822	
Smoking status				
Current smoker	86	9.77	5.836	
Ex-smoker	24	12	5.373	0.275
nonsmoker	220	10.08	6.233	
Living in industrial area				
Yes	66	16.67	4.953	**0.000****
No	264	8.51	5.179	
Sharing home with people who smoke				
Yes	72	16.11	5.385	**0.000****
No	258	8.47	5.152	
Daily images performed at one shift				
1-10 images	38	8.42	8.849	
11-15 images	84	9.00	5.264	**0.009****
>15 images	208	10.91	5.655	
Period of stay in the darkroom at one shift				
1-60 minutes	176	9.44	6.877	
60-90 minutes	100	10.48	4.629	**0.037****
>90 minutes	54	11.78	5.365	
Availability of a window in the darkroom				
Yes	38	11.68	5.705	0.096
No	292	9.94	6.108	
Availability of an extra door in the darkroom				
Yes	76	11.71	5.842	**0.010****
No	254	9.67	6.083	
Availability of a ventilating machine in the darkroom				
Yes	174	9.00	5.696	**0.000****
No	156	11.41	6.260	
Availability of an exhaust in the darkroom				
Yes	84	10.69	6.793	0.337
No	246	9.95	5.820	

**Statistically significant ($p < 0.05$).

Table 4.6 above outlines the association of the mean number of symptoms (yes) among radiographers (N=330) with other independent variables. This

table shows that age, monthly net income, residence place, years of experience, living in industrial area, sharing home with people who smoke, daily images performed at one shift, period of stay in the darkroom at one shift, availability of an extra door in the darkroom and availability of a ventilating machine in the darkroom were all significant with the mean number of reported symptoms.

4.8 Multivariate linear regression analysis for the mean number of symptoms among radiographers

Table 4.8 below shows the multivariate linear regression model for the mean number of symptoms among radiographers with some possible predictors. The monthly income was a significant predictor for the mean number of symptoms with a positive association. However, living in a village, reporting living in an industrial area (yes), reporting sharing home with people who smoke (yes), the years of experience (more than 10 years) showed a significantly positive association with the mean number of reported symptoms.

Regarding some occupational factors, the period of stay in the darkroom per shift showed a strong significant association with the mean number of reported symptoms (i.e., reporting staying more than 30 minutes in the darkroom per shift was associated with a significant increase in the mean

number of reported symptoms). However, the availability of a ventilating machine in the darkroom showed a strong negative association with the mean number of reported symptoms (i.e., reporting having a ventilating machine in the darkroom was associated with a significant decrease in the mean number of reported symptoms). All other variables did not remain significant after adjusting for other variables in the model.

Table 4.7: Multivariate linear regression model* for the association of the mean number of symptoms with some possible predictors among radiographers (N=330).

Independent variables	B	SE	Beta	*P*-value	95%CI for B
Age (20-40 years/>40 years)	0.92	0.66	0.07	0.16	(-0.37-2.22)
Monthly net income (≤2500/>2500) NIS	2.35	0.70	0.14	**0.001**	**(0.96-3.74)***
Residence place (city and refugee camp/ village)	1.15	0.52	0.09	**0.03**	**(0.12-2.19)***
Years of experience (1-10 years/>10 years)	1.31	0.59	0.10	**0.03**	**(0.15-2.47)***
Daily working hours (≤8 hours/>8 hours)	0.51	1.11	0.02	0.65	(-1.68-2.69)
Living in industrial area (no/yes)	5.63	1.13	0.37	**0.001**	**(3.39-7.86)***
Sharing home with people who smoke (no/yes)	3.79	1.12	0.25	**0.001**	**(1.57-6.004)***
Daily images performed per working shift (≤15 images/>15 images)	-0.12	0.65	-0.009	0.85	(-1.39-1.16)
Period of stay in darkroom per shift (1-30 minutes />30 minutes)	3.28	0.62	0.27	**0.001**	**(2.06-4.51)***
Availability of a window in the darkroom (no/yes)	1.58	1.11	0.08	0.15	(-0.61-3.77)
Availability of an extra door in the darkroom (no/yes)	1.19	0.80	0.08	0.13	(-0.38-2.77)
Availability of a ventilating machine in the darkroom (no/yes)	-1.98	0.54	-0.16	**0.001**	**(-3.05- -0.91)***
Availability of an exhaust in the darkroom (no/yes)	-0.57	0.64	-0.04	0.37	(-1.83-0.68)

Variables entered in the model are those with a P-value of <0.05 in One-way ANOVA. Number of worked hours per day, availability of exhaust, availability of window in the darkroom were entered in the model although not significant in the biivariate analysis; NIS, New Israel Shekels; SE, standard error; B, unstandardized regression coefficient; Beta, standardized regression coefficient; CI, confidence interval. and bold are statistically significant (p <0.05). Enter regression method was used. R for the model=0.71; Adjusted R square=0.46 (R^2=0.477; overall significance of regression model P value <0.001).

4.9 Summary

This chapter introduced the results of the statistical analysis. It showed the distribution of the socio-demographic variables in both study groups and the calculated prevalence of darkroom disease symptoms between the two study groups as well. Finally, a multivariate linear regression model was developed to assess the predictor variables with the mean number of symptoms among radiographers.

Chapter Five

Discussion

5.1 The main study findings

The aim of the present study was to assess the prevalence of occupationally-related darkroom disease symptoms among the radiographers (exposed group) compared to the nurses (non-exposed group) in the Palestinian hospitals in the West Bank in order to implement preventive measures for the control of this occupationally-related disease. The main study finding showed that, the differences in the reported prevalence of symptoms among radiographers showed a statistically significant higher proportion for each reported symptom compared to the nurses (P-values=0.001; see table 4.3) for all the reported symptoms. In multivariate linear regression analysis the monthly income was a significant predictor for the mean number of symptoms with a positive association among radiographers. However, living in a village, reporting living in an industrial area (yes), reporting sharing home with people who smoke (yes), the years of experience (more than 10 years) showed a significantly positive association with the mean number of reported symptoms among radiographers.

Regarding some occupational factors, the period of stay in the darkroom per shift showed a strong significant association with the mean number of

reported symptoms among radiographers (i.e., reporting staying more than 30 minutes in the darkroom per shift was associated with a significant increase in the mean number of reported symptoms). However, the availability of a ventilating machine in the darkroom showed a strong negative association with the mean number of reported symptoms among radiographers (i.e., reporting having a ventilating machine in the darkroom was associated with a significant decrease in the mean number of reported symptoms).

5.2 Socio-demographic factors associated with the study results

The radiographers were 330 subjects who represent nearly 57.7% of all population. However, the male nurses were 242 in this study representing nearly 42.3% of all population in both groups (572). The possible reasons which could have contributed to a lower response rate for both groups are scheduling of examinations, vacation leave, sick leave, resignation and scheduling of work shifts. Nurses were chosen as the non-exposed group. This group served as effective controls since, with the exception of contact with film processing, they were similar to radiographers in that both professions are made up of a predominately married population (71.7%) and are of a convergent qualification (Master 55.2%) and the majority in both groups are between 36-43 years old. No significant differences in age and marital status were noted between the two groups and both groups

showed a statistical similarity regarding sharing home with people who smoke and smoking status variables. However, nearly 20% of radiographers and 7.5% of nurses reported being lived in an industrial area with a statistically significant difference between the two groups.

5.3 Evaluation of darkroom disease's symptoms among radiographers and nurses

In Palestine, data about darkroom disease symptoms among radiographers are lacking. Hence, the present study tried to establish whether radiographers showed an increased prevalence of developing the reported symptoms when compared with another group of hospital personnel. The present study has found that radiographers have a total of 3346 (78.9%) symptoms, while nurses count for about 896 symptoms (21.1%) in cumulative. A variety of symptoms has been described in this study by radiographers working in contact with X-ray processing chemicals.

The present study is the largest review of radiographers to assess work attributed symptom complexes consistent with darkroom disease. These symptom clusters were significantly more common among radiographers than among nurses, occurring over four times as often, consistent with previous studies of darkroom disease symptoms **(Genton, 1998).** Darkroom disease symptoms such as headache, abdominal pain, blurred

vision, skin rash and night sweats, which have been reported to be part of darkroom disease symptoms, were not similar in both groups and were very high in prevalence involving radiographers.

The key to working safely with processing chemicals is to understand the potential health hazards of exposure to chemical and to manage the risk to an acceptable level. Recognition and control of potential hazards begins with reading and understanding product labels and safety data sheets. Increased radiographic personnel reported symptoms and a growing concern about the safety of their working environment provoked several studies of the risks of chemistry in developed countries **(Hewitt, 1993; Glass, 1997; Genton, 1998; Teschke et al*;* 2000)**. Radiographers need adequate information in order to make informed decisions concerning possible health risk in their working environment.

On analysis of the questionnaire data on symptoms prevalence it was found that the exposed group had suffered from ear, nose and throat illnesses, headaches, abnormal tiredness, abnormal heart beat and skin illnesses which are normally associated with exposure to darkroom chemicals. The most significant symptoms measured in the exposed group was headache (75.8%), sneezing/nose itchy (70.9%), irritation of throat (69.1%), unexpected fatigue (65.5%), runny nose (63%) and chemical taste (61.2%). In addition to these common symptoms, the exposed group also reported

chest illness, nausea, painful joints, ringing ears, skin rash, lip sores, mouth sores, abnormal heart beat and numbness of arms and legs. It is suggested that these darkroom disease symptoms clusters reported by the exposed group of radiographers could be related to exposure to high air concentrations of chemicals (and this should be mentioned with caution in this study as we did not perform an air sampling of the workplace). The findings of this study compare favorably with those of Tarlo et al. (2004) on medical radiation technologist and found, that sore throat, headache, sore or itchy eyes, abnormal heart beating and runny nose were significant symptoms compared to non-exposed group..

Indeed, the notably higher response rates of the radiographers in this study regarding reporting current health problems particularly respiratory problems as a main complain is concomitant with other studies findings. For example, a study results performed by Semedly (1996) showed an apparent surplus of occupational work related symptoms (similar to the symptoms reported in this study) among radiographers than nurses . Furthermore, another study conducted by Prabhakara and Lakshman. (2002), showed that respiratory problems among radiographers were several times higher than compared group (physiotherapists) with increased respiratory complains within working hours. These increased related

symptoms were attributed to the exposures of radiographers to chemical fumes in the darkroom in the mentioned study..

The reported prevalence of the symptom bad chemical taste amongst radiographers was nearly 61.2% of all radiographers, while nurses did not practice such chemical taste at all. Indeed, sulphur dioxide, a by-product of the fixation process, is known to be responsible for an unpleasant metallic taste and a bad odour within X-ray departments. It has also been established that the threshold values for the effects of SO2 are below the level of the UK occupational exposure limit of 2 parts per million (time weighted average). This means that, although departments may be working within strict exposure guidelines, symptoms such as a bad taste are not automatically eliminated. The obvious differences between the two professions regarding the prevalence of bad taste should encourage active SO_2 monitoring within X-ray departments and a reconsideration of exposure limits in further future studies.

A less impressive, but nevertheless significant, increased prevalence of night sweat (29.7%) was reported by radiographers compared with the nurses (7.4% in nurses). It must therefore be acknowledged, whilst not reducing the importance of the findings for this study, that there was increased prevalence amongst radiographers for mostly all the symptoms in all over the hospitals investigated. Smoking status was not statistically

significant between the two study groups which could minimize or diminish interference and confliction of smoking on results.

The prevalence of new onset headache (since starting in the profession) was greater among radiographers than nurses (75,8% vs. 58.7%; respectively). Compared with nurses, the proportion of reporting nausea was more than four folds (4.72) among radiographers, runny nose among in radiographers was more than five folds (5.47), feeling, unexpected fatigue among radiographers was more than two folds (2.45) and the proportion of skin rash was more than seven folds (7.53) in the past 6 months as more frequent among radiographers.

5.4 Association of the mean number of symptoms with some possible predictors among radiographers

Among radiographers, multivariate linear regression model for the association of the mean number of symptoms with some possible predictors showed that symptoms were associated with some factors, such as the monthly income (95%CI for B, 0.96-3.74; B, regression coefficient; CI, confidence interval) where monthly income showed significant predictor for the mean number of symptoms with a positive association. However, living in a village compared to living in a city/refugee camp (95%CI for B, 0.12-2.19), reporting living in an industrial area (95%CI for B, 3.39-7.86),

years of experience (more than 10 years) (95%CI for B, 0.15-2.47) and reporting sharing home with people who smoke (95%CI for B, 1.57-6.004), also showed a positive association with the mean number of symptoms.

Regarding some workplace and occupational factors such as, the period of stay in the darkroom per shift showed a strong significant association with the mean number of reported symptoms (i.e., reporting staying more than 30 minutes in the darkroom per shift was associated with a significant increase in the mean number of reported symptoms; 95%CI for B, 2.06-4.51). However, the availability of a ventilating machine in the darkroom showed a strong negative association with the mean number of reported symptoms (i.e., reporting having a ventilating machine in the darkroom was associated with a significant decrease in the mean number of reported symptoms, 95%CI for B -3.05- -0.91). All other variables did not remain significant after adjusting for other variables in the model. While the hazards of processing chemistry are well documented in the literature and, given the importance that the WHO places on safety in the working environment, safety defensive measures are however not operative in darkrooms in Palestine. Our results suggested a lack of information of darkroom disease among the Palestinian radiographers. Perhaps this is because most of the studies were done in developed countries like New Zealand and UK. However, a study in Gaza strip (GS) was found that

persons at high risks of developing darkroom disease symptoms are those who spend long periods in diagnostic imaging departments **(Al-Ajerami, 2008)**. This conclusion is in accordance with our results that found a significant positive association of the period of stay in darkroom per shift with the mean number of reported symptoms among radiographers. Indeed, our study results were consistent and concurrent with the study conducted by Teschke et al. (2000), which showed that the number of films processed and the time workers spent near the machines increased exposures to chemicals and eventually this was linked to darkroom disease symptoms.

It is of notion that most of radiographers (67.8%) task more than 15 images a day which was found to be positively associated with the mean number of reported darkroom disease symptoms among radiographers..Our results therefore, suggest a consistency with other studies. For example, a study conducted Gaza strip in the year 2008, pointed out that the number of hours (> 10 hours per week) that radiographers spend at the darkroom is the strongest predictor of the reported symptoms **(Al-Ajerami, 2008)**. However, in another study carried out in the year 2004, about 8% of the radiographers who reported darkroom disease symptoms were spending an average of 8.8 hours per week in the darkroom **(Tarlo et al., 2004).** However, in 1986, Kipen et al., researched the respiratory abnormalities among three photographic developers who were responsible for processing

the x-ray films and who spent approximately five hours in these laboratories, one whom had worked for two years in a cardiac catheterization laboratory and who experienced headaches, tiredness, nasal hyper secretion, sore throat, nausea and two episodes of severe left chest pain. The authors suggested that although the air levels of each individual chemical might be below the threshold limit value (TLV), the impact of the exposure to complex and varied combinations of substances may result in adverse effects at levels that would be endurable if exposures were only to a single compound. A more possible explanation for our previous finding also, is that many radiographers spend incredibly long hours in their darkrooms which are often cramped makeshift quarters at home; in closets, bathrooms or kitchen counters. All too often, these darkrooms provide no safety equipment such as ventilation systems, eye washes or fire extinguishers.

On the other hand, our results revealed no significant differences in the multivariate linear regression model for the association of the mean number of symptoms with the availability of a window in the darkroom among radiographers (95%CI for B, -0.61-3.77). Also, current study findings showed no significant differences in the multivariate linear regression model for the association of the mean number of symptoms with the availability of an extra door in the darkroom among radiographers (95%CI

for B, -0.38-2.77). However, the availability of a ventilating machine in the darkroom showed a strong negative association with the mean number of reported symptoms (i.e., reporting having a ventilating machine in the darkroom was associated with a significant decrease in the mean number of reported symptoms; 95%CI for B, -3.05- -0.91). This coincides with the study conducted by Al Ajerami. (2008), who attributed mainly the exposure of radiographers to chemical fumes in the darkroom to the closed ill-ventilated processing darkrooms and revealed deficiency of quality control measures for dark room processing in almost 80% of all studied darkrooms, also the authors found a lack of effective departmental ventilation system in almost 73.7% and lack of special dark room ventilation system in almost 78.9% of all studied darkrooms. Hence, different studies concluded that the poor design together with the operational ventilation deficiencies were the major characteristics that resulted in the increased percentages of reported symptoms in such an occupational complex setting **(Al Ajerami, 2008; Hewitt, 1993).**

In our study, the health complains and problems of radiographers could be attributed to poor ventilation procedures such as weak structural design and deficiencies in operational materials and equipment. Concur to our study results, the study conducted by Taro et al., (2004), showed significant correlation between the darkroom disease symptoms to radiographers and

poor design of the radiographic departments presented by mal-ventilation, thereby presenting occupational hazard of chemical exposure to the radiographic personnel. In fact, automatic processors can generate considerable heat to hasten the film development process, thus, it is essential that the darkroom ventilation systems meet the current international guidelines. The primary purpose of general ventilation in the darkroom is the removal of excessive heat, moisture, traces amounts of vapors and gases. If there are significant amounts of toxic chemicals in the darkroom, local exhaust ventilation is needed **(Teschke et al., 2004).** Finally, Hewitt, (1993) denoted that the most common problem among radiographers and their reported symptoms is that there was a lack of understanding of the risk associated with chemical exposures, and slow and often-inappropriate responses to reported problems such as poor ventilation or no extractor fans in the darkroom.

5.5 Possible limitations attributed to some other factors

This study might have some limitations usually encountered in such epidemiological studies. A possible limitation of this study might have been attributed to the healthy-worker bias where sick workers might have been absent or in vacation so underestimation of the reported symptoms

could have been occurred. This is a recall study where an over or under-estimation of the reported symptoms could have been occurred. Due to the study design we have performed, we can't generate causal relationships between the symptoms of darkroom disease and exposed chemicals in the darkroom. Furthermore, the resulted symptoms could have been attributed to some other factors (living in an industrial area, sharing home with people who smoke) or other confounders that haven't been taken into account in this study. Despite these shortcomings, we believe that our study provided important findings necessary to generate hypothesis on the darkroom disease and its associated occupational factors among radiographers in the West Bank hospitals.

5.6 Conclusions

To summarize, radiographers showed an increase in the prevalence of certain symptoms representing the darkroom disease in comparison with the non-exposed group (hospitals' nurses). However, trying to interpret this finding in relation to chemicals exposure in their workplace should be interpreted with caution due to the absence of active or passive monitoring in the workplace for the suspected chemicals. Furthermore, radiographers in the Palestinian West Bank hospitals showed a significantly higher prevalence for all the study symptoms compared with the nurses. Some related occupational factors were strong positive predictors for the mean

number of reported symptoms among radiographers such as years of experience and period of stay in darkroom per shift. However, other occupational factors were strong negative predictors of the mean number of reported symptoms among the radiographers such as availability of a ventilating machine.

We could conclude that darkroom disease is a very real problem faced by the radiographers in the West Bank hospitals. The severity of darkroom disease symptoms illustrates the need for legal compliance in order to minimize the occurrence of darkroom disease symptoms. This study improved our understanding in a way that might help overcome the limitations of environmental exposure assessment in such a very complex occupational setting. This study increased our knowledge regarding total exposure to complex mixtures of toxic chemicals along different pathways (lung, skin and gastrointestinal routes of exposure) and their associated adverse health effects in the Palestinian darkrooms. Nevertheless, and in order to decrease the morbidity from darkroom disease symptoms, further research is considered necessary to elucidate outstanding issues in the understanding of darkroom disease.

5.7 Recommendations

This study makes the following recommendations for radiographic personnel, policy-makers and future research studies towards minimizing the occurrence and effect of darkroom disease symptoms:

5.7.1 Recommendations for radiographic personnel:

- It is apparent that awareness of this issue is minimal in the radiography profession, with most instances of darkroom disease arising through lack of knowledge. Therefore, it is imperative that education with respect to film-processing chemicals be introduced in all undergraduate courses, detailing not only the health concerns, but also the legal issues associated with its use. Employers should provide further training in the workplace with respect to safe and correct handling of film-processing chemicals. This should include information on the health effects indicative of the disease in order to promote awareness in the workplace.
- If a hazardous substance cannot be eliminated, practical measures must be implemented to minimize employee exposure. Radiographic departments and their employees need to seriously review their use of such measures, and ensure they are effective (such as ventilation). Also, automated processors and silver recovery units help reduce levels of exposure. Observational assessments must be performed within the department to ensure these measures are being followed.

- Undoubtedly, educating radiology workers about potential hazards and prevention techniques should form a crucial constituent of their training.

5.7.2 Recommendations for policy-makers:

- Developing clear diagnostic criteria for the darkroom disease so that this disease can be recognized by both the individual and the legal system in the occupational settings in the Palestinian hospitals. However, not including clear diagnostic criteria for this disease, the understanding of this disease will remain unclear by the individuals and policy-makers and any legal proceedings to claim for compensation will be hindered.
- A Prevention option may ultimately eradicate the chemical exposures through the adoption of digital imaging processes. Digital imaging is promptly being adopted in the industry because it allows computer transfer and manipulation of the x-ray images, improving their diagnostic utility.
- The producer should provide the material safety data sheet in a physical form with each delivery of film-processing chemicals so that it is readily available to the radiographer. Development of plain-English versions of the material safety data sheet or an information

pamphlet could be options to increase the radiographer's understanding of hazards associated with these chemicals. Also, labeling on each bottle should be made clearer and larger, with the associated hazards and explicit detailed instructions for its use.

5.7.3 Recommendations for future research studies:

- Any future studies of wet-chemical film processing should include measurements of dermal exposure to both the volatile and non-volatile constituents of the developers and fixers, and also they should investigate methods to reduce detection limits of airborne exposures, and should endeavor to assess exposures during spills and manual mixing. Studies investigating the relationship between both dermal and airborne exposures and health effects would greatly improve the ability to design and locate control measures. Therefore, we recommend further future studies in the Palestinian hospitals X-rays departments that would use active and passive measurements and dosimeters in order to correlate the reported symptoms with the exposure chemicals more appropriately.
- We recommend following radiographic workers in the future (follow up studies) to provide further understanding to the role played by darkrooms and their chemicals in the etiology of these symptoms.

5.8 Summary

This chapter has discussed the main study findings in relation to the researcher point of view and in comparison with other similar previous studies. The main findings of the study showed that darkroom disease symptoms is a real problem among radiographers in X-rays departments in the Palestinian's West Bank hospitals and therefore effective control measures and darkroom disease check list should be implemented as soon as possible. We finally provided conclusions and recommendations in regard to the main study findings.

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Annex (A): Institutional review board (IRB) approval of the study protocol.

An-Najah
National University
Faculty of Medicine

بسم الله الرحمن الرحيم

جامعة
النجاح الوطنية
كلية الطب

IRB Approval letter

Study title:
Evaluation of Darkroom Disease Symptoms among Radiographers and their Associated Occupational Factors in the West Bank"

Submitted by:
Yaser Nazzal

Date Reviewed:
Dec 26, 2011

Date approved:
Dec 28, 2011

Your study titled" Evaluation of Darkroom Disease Symptoms among Radiographers and their Associated Occupational Factors in the West Bank". Was reviewed by An-Najah National University IRB committee & approved on Dec 28, 2011

Samar Musmar,MD, FAAFP
IRB Committee Chairman,
An-Najah National University

IRB

نابلس - ص.ب ٧٠٧,٧ هاتف: ٠٩-٢٣٤٩٠٢/٤/٧/٨/١٤ (٠٩)(٩٧٢)، فاكسميل ٠٩-٢٣٤٩٧٣٩ (٠٩)(٩٧٢)
Nablus - P.O.Box 7,707 - Tel. (972)(09)2342902/4/7/8/14 - Facximile (972)(09)2349739
Web Site:www.najah.edu

Annex (B): The An-Najah national university letter to the private hospitals to facilitate the student's mission

An-Najah
National University
Vice President Office for Academic Affairs

جامعة
النجاح الوطنية
مكتب نائب الرئيس للشؤون الأكاديمية

الرقم: ن ك ص/ ٤٠ك٢/٢٠١٢
التاريخ: ٢٠١٢/١/٣٠

السادة مدراء المستشفيات الخاصة المحترمين،

- مستشفى العربي التخصصي / نابلس
- الرعاية العربية/ رام الله
- مستشفى الزكاة/طولكرم
- مستشفى الرازي/جنين
- مستشفى الأهلي /الخليل
- مستشفى الوكالة/قلقيلية

تحية طيبة وبعد،

الموضوع: تسهيل مهمة

تهديكم جامعة النجاح الوطنية أطيب التحيات ونعلمكم بأن **الطالب ياسر محمود انيس نزال طالب** ماجستير تخصص صحة عامة ويحتاج إلى توزيع استبانة على العاملين في اقسام الأشعة والممرضين في الأقسام الأخرى في المستشفيات الحكومية والخاصة في الضفة الغربية وقد تمت الموافقة على اطروحته للماجستير والتي بعنوان "**تقييم أعراض مرض الغرف المظلمة لدى فنيي الأشعة والعوامل المهنية المرتبطة بها في الضفة الغربية**) يرجى من حضرتكم الايعاز للمعنيين تسهيل مهمة الطالب علما بأن المعلومات لآغراض البحث العلمي فقط.

شاكرين لكم حسن تعاونكم.

وتفضلوا بقبول وافر الاحترام.

نائب الرئيس للشئون الأكاديمية

أ.د. ماهر النتشة

نسخه: د. عميد الدراسات العليا.

نابلس-ص.ب ٧، ٧٠٧ هاتف: ٢٣٤٥١١٣/٧، ٢٣٤١١٢٨، ٢٣٤٦٢٦٢، ٢٣٤٥٥٦٠، ٢٣٤٥٦٧٧ (٠٩) * فاكسميل: ٢٣٤٥٩٨٢(٠٩)(٩٧٢)
Nablus-P.O Box 7, 707 Tel. (972)(09)2345677, 2345560, 2341128, 2345113/7 Ext. (2217)
Facsimile: (972)(09)2345982. email: natsheh@najah.edu Web Sit: www.najah.edu

Annex (C): Arabic version of the consent form

بسم الله الرحمن الرحيم

Consent form

الموضوع: الموافقة على المشاركة في دراسة علمية لرسالة ماجستير في الصحة العامة.

عنوان الدراسة: تقييم أعراض مرض غرف التحميض المظلمة لدى فنيي الأشعة في مستشفيات الضفة الغربية.

الطالب : ياسر محمود أنيس نزال .

المشرف الأكاديمي: د. حمزة الزبدي .

تحية طيبة وبعد :-

أنا الطالب ياسر محمود نزال من مدينة جنين / قباطية أقوم بدراسة أعراض مرض الغرف المظلمة في الضفة الغربية كمتطلب لاستيفاء درجة الماجستير في الصحة العامة / جامعة النجاح الوطنية .

تهدف هذه الدراسة إلى معرفة مدى انتشار أعراض هذا المرض بين العاملين في أقسام الأشعة في الضفة الغربية بحيث يتم أيضا أخذ عينة من الممرضين كمجموعة مقارنة مع فنيي الأشعة. تتطلب تلك الدراسة القيام بتعبئة استبانه من قبل فنيي الأشعة و الممرضين الذكور.

نرجو من حضرتكم التكرم بالموافقة على المشاركة في هذه الدراسة حيث لا يوجد مخاطر من الاشتراك بها، والمعلومات التي سنحصل عليها ستبقى سرية ولن تستخدم إلا لأغراض البحث العلمي فقط ولك الحق في الانسحاب متى تشاء من الدراسة .

مع وافر الاحترام
الطالب : ياسر محمود نزال .
الجوال : 0599730906
البريد الالكتروني : yasernazal2013@yahoo.com

لقد قرأت التوضيح أعلاه وبناء عليه أوافق على المشاركة بمحض إرادتي :

الاسم: .....

التوقيع :.....

التاريخ :.....

Annex (D): English version of the consent form

Subject: Consent to participate in a scientific study for the Master of Public Health program.

Study Title: Evaluation of Darkroom Disease Symptoms among Radiographers in West Bank hospitals, Palestine.

Student: Yaser Mahmoud Anis Nazzal

Academic supervisor: Dr. Hamzeh Al Zabadi

Hello, -

I am Yaser Mahmoud Anis Nazzal from Jenin/Qabatiya. I am conducting a study research to evaluate the Darkroom Disease Symptoms among Radiographers in West Bank hospitals as a requirement for the Master's degree in Public Health from An-Najah National University.

The aim of this study is to investigate the prevalence of the symptoms of this disease among workers in the radiology departments in West Bank hospitals. This study requires also taking a sample of nurses as a control group to compare with the radiologists. This study requires filling a face-to-face administered questionnaire by male radiographers and nurses.

We hope that you will kindly agree to participate in this study where there is no risk due to participation and that all the collected information will remain confidential and for research purposes only. You have also the right to withdraw from the study whenever you want.

Respectfully,
Student: Yaser Mahmoud Nazzal

Mobile: 0599730906

E-mail: yasernazal2013@yahoo.com

I have read the explanation above, and based upon I agree to participate voluntary in the above mentioned study:

Name: ..... .
Signature:.....
Date:..... ...

Annex (E): The study questionnaire (Damases, 2006 with permission).

Section 1: Socio-Demographic Characteristics

1-1) How old are you?

1. Between 20-27
2. Between 28-35
3. Between 36-43
4. Between 44-51
5. Above 51

1-2) Marital status ?

1.Single
2.Married
3.Widower
4.Divorced

1-3) Educational level

1. Diploma
2. Bachelor
3. Master
4. PhD

1-4) Monthly net income

1- 1500 -2000 NIS
2- 2001-2500 NIS
3- 2501-3000NIS
4- 3001-3500 NIS
5- More than 3500 NIS

1-5) Residency place

1- City
2- Village
4- Refugee camp

1-6) Current occupation

1. Radiographer
2. Nurse

1-7) Living district

1. Jenin
2. Nablus
3. Tulkarem
4. Qalqilya
5. Salfit
6. Rammallah
7. Bethlehem
8. Hebron
9. Jericho

1-8) What type of hospitals?

1. Non-Governmental
2. Governmental

1-9) How long have you been in your current occupation at this hospital?

1. Less than 1 year (if yes, please stop and thank you) .
2. 1-5 years
3. 6-10 years
4. 11-15 years
5. more than 15 years

1-10) How many hours do you work per day?

1. Less than 8 hours
2. 8hours
3. More than 8 hours

Section 2: Exposure to internal factors which influence health

2-1) Are you?

1- Current smoker
2- Ex-smoker
3- Non – smoker

Section 3: Health and illness information

3-1) In the past 6 months have you had more than two episodes of headaches?

1. Yes
2. No

3-2) If yes ,do you have this on

1. Daily?
2. Weekly?
3. Monthly?
4. Yearly?

3-3) In the past 6 months, have you had more than two episodes of nausea?

1. Yes
2. No

3-4) If yes ,do you have this on

1. Daily?
2. Weekly?
3. Monthly?
4. Yearly?

3-5) In the past 6 months, have you had more than two episodes of runny nose?

1. Yes
2. No

3-6) If yes, do you have this on

1. 1.Daily?
2. 2.Weekly?
3. Monthly?
3. Yearly

3-7) In the past 6 months, have you had more than two episodes of irritation of the throat?

1. Yes

2. No

3-8) If yes, do you have this on

1- Daily
2- Weekly
3- Monthly
4- Yearly

3-9) In the past 6 months, have you had more than two episodes of feelings of unexpected fatigue?

1-Yes
2-No

3-10) If yes, do you have this on

1- Daily?
2- Weekly?
3- Monthly?
4- Yearly?

3-11) In the past 6 months have you had more than two episodes of ringing in the ears?

1-Yes
2-No

3-12) If yes, do you have this on

1- Daily?
2- Weekly?
3- Monthly?
4-Yearly?

3-13) If yes, do you have this on

1- Daily?
2- Weekly
3- Monthly?
4-Yearly?

3-14) In the past 6 months, have you had more than two episodes of lip sores?

1-Yes
2-No

3-15) If yes, do you have this on

1- Daily?
2- Weekly?
3- Monthly?
4-Yearly?

3-16) In the past 6 months, have you had more than two episodes of sores in mouth?

1-Yes
2-No

3-17) If yes, do you have this on

1- Daily?
2- Weekly?
3- Monthly?
4-Yearly?

3-18) In the past 6 months, have you felt your heart beating abnormally on more than two occasions?

1-Yes

2-No

3-19) If yes, do you have this on

1- Daily?
2- Weekly?
3- Monthly?
4-Yearly?

3-20) In the past 6 months, have you had more than two episodes of unusual numb arms and legs?

1-Yes
2-No

3-21) If yes, do you have this on

1- Daily?
2- Weekly?
3- Monthly?
4-Yearly?

3-22) In the past 6 months have you had more than two episodes of skin rash?

1- yes
2- No

3-23) If yes, do you have this on

1- Daily?
2- Weekly?
3- Monthly?
4-Yearly?

3-24) In the past 6 months, have you had more than two episodes of abdominal pain?

1-Yes
2-No

3-25) If yes, do you have this on

1- Daily?
2- Weekly?
3- Monthly?
4- Yearly?

3-26) In the past 6 months, have you had more than two episodes of blurred vision?

1-Yes
2-No

3-27) If yes, do you have this on

1- Daily?
2- Weekly?
3-Monthly ?
4-Yearly?

3-28) In the past 6 months, have you had more than two episodes of dizziness?

1-Yes
2-No

3-29) If yes, do you have this on

1- Daily?
2- Weekly?
3- Monthly?
4-Yearly?

3-30) In the past 6 months, have you had more than two episodes of runny eyes?

1-Yes
2-No

3-31) If yes, do you have this on

1- Daily?
2- Weekly?
3- Monthly?
4-Yearly?

3-32) In the past 6 months, have you had more than two episodes of night sweat?

1-Yes
2-No

3-33) If yes, do you have this on

1- Daily
2- Weekly
3- Monthly
4-Yearly

3-34) In the past 6 months, have you had more than two episodes of palpitation?

1-Yes
2-No

3-35) If yes, do you have this on

1- Daily?
2- Weekly?
3-Monthly?
4-Yearly?

3-36) In the past 6 months, have you had more than two episodes of pain on urination?

1-Yes
2-No

3-37) If yes, do you have this on

1- Daily?
2- Weekly?
3-Monthly?
4-Yearly?

3-38) In the past 6 months, have you had more than two episodes of chemical taste?

1-Yes
2-No

3-39) If yes, do you have this on

1- daily?
2- weekly?
3-Monthly?
4-yearly?

3-40) In the past 6 months, have you had more than two episodes of sneezing or nose itching (not including common cold)?

1-Yes
2-No

3-41) If yes, do you have this on

1-Daily?
2- Weekly?

3- Monthly?
4-Yearly?

Section 4: Exposure to external factors

4-1) Do you live in an industrial area?

1-Yes
2-No

4-2) Do you share your home with people who smoke?

1-Yes
2-No

Section 5: Working conditions (Only for radiology workers)

5-1) How many radiographic images do you perform every day ?

1- 1-5 images
2- 6-10 images
3- 11-15 images
4- More than 15 images .

5-2) The duration time in the dark room during the working shift

1- 1-30 minutes
2- 31-60 minutes
3- 61-90 minutes
4- More than 90 minutes

5-3) Is there a window in the dark room ?

1- Yes
2- No

5-4) Does the darkroom have more than one door where you work ?

1- Yes
2- No

5-5) Is there a ventilating machine in the dark room where you work ?

1- Yes
2- No

5-6) Is there an exhaust to transmit the fumes outside the dark room ?

1- Yes
2- No

Thank you for your assistance.

If you have further questions, or can provide more information about this question, please do not hesitate to call:

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Annex (F): One-way ANOVA analysis for the association of the mean number of symptoms (yes) among radiographers' (N=330) with the variables that have been only re-categorized into two different categories and were significant at more than two categories in table 4.6.

Variable	N=330	Mean	SD	ANOVA P-value
Age				
20-40 years	240	9.70	6.158	**0.032****
>40 years	90	11.31	5.739	
Monthly net income				
≤2500 NIS	272	9.64	5.942	**0.001****
>2500 NIS	58	12.48	6.227	
Residence place				
City and refugee camp	166	9.25	6.297	**0.008****
Village	164	11.04	5.733	
Years of experience				
1-10 years	190	9.47	6.096	**0.020****
>10 years	140	11.04	5.963	
Daily working hours				
≤8 hours	310	10.06	6.034	0.379
> hours	20	11.30	6.822	
Daily images performed at one shift				
≤15 images	122	8.82	6.559	**0.002****
>15 images	208	10.91	5.655	
Period of stay in the darkroom at one shift				
1-30 minutes	176	9.44	6.877	**0.026****
>30 minutes	154	10.94	4.921	

**Statistically significant ($p < 0.05$).

جامعة النجاح الوطنية

كلية الدراسات العليا

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قدمت هذه الأطروحة استكمالاً لمتطلبات درجة الماجستير في الصحة العامة بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس- فلسطين.

2013

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الملخص

خلفية الدراسة:

يتعرض العاملون في أقسام الأشعة والتشخيصية إلى مواد كيميائية معينة أثناء استخدامهم المحاليل الخاصة بتظهير صورة الأشعة وتثبيتها، بعض هذه المواد الكيميائية قد يؤدي إلى بعض الآثار السلبية على الصحة. علاوة على ذلك، فإن فنيي الأشعة قد سجلوا كثيرا من الأعراض غير المبررة والتي تعزى إلى أسباب ذات صلة بمرض (أعراض مرض الغرف المظلمة). لقد هدفت هذه الدراسة إلى تقييم مدى انتشار أعراض الغرف المظلمة بين فنيي الأشعة بالمقارنة مع الممرضين الذكور في مستشفيات الضفة الغربية.

المنهجية:

أجريت هذه الدراسة المقطعية على عينة هادفة وغير عشوائية من فنيي الأشعة والممرضين الذكور مستخدمة استبانة سابقة معيارية ومحققة الصحة بحيث تم تعبئة هذه الاستبانة عن طريق مقابلات شخصية مباشرة من قبل الباحث مع الفئة المستهدفة في المستشفيات الحكومية وغير الحكومية في الضفة الغربية. تم اختيار فنيي الأشعة والممرضين الذكور بشرط أن يكونوا قد أمضوا في عملهم ما لا يقل عن سنة مع استثناء الأشخاص الذين تم تشخيصهم سابقا وقبل انخراطهم في عملهم الحالي بمرض الربو من قبل الطبيب .

النتائج:

لقد تمكنا من اختيار و جمع 572 مشاركا من كلا المجموعتين بحيث كان عدد فنيي الأشعة 330 مشاركا بنسبة 57,7% من مجتمع الدراسة بينما كان عدد الممرضين 242 مشاركا بنسبة 42,3% من مجتمع الدراسة. بعد التحليل تبين إن 28% من فنيي الأشعة وقعت أعمارهم مابين 36 و43 سنة وكذلك النسبة كانت بين الممرضين متماثلة مما أظهر عدم وجود فروق ذات دلالة إحصائية واضحة من حيث الفرق بالأعمار بين المجموعتين وكذلك الحالة الاجتماعية بحيث كانت قيمة (p-value) أكبر من 5% في كلا الحالتين .

أظهرت الفروق المسجلة من حيث نسب انتشار أعراض المرض بين فنيي الأشعة وجود دلالة إحصائية عالية لكل عرض من الأعراض بالمقارنة مع الممرضين بحيث كانت النسب دائما أعلى بين فنيي الأشعة (p-value = 0.001). إن أكثر الأعراض أهمية وظهورا بين فنيي الأشعة كان الصداع بحيث بلغت نسبة الفنيين الذين يعانون من الصداع 75.8%، العطس والحكة الأنفية 70.9 % ، تحسس الحنجرة 69.1 % ، الشعور بالتعب والإرهاق غير المبرر 65.5 %، سيلان الأنف 63% بينما كان الشعور بوجود طعم كيميائي بالفم 61.2 %.

بينت الدراسة من خلال تحليل الانحدار الخطي متعدد المتغيرات وجود علاقة ايجابية بين الدخل الشهري ومعدل عدد الأعراض عند فنيي الأشعة بحيث كانت قيمة [p-value عند درجة الثقة 95 % لمعامل الانحدار B ,[(3.74–0.96) 0.001,2.35] .علاوة على ذلك، السكن في قرية [(2.19–0.12) 0.03, 1.15] ، الإبلاغ بالعيش في منطقة صناعية (نعم) [0.03, (7.86–3.39) 5,63]، تقاسم البيت مع الناس المدخنين (الإجابة بنعم) [(6.004–1.57) 0.001,3.79]، عدد سنوات الخبرة لأكثر من عشر سنوات [(2.47–0.15) 0.03,1.31] جميعها أظهرت علاقة ايجابية مع معدل عدد الأعراض عند الفنيين.

أما بشأن العوامل المهنية، أظهر متغير المكوث في الغرفة المظلمة (غرفة التحميض) لأكثر من 30 دقيقة خلال المناوبة الواحدة ارتباطا مع ازدياد معدل عدد الأعراض المسجلة بين الفنيين [(4.51–2.06) 3.28, 0.001].بينما أظهر متغير وجود جهاز تهوية وشفاط في الغرفة

المظلمة علاقة سلبية قوية مع معدل عدد الأمراض المسجلة[(0.91-_3.05-)1.98-,0.001].

الاستنتاجات:

أظهر فنيو الأشعة زيادة في نسب انتشار أعراض مرض الغرف المظلمة بالمقارنة مع الممرضين. إن هذا يوضح وبجلاء الحاجة إلى الامتثال لقوانين الحد من حدوث هذا المرض وذلك من أجل الحد من الأعراض الناتجة عنه. إن هذا البحث يعتبر هاما لأجل زيادة فهمنا لمرض أعراض الغرف المظلمة من اجل تقليل المخاطر الصحية الناتجة عنه. انه مما لا شك فيه بأن وضع معايير واضحة لتشخيص هذا المرض ، وتعليم العاملين بالأشعة عن مخاطر الإصابة به و آليات الوقاية منه سوف تشكل أساسا حاسما في تدريبهم. وبناء على ذلك فإننا نوصي بالمزيد من الدراسات في أقسام الأشعة في المستشفيات الفلسطينية باستخدام مقاييس فعالة من أجل الربط بين الأعراض المسجلة والمواد الكيميائية التي يتعرض لها العاملون. كما نوصي بمتابعة العاملين في الأشعة في المستقبل بمزيد من الدراسات لتوفير مزيد من الفهم حول دور الغرف المظلمة في قسم الأشعة والمواد الكيميائية المستخدمة فيها في مسببات تلك الأعراض.