THE ASSOCIATION OF NIGHT-SHIFT WORK WITH THE DEVELOPMENT OF BREAST CANCER IN WOMEN.

by

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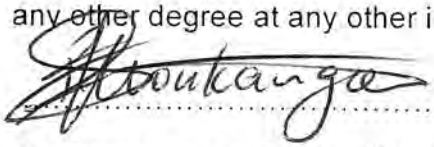
Dedication

This dissertation is dedicated to both my late younger brother Tsietsi Maphoto Moukangoe and father Lucas Hlakudi Moukangoe.

Student number: 34751173

DECLARATION

I declare that **THE ASSOCIATION OF NIGHT-SHIFT WORK WITH THE DEVELOPMENT OF BREAST CANCER IN WOMEN** is my own work and thata all the sources that I have used or qouted have been indicated and acknowledged by means of complete references and that this work has not been submitted before for any other degree at any other institution.



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ABSTRACT

Breast cancer poses a serious public health concern. This case-control study describes the relationship of night-shift working on the development of breast cancer in 57 women diagnosed with breast cancer compared to 49 women with other types of cancer in the Vaal Triangle area (selected through non-probability purposive sampling from CANSA). The study revealed that women who work night-shift developed breast cancer 1.24 times more often than women who do not work night-shift (OR=1.24 [95% CI 0.52 to 2.89]). The odds ratio was further increased in women who worked rotating-shift (OR=1.44 [95% CI 0.58 to 3.59]). Night-shift work exposure was not statistically related to the development of breast cancer. It is recommended that the relationship between night-shift exposure and breast cancer risk be further explored through cross-sectional and cohort studies, and other breast cancer pathways.

KEY CONCEPTS

Breast cancer; cancer; night-shift; rotating-shift; regular night-shift; parity; genetic predisposition.

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BRCA	Breast Cancer gene
CANSA	Cancer Association of South Africa
CI	Confidence Interval
CVD	Cardovascular Disease
IARC	International Agency for Research on Cancer
LR	Lifetime Risk
MPH	Master's in Public Health
MRC	Medical Research Council of South Africa
NCR	National Cancer Registry
OR	Odds Ratio
RR	Relative Risk

ANNEXURE

CHAPTER 1

ORIENTATION TO THE STUDY

1.1 INTRODUCTION

Breast cancer is the commonest cause of cancer death in women worldwide. Breast cancer rates vary about five-fold around the world, but they are increasing in regions that until recently had low rates of this disease, for example, in China rates have traditionally been low in comparison with Western countries (Fan, Zheng, Yu, Liu, Wu, Lu, Shen, Shen, and Shao, 2009:409-416; Key, Verkasalo, and Banks 2001:133-140). As mentioned by South African Medical Research Council (2013) it is estimated that one in seven South Africans will develop cancer in their lifetime. According to Urban, Banks, Egger, Canfel, O'Connell, Beral, and Sitas (2012:3-33), 80% of cancer cases are thought to be due to external, non-inherited factors which could potentially have been prevented. Cancer is considered one of the major killers throughout the world, including South Africa. According to the 2000-2001 National Cancer Registry (NCR) Report 2000-2001 women have a lifetime risk (LR) of 1 in 8 of getting cancer, with breast cancer having an LR of 1 in 29 (Cancer Associantion of South Africa 2010).

The effect of night-shift work on breast cancer, has received increasing interest since a panel of the International Agency for Research on Cancer (IARC) declared in 2007 that "shift work that involves circadian disruption is probably carcinogenic to humans"(Straif, Baan, Grosse, Secretan, Ghissassi, Bouvard, Altieri, Benbrahim-Tallal, and Cogliano 2007:1065). This designation of night-shift work as a potential cause of cancer by the IARC was based mainly on animal experimental studies. Experimental studies done by the IARC noted an increase in the incidence of progression of tumors including breast cancer in animals exposed to light at night (Stevens 2009:963-970; Straif, et al., 2007:1065-1066). The evidence is strongest for breast cancer, although the risk of prostate and colorectal cancer may also be increased by working night-shift (Wise 2009:338-1152).

Exposure to light at night, including disturbance of the circadian rhythm has been suggested as a risk factor for breast cancer. Melatonin plays an intergral part in the

development of tumours. Hence, persons who engage in night-shift work may exhibit altered night-time melatonin levels and reproductive hormone profiles that could increase the risk of breast cancer. However, this conclusion was based on sufficient evidence from animal studies but limited human studies (Wise 2009:338-1152).

Until now only few epidemiological studies have evaluated breast cancer risk from night-shift work. However, most of these studies have methodological flaws, especially concerning assessment of light exposure (Hansen 2006:531-537). The Danish National Board of Industrial Injuries has compensated 38 women with breast cancer who had previously worked night-shifts for at least 20 years (Wise 2009:338-1152). Good opportunities for epidemiological cancer research exist, and several studies on different aspects of breast cancer, work schedules, light exposure and melatonin levels are ongoing in order to further examine different aspects of this issue (Hansen 2006:531-537).

This study aims to evaluate whether breast cancer risk is raised in women between the ages 18 and 80 who works or worked night-shift. The risk was evaluated by assessing responses from structured interviews (Annexure A).

The breast cancer patients registered with the Cancer Association of South Africa (CANSA) in the Vaal Triangle offices was used as a sampling frame for this study. The duration of the data collection of the study was three months. 106 women participants between the ages of 18 and 80 years were recruited at CANSA offices in the Vaal Triangle area. Research was conducted with permission from CANSA. Participants diagnosed with breast cancer made up cases for the study. 49 women between the ages 18 and 80 years registered with CANSA in the Vaal Triangle for other types of cancer, were compared with the cases. At the initial interview, participants were requested to sign a Consent and Information Form (Annexure B). Questionnaires were then used to conduct a structured interview. Data was analysed for statistical significance using Epi-Info 7.

1.2 BACKGROUND INFORMATION ABOUT THE RESEARCH PROBLEM

1.2.1 *Source of the research problem*

The researcher has always had an in interest in the field of Oncology. The researcher read a lot of literature in this subject which stimulated the interest even further and came across studies being done on night-shift as a possible risk factor for breast cancer development. However, the results of most studies have been inconsistent and the researcher realised that in South Africa there were no published studies linking the association of night-shift work and the development of breast cancer. Since night-shift work is prevalent in westernised countries like South Africa, this exposure is of public health concern and necessitates thorough investigation.

1.2.2 *Background to the research problem*

Breast cancer is the most frequent cancer among women, and the number of cases is increasing worldwide. It is the commonest cause of cancer death in women (Key et al., 2001:133-140). South Africa also has high breast cancer rates. Each year, breast cancer causes more fatalities among women in South Africa than any other type of cancer. Among white and Asian women, breast cancer is the most commonly diagnosed cancer, while among black women it is the second most common cancer. One in 29 South African women is diagnosed with breast cancer each year, a significant number that translates to thousands of cases annually. Most terminal cases occur among black women, the majority of whom seek medical help after the disease has developed into its late stages (Vorobiof, Sitas, and Vorobiof 2001:125-127).

This type of cancer is strongly associated with a Western lifestyle, but the specific risk factors behind this observation are not well known. Prolonged exposure to light at night has been suggested as a contributing cause of breast cancer. Since night-shift work is prevalent and increasing in modern societies, this exposure may contribute to the continuing elevation in breast cancer risk. Few epidemiological studies have evaluated

breast cancer risk after night-shift work. Further, there have been, methodological weakness, especially concerning assessment of light exposure(Kloog, Haim, Stevens, Barchana, and Portnov. 2008). Results from a study by Hansen (2006:531-537), has shown an increase in cancer risk associated with night-shift work.

Increased exposure to light at night has been hypothesized to be in part responsible for the rise in breast cancer incidence seen in the industrialized world (Stevens 2009:963-970). Based on evidence from rodent models, Tamarkin, Cohen, Roselle, Reichert, Lippman, and Chabner, (1981:4432-4436), and Cos and Sanchez-Barcelo (2000:133-170) proposed that light at night suppresses the secretion of a nocturnal hormone called melatonin.

The suppressed melatonin production may in turn influence cancer risk through a variety of direct and indirect mechanisms, including alteration of endogenous estrogen concentrations, an established risk factor for breast cancer (Borugian, Gallagher, Friesen, Switzer, and Aronson 2005:1268-1275). There is some support in the epidemiological literature for the melatonin hypothesis in relation to night-shift work. Firstly, results from some of the studies focusing on the relationship between night-shift work and melatonin production support the hypothesis that night-shift work causes suppression of nocturnal melatonin (Schernhammer, Rosner, Willett, Laden, Colditz, and Hankinson 2004:936-943). Secondly, as mentioned by Schernhammer, Berrino, Krogh, Secreto, Michell, Venturelli, Grioni, Sempos, Cavalleri, Schunemann, Strano, and Muti (2010:729-737) higher melatonin levels have protective effect on breast cancer.

Breast cancer incidence rates in countries like China have traditionally been low in comparison with Western countries, because of differences in diet, reproductive factors, and physical activity. Rising breast cancer incidence in China has been attributed to changes in these risk factors associated with the transition to a more “Western” lifestyle (Fan et al., 2009:409-416; Porter 2008:213-216). The reason for the lack of an association between night-shift work and breast cancer in the Chinese population remains unclear. Recent work has shown ethnic variability in circadian “clock” gene variants (Ciarleglio, Ryckman, Servick, Hida, Robbins, Wells, Hicks, Larson, Wiedermann, Carver, Hamilton, Kidd, Kidd, Smith, Friedlaender, McMahon, William, Summar, and Johnson 2008:330-340). According to Anjoeka, Bu-Tian, Xiao-Ou, Shouzheng, Gong, Hong-Lan, Nathaniel, Yu-

Tang, Wei, and Wong-Ho (2010:953-959), these findings raise the possibility of genetic differences in response to night-shift work.

Megdal, Kroenke, Laden, Pukkala, and Schernhammer (2005:2023-2032) carried out a meta-analysis of the data on night-shift work and breast cancer and reported a summary relative risk of (RR) 1.48 (95% confidence interval (CI) 1.36–1.91) for all studies combined. The expert working group at IARC identified studies of night-shift work and breast cancer, noted a modestly increased risk of breast cancer in long-term night workers compared with those who were not engaged in night-shift work (Straif et al., 2007:1065-1066).

A study in the United States, estimated that nurses reporting more than 30 years of rotating- and night-shifts were 36% more likely to get breast cancer than those who did not report working rotating- and night-shifts (RR = 1.36, 95% CI 1.04–1.78) (Schernhammer, Laden, Speizer, Willet, Hunter, Kawachi, and Colditz 2001:1563-1568 2001:1563-1568). In the Nurses' Health Study II, women who reported ≥20 years of rotating- and night-shifts had an elevated risk for breast cancer compared with women who did not report working rotating- and night-shifts (RR = 1.79, 95% CI 1.06–3.01) (Ciarleglio et al., 2008:108-111).

In two prospective cohort studies of nurses that incorporated specific questions on night-shift work, investigators reported elevated risks of breast cancer associated with engaging in night-shift work for over 20 years (Schernhammer, Kroenke, Laden and Hankinson 2006:108-111) and over 30 years (Schernhammer et al., 2001:1563-1568).

In a registry-linked case-control study conducted among nurses which assigned exposure on the basis of which hospital department they work in, Lie, Roessink and Kjaerheim (2006:39-44) also found an elevated risk of breast cancer associated with working night-shifts for over 30 years. However, a population-based case-control study showed a non-significant increased risk for engaging in shift-work for over 20 years (Pesch, Harth, Rabstein, Baish, Schiffermann, Bonberg, Heinze, Spickenheuer, Justenhoven, Brauch, Hamann, Ko, Straif, and Bruning 2010:134-141). Findings for shorter durations of night-shift work are less consistent. Two population-based case-control studies of breast cancer using specific questions on night-shift work showed an elevated risk (Davis, Mirick, and Stevens 2001:1557-1562) and a reduced risk of breast cancer (O'Leary, Schoenfeld,

Stevens, Kabat, Henderson, Grimson, Gammon, Gammon, and Leske 2006:358-366). In a population-based registry-linked case-control study with job exposure matrix assignments of full occupational history, Hansen (2001:1513-1515) reported elevated breast cancer risk among night-shift workers, while a similar study with job exposure matrix assignments at two census years did not demonstrate such an association (Schwartzbaum, Ahlbom, and Feychting 2007:336-343). Lastly, in a case-control study nested within a cohort of shipboard telegraph operators, Tynes, Hannevik, Andersen, Vistnes and Haldorsen (1996:197-204) reported a significant trend of increasing breast cancer risk with increasing duration of shift-work among women over age 50 years only. Inconsistent findings from these studies may be explained, in part, by variations in definition of shift-work and study design, potential recall bias, focus on a single profession versus multiple professions, and incomplete adjustment for confounding factors (Anjoeka et al., 2010:953-959). A significantly increased incidence of breast cancer in comparison with the general population has also been observed in 6 out of 7 studies of flight attendants (Megdal et al., 2005:2023-2032). However, those studies lacked information on night-shift work and may have been rendered inaccurate by participants' exposure to cosmic radiation (Kolstad 2008:5-22).

Kolstad (2008:5-22) provided a more cautious interpretation of the published data than the summary from the IARC working group, concluding that while there were some indications that long-term night-shift work might increase risk, overall there was only limited evidence for an association between night-shift work and breast cancer. A number of problems were highlighted including the limited number of studies on the topic, the generally small magnitude of the reported association, and that the predominant positive and prospective data are only available for one occupational group.

Wang, Armstrong, Caims, Key, and Travis (2011:78-89) carried out systematic and critical reviews of recent original studies indexed in PubMed. The main conclusions from reviews and published evidence are suggestive but not conclusive for an adverse association between night-shift work and breast cancer but limited and inconsistent for cancers at other sites and all cancers combined. Findings on shift-work, in relation to risks of cardiovascular disorders, metabolic syndrome and diabetes are also suggestive, but not conclusive, for an adverse relationship.

1.3 RESEARCH PROBLEM

In South Africa one in twenty nine females is diagnosed with breast cancer, which remains one of the top causes of death among women. Several studies were conducted worldwide recently to investigate the association of breast cancer and working night-shift, and have suggeted that exposure to light at night may be a contributing cause of breast cancer (Anjoeka et al., 2010:958, Franeze and Nigri 2007:93, Megdal et al., 2005:2031-2032). However, this conclusion was based largely on evidence from animal studies with limited data from human studies (Wise 2009:338-1152).

Anjoeka and co-workers (2010:958) conducted a large prospective study that did not show an increased risk of breast cancer in relation to night-shift work, adding to the already inconsistent scientific evidence regarding the role of night-shift work in breast cancer in humans. This inconsistency may be attributed to limited knowledge on specific aspects of shift-work associated with cancer, such as timing, regularity, and light intensity, and suggests that it may be premature to label shift-work a probable cause of human cancer.

Further research is therefore needed to study the association of shift-work and breast cancer, also taking into concideration all the possible confounders of various aspects of shift-work associated with breast cancer.

1.4 AIM OF THE STUDY

1.4.1 Research purpose

The aim of this study is to evaluate whether breast cancer risk is raised in women between the ages 18 and 80 years who have worked night-shift in the past five to 20 years in the Vaal Triangle area in South Africa.

1.4.2 Research objectives

The objectives of this study are: 1) to determine the relationship of night-shift work and the development of breast cancer. 2) to explore the relationship between night-shift work and other types of cancer. 3) to explore any difference between night-shift work and breast cancer, and night-shift work and other types of cancer.

1.5 SIGNIFICANCE OF THE STUDY

Breast cancer is strongly associated with a Western lifestyle, but the specific risk factors behind this observation are not well known. Exposure to light at night has been suggested as a contributing cause of breast cancer. Since shift- and night-time work is prevalent and increasing in modern societies, this exposure may be of public health concern (Hansen 2006:535). Hence, further knowledge in this regard is needed to reduce the risk of breast cancer and help promote health and alleviate incurring excessive medical costs among potential breast cancer patients.

1.6 DEFINITIONS OF TERMS

According to Polit and Beck (2008:91) the researcher must define a concept or variable in terms of the events by which it is measured in the study. For the purpose of this research terms were defined as follow:

1.6.1 Circadian Rhythm

The word “Circadian” comes from the Latin “*Circa dies*” which means “about a day”. Circadian rhythms are partly driven by the internal clock and partly synchronized to the external world by cues known as zietgebers (Pheasant 1991: 171-172). In this study the term is used to indicate a daily cycle of biological activity based on a 24-hour period influenced by the alteration of night and day.

1.6.2 Shift

Shift refers to hours of the day in which a worker or a group of workers is scheduled to be in the workplace (Kogi 2001:1352).

1.6.3 Night-shift

This is a group of workers who work a shift during the night in an industry or occupation where a day-shift or a night-shift are also worked. According to the Basic Conditions of Employment Act No 75 of 1997, as amended, night-shift can also be defined in terms of time as work performed between 18:00pm and 06:00am the next day.

1.6.4 Rotating-shift

This is a work schedule that changes on a regular, predictable basis. For example, an employee may work the day-shift for a week followed by the night-shift for the following week, and so on (International Labour Organization 1995).

1.6.5 Regular evening-shift

This refers to work being performed during the evening, as between 4pm and midnight, on a regular basis. In terms of time it can be defined as follows, between 2pm and 12pm or between 4pm and 12pm (International Labour Organization 1995).

1.6.6 Breast cancer

Breast cancer is a type of cancer originating from the inner lining of milk ducts or the lobules that supply the ducts. Breast cancers originating in the ducts are known as ductal carcinomas, while those originating in the lobules are known as lobular carcinomas (Sariego 2010:1397-1401). Definitive diagnosis of breast cancer is by a biopsy (Saslow, Hannan, Osuch, Alciati, Baines, Barton, Bobo, Colema, Dola, Gaumer, Kopans, Kutner, Lane, Lawson, Meissner, Moorman, Pennypacker, Pierce, Sciandra, Smith and Coates 2004:327-344). All participants in this study were diagnosed by medical practitioners.

1.6.7 Other types of cancer

This refers to other types of cancer diagnosed in research participants.

1.6.8 Genetic predisposition

It refers to the genetic susceptibility that may play a role towards developing cancer (Pasche 2010:19-20).

1.7 THEORETICAL FOUNDATIONS OF THE STUDY

This study is based on Neuman's system model. The model is a unique, open system-based perspective that provides a unifying focus for approaching a wide range of health concerns. The Neuman system model is based on the assumptions that each patient is unique, and that many known and unknown, universal stressors exist. Each stressor differs in its potential for disturbing a patient's line of defence. The particular inter-relationships of patient variables at any point in time can affect the degree to which a patient is protected by the line of defence against reaction to stressor. The purpose of the health care practitioner is to retain this system's stability through the three levels of prevention. The prevention requires that knowledge be applied in patient assessment and intervention, in identification and reduction of possible or actual risk factors (Neuman 2012).

This study seeks to evaluate night-shift work as a risk factor for the development of breast cancer. The purpose is to develop knowledge that will help identify whether night-shift work is a risk factor and may indirectly help in possible reduction of morbidity and mortality from breast cancer.

1.8 RESEARCH DESIGN AND METHOD

This section of the chapter serves to outline the research design and methods employed in this study.

1.8.1 Research design

The researcher used a quantitative analytical case-control design to systematically test the hypothesis and designed mechanisms to control variables in the study in order to yield the strongest possible evidence to answer the research question.

The study compared the cases with controls according to age, race, employment status, genetic predisposition and air pollution exposure. The duration of the data collection of the study was twelve weeks. Participants were requested to sign a Participant Consent and Information Form (Annexure B) and to answer questions during interviews with research assistants from CANSA in the Vaal Triangle area (Annexure A). Research assistants were trained in conducting interviews, ethical research behaviour and in-depth understanding of the questions in the questionnare. Structured questionnaires were used for the purpose of this study and to ensure consistency. The finalisation of the questionnares included a consultative process with breast cancer and methodological experts who also served as validators.

Fifty seven research participants with breast cancer were selected using a nonprobability convenience sampling, and they were compared with fourty nine control group participants diagnosed with other types of cancer.

1.8.2 Research population and sample selection

A sample size of 106 research participants was recruited from a population of 150 female cancer patients between the ages of 18 and 80 who are registered with the CANSA office in the Vaal Triangle area.

For the purpose of this study a non-probability convenience sampling was used. 57 female breast cancer research participants aged between 18 and 80 years were enrolled for this study with permission from CANSA. The inclusion criteria for this study was for participants to have been diagnosed with breast cancer and that they should be between the ages of 18 and 80 years. The participants should be registered with CANSA offices in the Vaal Triangle area.

The control group was comprised of forty nine (49) women diagnosed with other types of cancer excluding breast cancer. The participants should be between the ages of 18 and 80 years of age and be registered with the CANSA offices in the Vaal Triangle area.

1.8.3 Data collection

The data collection plan involved structured interviews. An efficient data collection tool was developed to ensure that the questionnaires given are the same for all participants and was of high quality. The control group also received the same questionnaires. For the purpose of this study closed-ended questions was used to collect the data with the aid of interviews with research assistants.

Research assistants from CANSA attended a three day training course on data collection. The research assistants were volunteers from CANSA who are familiar with the patients and other related issues (this provided a sense of comfort to the participants). Six research assistants were used as the number of participants exceeded the capacity of a single individual. Since the researcher is male and the study involves female participants the researcher provided an oversight and supervision to the research assistant team who comprised of females.

The variables measured included the following:

- ► Age
- ► Race
- ►Employment status
- ►History of smoking
- ►History of alcohol abuse
- ►Use of contraceptives
- ►Genetic predisposition
- ►Personal history of benign breast cancer disorders
- ►Parity
- ►Number of births (both live and dead)
- ►Weight
- ►Number of years of employment

►Number of nights worked night-shift per week.

►Number of years worked night-shift.

1.9 SCOPE OF THE STUDY

The scope of study is limited to night-shift work and to women cancer patients registered with the CANSA offices in the Vaal Triangle area and as such the results cannot be generalised. The sampling frame was restricted to one CANSA office. Therefore the generalizability of this study is expected to be limited and the results will not be representative of all breast cancer patients. The participants honesty is also a potential source of error. Constraints on funding and time limited both the scope and the findings of the study. However, the inclusion of research assistants allowed for a larger sample to be included and alleviate time restrictions.

1.10 STRUCTURE OF THE DISSERTATION

This study is divided into following five chapters:

Chapter 1: This chapter is based on the research proposal and explains what the study intended to achieve. It describes the following in detail; the background to the problem, the purpose of the study, as well as the the objectives. It also describes the design and scope of the study.

Chapter 2: This chapter reviews literature from different settings that are relevant to this study.

Chapter 3: Research design and methods, as well as the data collection methods and processes used in this study are explained in this chapter.

Chapter 4: This chapter provides analysis of data using relevant statistical methods.

Chapter 5: This chapter provides a discussion of the findings, limitations and recommendations, as well as the conclusion of the study.

1.11 CONCLUSION

This chapter provided an introductionto the study. It presented a concise, but detailed background to the study and oulined the research questions, the purpose of the study, the research objectives and the research design.The data collection procedures were also outlined in this chapter. The next chapter will present the literature review.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter is structured in the following manner: epidemiology of breast cancer will be presented first; then host factors in breast carcinogenesis, the circadian rhythm as well as the health impact of night-shift working will be discussed. Finally, studies in literature relating to the relationship of breast cancer and melatonin will be presented in this chapter.

2.2 EPIDEMIOLOGY OF BREAST CANCER

Breast cancer as a public health problem is growing worldwide, but especially in developing countries where the incidence is as much as 5% per year (International Agency for Research on Cancer Working Group 2002). In South Africa breast cancer is one of the leading causes of cancer deaths among women, following a similar worldwide trend. Of relevance to South Africa is that the majority of women have limited knowledge of their relative risk of developing this condition, and of associated risk factors and of the potential breast cancer-related symptoms (Pillay 2002:103-114). The risks of developing breast cancer vary from a low of one in 81 in African women to a high of one in 13 among white women. Age and stage at presentation differ considerably between races in South Africa (Vorobiof et al., 2001:125-127).

Breast cancer is newly diagnosed in more than 1 million women worldwide and more than 400, 000 women die as a result of it (Ferlay, Shin, Bray, Forman, Mathers, and Parkin 2008:2893-2917; Mayberry and Stoddard-Wright 1993:1445-1456). The mortalitity and incidence ratio is much higher in developing countries than in developed countries and accounts for more deaths (Ferlay et al., 2008:2893-2917). The high mortality rate from breast cancer in developing countries could be attributed to poverty. In most parts of Africa, health care is not accessible, and as a result, women delay before presenting at the hospital. It is not uncommmon for them to have used unorthodox medicine before eventually visiting the hospital. In most instances the disease would have reached an advanced stage (Research United Kingdom Cancer 2011). In South Africa, breast cancer

is the leading cancer among all females except for Black females where it is the second leading cancer.ncer. However, according to South African Medical Research Council (2013) cervical cancer was the leading cause of death in the year 2000.

Women with different racial backgrounds have different breast cancer risks, due to environmental and genetic factors. It is the most common cancer in Asian (24.4%) and white women (17.9%) and the second most common cancer in mixed race and black women. Breast cancer is found to be less common in black women that in other population groups (Vobriof et al., 2001:125-127). However, Pillay (2002:103-114) have shown that the incidence of breast cancer among young black women in South Africa is rising. Similar reports from Europe and America have also documented the rise in early onset breast cancer among young black women (Banning 2011:16-22). South African black women have unique factors of importance in the epidemiology of breast cancer that makes the incidence of this disease low in this group as compared to other population groups. These factors include late onset of menstrual periods in black females, early age at birth of the first child, high parity and lactation (Vobriof et al., 2001:125-127).

2.3 HOST FACTORS IN BREAST CARCINOGENESIS

In addition to the extrinsic factors in breast carcinogenesis, there are also several host factors of both medical and epidemiological importance which influence the breast cancer risk. Below is the list of host factors which can influence the development of breast cancer:

- Gender
- Long interval between menarche and menopause
- Older age at first full-term pregnancy
- Age
- Obesity and high fat diet
- Inherited predisposition towards breast cancer
- Premalignant lesions and conditions
- Transplacental exposure (King and Robins 2006:44-277).

Inheritance of mutated genes such as breast cancer 1 and 2 (BRCA1 and BRCA2) genes confers an increased risk of developing breast cancer. BRCA1 and BRCA2 are tumour suppressor genes. Loman, Johannsson, Kristoffersson, Olsson and Borg (2001:1215-

1223) have demonstrated that these genes contribute to an increased risk of breast cancer among European women. BRCA mutations are more frequent among case subjects with one first- or more than one first- or second-degree relative with breast cancer. Epidemiological evidence has also shown a two- to three-fold increased risk of developing breast cancer if a mother or sister has the disease (King and Robins 2006:135).

2.4 CIRCADIAN RHYTHM

A circadian rhythm is any biological process that displays an endogenous, entrainable oscillation of about twenty four hours. The term circadian comes from the Latin *circa*, meaning “around” and *diem* or *dies*, meaning “day”. Although circadian rhythms are endogenous, they are adjusted to the local environment by external cues called zeitgebers, commonly the most important of which is daylight (Akerstedt 1996:10-11). This rhythm is coordinated to allow for high activity during the day and low activity at night. Normally the body uses cues from its processes and from the environment such as clock time, social activities, the light/dark cycle, and meal times to keep the various rhythms on track. The night-shift worker’s rhythms become disorientated, and this can impact the health of the shift worker negatively (Madide 2003:1-22).

Circadian rhythms allow organisms to anticipate and prepare for precise and regular environmental changes; they have great value in relation to the outside world. The rhythm appears to be as important in regulating internal metabolic processes, as in coordinating with the environment (Sharma 2003:901-919).

A disturbance of the circadian rhythm can result in health problems. These include seasonal affective disorder, delayed sleep, as well as phase syndrome and other circadian rhythm related disorders. A disruption of the circadian clockwork plays a role in the development of metabolic disorders. Shift-work has profound consequences on circadian and metabolic events in our body (Arble, Bass, Laposky, Vitatema, and Turek 2009:2100-2102).

Shift-work can also exacerbate symptoms and progression of chronic diseases, such as sleeping disorders, digestive disease, hypertension, epilepsy, mental disorders, substance

abuse, type 1 diabetes mellitus, asthma and health conditions that require medication with circadian changes in effectiveness (Costa 2001:1359-1360).

According to Figuero and Rea (2010:92-96) light has a direct effect on circadian rhythms and, consequently, on performance and wellbeing. Students who experience disruption in lighting schemes in the morning consequently experience disruption in sleeping patterns. The change in sleeping pattern may lead to a negatively impacted student performance and alertness. Removing circadian light in the morning delays the dim light melatonin onset by six minutes a day, for a total of thirty minutes for five days. Disruption of the circadian rhythm in the longer term is believed to have significant adverse health consequences on cardiovascular diseases.

Because the incidence of breast cancer in many countries is increasing, for unknown reasons, it is not surprising that society is demanding explanations and researchers are searching for new causes. One avenue of research is the potential link between night-shift working and breast cancer risk (Hansen 2006:74-77).

Several studies have been conducted to investigate the effects of factors that can disrupt circadian rhythm alter normal nocturnal production of melatonin and reproductive hormones. The studies have found (1) an increase in risk of breast cancer and (2) decreased nocturnal urinary levels of 6-sulphatoxymelatonin and (3) an increase in the urinary concerntration of luteinizing hormone, follicle stimulating hormone and estradiol (Davis et al., 2001:1557-1562; Sauchez-Barcelo, Cos, Mediavilla, Martinez-Campa, Gonzalez and Aloso-Gonzalez 2005:217-222; Sauchez-Barcelo,, Cos, and Mediavilla 2003:153-159).

2.5 HEALTH IMPACT OF NIGHT-SHIFT WORKING

Shift work is a work schedule involving irregular or unusual hours, compared to those of a normal daytime work schedule. Many different work schedules can be described as shift-work, including night-shift work and rotating-shift work. The practice typically sees the day divided into “shift” set periods of time during which different groups of workers take up their posts. A recent report on working conditions showed that 20% of the European working

population is involved in some form of shift-work (Abdulrahman Jr and Rahman 2012: 1-13). The term “shift-work” includes both long term night-shifts and work schedules in which employees change or rotate (Sloan Work and Family Research 2013).

Shift-work has been implicated as a risk factor for a number of chronic diseases, including breast cancer, cancers at other sites, cardiovascular disease (CVD) and other related chronic conditions. Shift-work increases the risk for the development of many disorders including:

- Shift work sleep disorder (Megdal et al., 2005:2023).
- Breast cancer (Megdal et al., 2005:2023-2032).
- Cluster headaches (Beck 2013:672-673).
- Type I Diabetes mellitus (Costa 2001:1359-1361)
- Ischaemic heart diseases (Knutsson 2008:152).
- Fatigue.
- Stress.
- Poor sexual performance.
- Eating disorders (Fido and Ghali 2008:453-457).

Costa (2001:1359-1361) indicates that women can be more vulnerable to night-shift work in relation to both their more complex circadian and hormonal rhythms and extra demands related to family life. Disorders of menstrual cycles and reproductive systems have been reported in many groups of women shift workers. The disorders include dysmenorrhoea, abortions, interference with fetal development and low birth weight. Besides, those with families to look after can have more difficulty in managing their irregular working schedule with additional domestic duties thus suffering more sleep troubles and chronic fatigue.

A study by Ohida, Kammal, Sone, Ishii, Unchinyama, Minowa and Nozaki (2001:150-156), further indicates a significant association between working night-shift and the use of alcohol to help induce sleep, and between working on night-shift and day time drowsiness. The average numbers of hours of sleep were also significantly associated with three related sleep items: poor sleep quality, difficulty waking up and day-time drowsiness.

Studies indicate that shift-work leads to negative cognitive effects such as learning and memory deficits, loss of attention and vigilance. Rotating- and night-shift work disrupts circadian clocks which is associated with a higher probability of developing obesity and further, contributing to strain of marital, family and personal relationships (Scheer, Hilton, Mantzoros and Shea 2009:4453-4458).

2.6 BREAST CANCER AND MELATONIN

Melatonin is a hormone produced in the brain mainly by the pineal gland. The production is triggered by darkness and stopped by light. The nocturnal secretion of melatonin is very sensitive to the inhibitory effect of light, and the exposure to light at night, even if it is a short-time exposure to light of low intensity, can cause the melatonin to become decreased or suppressed (Brainard, Kavet and Khaifets 1999:65-100).

Melatonin is absent from the circulatory system during day-time. Its onset in the dim light can be measurable in the blood. Its metabolites can also be measured in the urine early in the morning (Benloucif, Guico, Reid, Wolfe, L'hermite-Baleriaux and Zee 2005:178-188).

Melatonin influences the hormone oestrogen, which controls breast gland development and stimulates the growth of hormone dependent tumours. The mechanisms of action of melatonin in breast cancer development are: the down regulation of pituitary gland, leading to decrease in the circulating levels of gonodal hormones, and the ability to counteract the effects of the hormone eostrogen (Sanchez-Barcelo et al., 2003:153-159). Early research demonstrated that women with breast cancer had lower melatonin levels in their blood. These results are supported by studies that have demonstrated much lower incidence of breast cancer in blind women and even an inverse relationship between breast cancer and the degree of visual impairment. The great the visual impairment the higher the melatonin level, the lower the oetsrogen levels and the lower the risk of breast cancer. Working night-shift suppresses the melatonin levels and unsurprisingly increases breast cancer risk (Hahn 1991:208-210).

A study to investigate the effects of factors that can disrupt circadian rhythm found an altered normal nocturnal production of melatonin and reproductive hormones. The study

has found: 1) an increase in risk of breast cancer; 2) decreased nocturnal urinary levels of 6-sulphatoxymelatonin; and 3) an increase in the urinary concerntration of luteinizing hormone, follicle stimulating hormone and estradiol (Sauchez-Barcelo et al., 2005:217-222). Melatonin also decreases the synthesis of oestrogen from ovaries and as a result decreasing the levels circulating in the body and in reaching the breast. It interacts with the oestrogen receptors on breast cells making them less responsive to oestrogen, and also decreases the activity of aromatase enzyme in a manner similar to aromatase inhibiting drugs (Viswanathan & Schernhammer 2009:1-7). A study by Sauchez-Barcelo and co-workers (2005:217-222) has also found that melatonin in a concentration found in the body at night counteracts the effects of oestradiol at stimulating breast cancer cell growth and tumour invasion.

The hypothesis of the possible role of night-shift work in breast cancer development is based on the evidence that melatonin regulates some of the pituitary and reproductive hormones that control breast development and which are also responsible for the growth of hormone dependent breast tumours (Davis et al., 2001:1557-1562).

While the evidence for association between sleep duration and breast cancer is less convincing, there is increasing research support for a potential link between melatonin or circadian synchronization and breast cancer risk and possibly endometrial and colorectal cancer. Observational studies have implicated a potential role for melatonin in cancer. Persons who engage in night-shift work may exhibit altered night-time melatonin levels and reproductive hormone profiles that could increase the risk of hormone-related diseases (Davis & Mirck 2006:539-545).

Various studies have confirmed that patients diagnosed with breast cancer have measurably lower levels of melatonin. Studies based on the experiments on rodents have also confirmed that circadian disruption or pinealectomy can lead to spontaneous tumor development and increased growth and metastatic potential of existing tumours. While the retrospective trials consistently demonstrate lower melatonin levels in women with breast cancer, it is unclear whether this is due to over or understimulation (Blask 2009:257-264). Further support of light at night's influence can be found in a 2008 landmark study that used data from the US Defence Meteorological Satellite Program to compare light at night

and breast cancer incidence in 147 communities in Israel. The communities with the highest light at night exposure had a 73% higher rate of breast cancer than those living in darker areas (Kloog, Stevens, Haim and Portnov 2010:2059-2068).

While epidemiological data largely confirms the expected trend of increased risk of breast cancer in woman with circadian dysruption through working night-shifts, prospective studies assessing sleep duration and associated risk are conflicting and inconclusive. A study by Verskalo, Lillber, Stevens, Hublin, Partinen, Koskernru and Kaprio (2005:9595-9600), reported that women getting more than nine hours of sleep per night had a 31% lower relative risk of developing breast cancer as compared to those reporting 7-8 hours of sleep per night. In other studies there was no significant difference in the risk of developing breast cancer in those that slept more than nine hours compared to those who slept less (Pinheiro, Schernhammer, Thoroger, and Michels 2006:5521-5525). A fairly large study of 23,995 Japanese women found a significant higher risk in women who slept six hours per night or less (Kakizaki, Kuriyama, Sone, Ohmori-Matsuda, Hozawa, Nakaya, Fukudo and Tuji 2008:1502-1505).

2.7 CONCLUSION

The burden of breast cancer on health care systems has been acknowledged in the resolution of cancer prevention and control by the 58th World Health Assembly which urged for the development and reinforcement of a comprehensive cancer control programme to reduce risk of cancer and improve quality of life for cancer patients and their families, as a result prevention and control were adopted in May 2005 (World Health Organization 2005).

This chapter has presented an overview of breast cancer both locally (South African situation) and globally. The literature review has also identified and discussed in detail a number of factors that can influence the development of breast cancer. The next chapter will discuss the research methodology.

CHAPTER 3

RESEARCH DESIGN AND METHOD

3.1 INTRODUCTION

Chapter 3 discusses the research design and methodology as well as internal and external validity of the study. This study employs an observational descriptive case-control research design to adress the research question formulated in Chapter 1. Research methods such as population, data collection methods, sampling procedures and collection methods are further discussed in this chapter. The validity and reliability of the data collection intrument as well as the ethical considerations are also discussed in this chapter. For the purpose of this study the researcher used the Neuman's model.

3.2 RESEARCH DESIGN

An observational analytical case-control study was conducted between the months of April and July 2013, using the following variables to asses the association of night-shift working and development of breast cancer: age, race, employment status, genetic predisposition and air pollution exposure. Women diagnosed with breast and other types of cancer were recruited. Study purposes and processes were explained during the consent process and written participation and information consent form was obtained. Interviews to assess the association of night- shift working and development of breast cancer were carried out after obtaining the written informed consent of each participant.

The research participants were requested to answer the questions in interviews with the help of research assistants from CANSA in the Vaal Triangle area. Research assistants were trained to conduct interviews and, on ethical research behaviour and in-depth understanding of the questions in the questionnare.

Structured questionnaires were used for this study. The finalisation of the questionnares include a consultative process with breast cancer and methodological experts. Fifty seven(n= 57) women with breast cancer were selected and compared with forty nine (n=

49) control group participants (women) with other types of cancer.

3.3 RESEARCH METHOD

3.3.1 Sampling

Sampling is the process of selecting a portion of a study population to represent the entire population (Polit & Beck 2008:340-345). The non-probability sampling approach was adopted for the purpose of this research as the study employed a case-control design that focuses on a specific disease.

3.3.1.1 Population

A population refers to the entire aggregation of cases in which a researcher is interested (Polit & Beck 2008:337). At the time of the study the population of breast cancer cases at Vaal Triangle offices flactuated around 150 persons. All women between the ages of 18 and 80 diagnosed with cancer and registered with the CANSA offices in the Vaal Triangle were recruited.

3.3.1.2 Sample size calculation

A sample of 96 research participants was calculated based on 95% confidence level and confidence inerval of 6. For non-response 10% was added to the sample size. So the final sample size for the study was 106. A sample size of 106 research participants were recruited from a site population of 150 female cancer patients between the ages of 18 and 80 who are registered with the CANSA office in the Vaal Triangle area. This sample was adequate for the study and valid to do statistical tests.

3.3.1.3 Sampling method

A non-probability convenience sampling was used to recruit participant from the database of the CANSA offices in Vaal Triangle area. All women between the ages of 18 and 80 diagnosed with breast cancer and are registered with the CANSA offices in Vaal Triangle were included in the study.

3.3.1.4 Ethical issues related to recruitment and sampling

Permission from CANSA in the Vaal Triangle area was obtained, as shown in Annexure D. The research proposal of this study also went through CANSA to ensure ethical considerations were met and that there was face-validity. All women between the ages of 18 and 80 diagnosed with cancer, and registered with the CANSA Vaal Triangle offices were included in the sampling frame to avoid biase. There was only one person who did not want to participate because no monetory incentives were given for participation. Informed consent was obtained from each women before participation in the study. The participants were informed that they could withraw from the study at any point and that, if they so desired, their questionnaire would be destroyed. Questionnaires were then assigned a unique reference number that had no link back to the research participant. Confidentiality and anonymity were ensured and at all times maintained.

3.3.1.5 Sample

The final sample of 106 research participants of this study consisted of 57 women diagnosed with breast cancer and 49 women diagnosed with other types of cancer. All research participants were registered with the CANSA Vaal Triangle offices. The inclusions were as follow:

- Women registered with the CANSA Vaal Triangle offices.
- Women between the ages of 18 and 80 diagnosed with cancer.
- All participants were able to read or understand English.

3.3.2 Data collection

The researcher appointed research assistants who were paid to collect data. Women aged between 18 and 80 diagnosed with cancer were invited to participate in the study. The research assistants explained the purpose of the study to all research participants. Research participants who signed participation and information consent forms were included in the study until 106 participants been found. Research participants were either interviewed immediately after signining a consent form or a convenient day was scheduled

for the interview by the research assistants.

3.3.2.1 Data collection approach and method

3.3.2.1.1 Research assistants recruitment and training

Initially about eight research assistants were recruited. After interviews by the researcher only five were given contracts. Research assistants were selected based on their understanding of the aims of the study and questionnaire used for the study and their ability to express themselves in English. Three days were allocated for the training of the research assistants in methodology of conducting the interviews, ethics and the correct use of the questionnaire. Research assistants were paid a stipend of R50.00 per questionnaire filled in properly.

This helped in capacity building and feedback was received that research assistants appreciate the new skills and feel that they can apply it when need be.

3.3.2.2 Development and testing of the data collection instrument

A questionnaire comprising of two sections and 65 questions was developed for the purpose of this reseach as shown in Annexure A**.** Closed-ended questions were used to collect the data. The questionnaire contained questions relating to age (in categories), family history of cancer, social and employment history as well as gynaecological and obstetric history. The initial questionnaire could have limited the responses of participant. However,after reviewing the literature, the researcher included more options. For example, working regular night-shift, regular evening-shift as well as rotating-shift. Questions on exposure to light at night (sleeping with light on at night) were also included.

The variables measured included the following:

► Age
► Race
►Employment status
►History of smoking

►History of alcohol abuse
►Use of contraceptives
►Genetic predisposition
►Personal history of benign breast disorders
►Parity
►Number of births (both live and dead)
►Weight
►Number of years of employment
►Hours worked night per shift (8 hours per night)
►Number of nights worked night-shift per week.
►Number of years worked night-shift.

The questionnaire was validated by two experts to ensure that the questions were valid and reliable. After recommended changes and validation by independent validators, the final questionniare was adopted for the purpose of this research. The questionnaire was then piloted during training to ensure validity and reliability. No further changes were needed after piloting.

3.3.2.3 Characteristics of data collection instrument

The researcher developed the data collection instrument. The items in the instrument were designed based on the literature review and experts opinion. The instrument consisted of biographical data and questions on the social and employment history related to night-shift working. Employment history includes questions on years of working night-shifts, rotating-shifts and whether research participants were exposed to smoke and fumes at their work place. Biographical data consisted of three questions pertaining to age categories, marital status and racial group. This information provides background about the participants, and it was used to assess the difference between the case and control groups or within groups. The average total responses were used for comparisons. The questionnaire is divided into the following two sections:

SECTION A: Biographical data**:**

Age, race and marital status

SECTION B: Factors that influence breast cancer development:

This section assesses personal cancer and medical history, family history of cancer, as well as social , employment and gynaecological history of research participants.

3.3.2.4 Data collection process

Research assistants were used for this study as the number of participants exceeded the capacity of a single individual. Since the researcher is male and the study involved female participants the researcher provided oversight and supervision to the research assistant team and did not interview participants.The research assistants were staff and/ or volunteers from CANSA who are familiar with the patients and other related issues (this was to provide a sense of comfort to the participants and to ensure that interviews were conducted in a sensitive manner).

Data was collected from all participants in exactly the same way, using a questionnaire. Research assistants scheduled an appointment with the prospective research participant who fulfilled the eligibility criteria. The research assistants explained the purpose of the study. Those who chose to participate were requested to sign a written participation and information consent form after being informed of the study, the benefits and risks and their right to withdraw from the study. Thereafter, the research assistants either scheduled another appointment for the interview or the interview took place immediately after signing the participation and information consent form.

3.3.2.4.1 Data verification

The researcher clarified the data with the relevant research assistant both on submission of the filled questionnaire, and when the need arose during data capturing. There was no data verification from the research participants as the data collected was anonymous and follow-up not feasible.

3.3.2.5 Ethical considerations related to data collection

Ethical permission for the study was obtained from the ethics committee of the Department of Health Studies of the University of South Africa (see Annexure E). Research participants were voluntarily requested to sign the participation and information consent form (see Annexure B). The participants were informed that they could withdraw from the study at any point and that, if they so desired, their questionnaire would be destroyed. Anonymity and confidentiality were ensured and maintained through-out the study. To further maintain confidetiality, no form of identifier was allowed in the questionnaires, except the name of the research assistant. Interviews to assess the association of night-shift working and development of breast cancer were conducted immediately or scheduled for the convenient day after obtaining the written informed consent.

The researcher maintained professional ethicality and scientific integrity by properly referencing any ideas, quotations, words, and other statements made by other authors.

3.3.3 Data analysis

The data entailed descriptive statistics which included frequency distribution and percentage for variables of interest. Association between the variables was tested by means of contingency tables and the chi-square (χ^2) (Polit & Beck 2008:556-641). Collected data was analysed (using statistical tests described above) using Epi-Info 7 computer software. In this study odds ratio (OR) is the main ratio used as the risk ratio (RR) is not relevant for case control studies. OR was calculated to provide information on the odds of exposure among cases and control. However, in a case-control study like this one, a predetermined number of cases and controls are selected so their numbers may not reflect the proportions of diseased and non-diseased in the population. It is for this reason that the risk ratio, relative risk and risk difference cannot be calculated (Szusmilas 202:227-229). Contingency tables and Chi-square were computed to describe the statistical significance of the relationship between night-shift work and the development of breast cancer. The analysis of the data will be discussed in more detail with the results in Chapter 4.

3.4 INTERNAL AND EXTERNAL VALIDITY OF THE STUDY

Validity refers to the degree to which an instrument measures what it is supposed to measure (Polit & Beck 2008:457). For the purpose of this study, validity of the data-collection instrument was tested based on face validity and content validity.

The face validity of the questionnaire (the questionnaire looks like it measures what it was intended to measure) was determined by ensuring the questions were phrased correctly. To assist with this validation, the questionnaire was submitted to CANSA who provided input into the different items.

Two other experts were included to determine the content validity of the questionnaire. One expert considered the questions against her knowledge of breast cancer. She is a lecturer in radiology at the University of Johannesburg, specialising in Mammography and breast cancer. She commented on the validity from the perspective of breast cancer patients and from expert knowledge on cancer symptoms and diagnosis.

The other expert considered the structure of the questionnaire and the appropriateness of the questions from a methodological stance. She is a researcher holding a PhD with more than 15 years of research experience and is considered a methodologist. She worked in community and rural health for the University of KwaZulu Natal and is currently employed by the Red Cross.

The researcher's supervisor has also played a crucial role of assisting in formatting, modifying, and validating the data-collection tool. In the end, the questionnaire was believed to measure the research objectives stated by the researcher.

All females diagnosed with cancer who were enrolled with CANSA Vaal Triangle were included in this study to avoid selection bias. These research participants were compared according to their age categories, race groups and genetic predisposition as well as their employment history. All research assistants received training in the methodology of conducting the interviews, ethics and the correct use of the questionnaire. The

questionnaire was then piloted during the training to ensure validity and reliability of the questionnaire and research assistants' conduct and ability to administer the questionnaire. Piloting did not lead to the data collection tool being changed much.

For the purpose of this study structured questions were used for the purpose of this study to ensure that the questionnaires given were the same for all participants and were of a high quality. The control group also received the same questionnaires as the cases. The structured interview was conducted after all research participants had signed a participation and information consent form.

3.5 CONCLUSION

The research design and methology employed by the researcher were discussed in detail in this chapter. Further, sample size, sampling method, population and the study site used were also discussed. In addition, ethical considerations, validity, reliability and characteristics of the data collection tool were described.

CHAPTER 4

ANALYSIS, PRESENTATION AND DESCRIPTION OF RESEARCH FINDINGS

4.1 INTRODUCTION

This chapter outlines the study findings based on the data that was collected from the reseach participants. The purpose of the study was to describe the association of night shift working and the development of breast cancer. The researcher will discuss the demographic characteristics of the research participants and genetic predisposition. Thereafter, employment history and exposure to shift-working will be described. Finally, the relationship between the variables will be described in depth.

4.2 DATA MANAGEMENT AND ANALYSIS

Data was captured manually on the questionnaires by the research assistants during the interview. The researcher used the adopted questionnaire format to developed a response project sheet in Epi-info 7. Data was then entered in the Epi-info sheet and stored as soft copies in the Epi-info. The hard copies are stored securely in a safe place and will be destroyed upon finalisation of the study.

Visual data screening was done by the researcher for any errors and missing values during submission of the questionnaires by the research assistants. Errors that arose during the screening process were clarified immediately by the research assistant where necessary.

Epi-info 7 computer software was used to perform statistical analysis using the captured data . The data entailed descriptive statistics which included frequency distribution and percentage for variables of interest. Association between the variables was tested by means of contingency tables and the Chi-square (χ^2). Contingency tables and Chi-square were computed to describe the statistical significance of the relationship between night-shift work and the development of breast cancer.

In this study the main emphasise is on the OR, since risk ratio is not relevant for case control studies. The OR represents the odds that an outcome will occur given that there was particular exposure as compared to the odds of the outcome occuring in the absence of that exposure. The OR was then calculated to provide information on the odds of exposure in the breast cancer cases compared to the control group. However, in a case-control study like this one, a predetermined number of cases and controls are selected, and as such their numbers may not reflect the proportions of diseased and non-diseased in the population. It is for this reason that the risk ratio, relative risk and risk difference could not be calculated (Szusmilas 2010:227-229).

4.3 RESEARCH RESULTS

4.3.1 Demographic data

In this section, findings on the demographic data of research participants, such as age and racial distribution are presented.

4.3.1.1 Age distribution

The age of research participants ranged from less than 18 to older than 75 years. Sixty seven percent (67%, n=71) of the research participants were in the age group 36-65 years. There was no statistical significant difference between the two groups (case and control) for age distribution (p-value of 0.745). Table 4.1 shows the age distribution of the research participants.

TABLE 4.1: FREQUENCY DISTRIBUTION OF THE AGE OF PARTICIPANTS (N = 106)

	CASES		CONTROL	
Age	**Frequency**	**Percent**	**Frequency**	**Percent**
18-25	2	3.51%	1	2.04%
26-35	5	8.77%	7	14.29%
36-45	10	17.54%	8	16.33%
46-55	21	36.84%	14	28.57%
56-65	11	19.30%	7	14.29%
66-75	5	8.77%	8	16.33%
Older than 75	3	5.26%	3	6.12%
Younger than 18	0		1	2.04%
TOTAL	57	100%	49	100%

4.3.1.2 Racial distribution

Research participants in this study were from black (African) and white women from the Vaal Triangle area of Gauteng province. Sixty seven percent (67%) (n=71) were black-African and thirty three percent (n= 35) were white. There was no statistical significant difference between the two racial groups with regards to cases and control group (p = 0.303). Figure 4.1 below depicts the distribution of the research participants according to racial grouping.

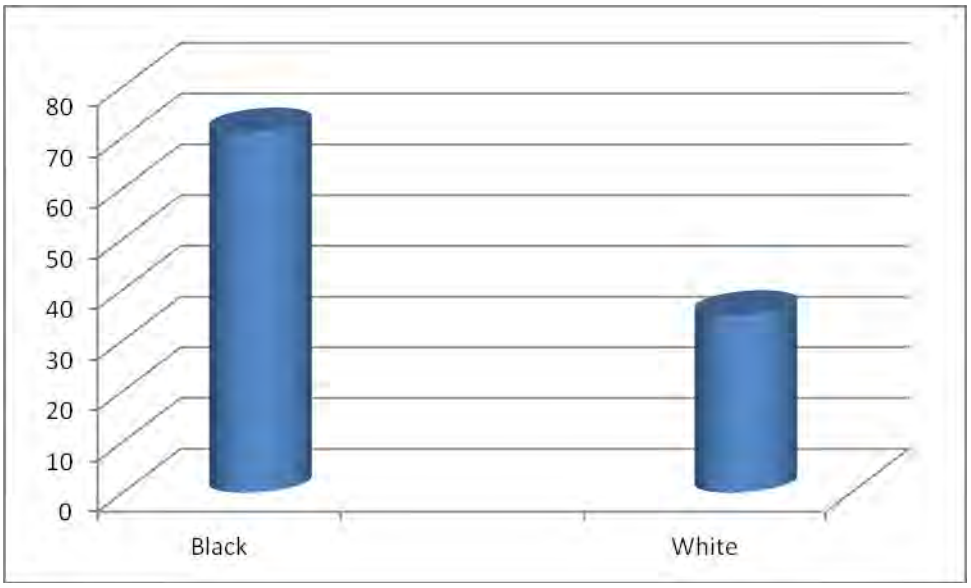

Figure 4.1 Racial distribution of research participants

4.3.2 Factors influencing the development of breast cancer

4.3.2.1 Age at first menses

The majority of the research participants (86%, n= 92) reported menarche at the ages of between 11 and 15 years of age with the mean and median age being 14 years. The distribution of age at first mense was also similar between the cases and control (p=0.0899). Table 4.2 below shows the distribution of research participants according to age at first menses.

TABLE 4.2: FREQUENCY DISTRIBUTION OF THE AGE AT FIRST MENSES OF PARTICIPANTS (N = 106)

	CASES		CONTROL	
Age at first menses	**Frequency**	**Percent**	**Frequency**	**Percent**
9	2	3.51%		
10	1	1.75%	2	4.08%
11	2	3.51%		
12	3	5.26%	8	16.33%
13	12	21.05%	14	28.57%
14	9	15.79%	6	12.24%
15	19	33.33%	8	16.33%
16	5	8.77%	8	16.33%
17	3	5.26%		
18	1	1.75%	2	4.08%
19			1	2.04%
TOTAL	57	100%	49	100%

4.3.2.2 Parity

The researcher also questioned research participants with regard to their parity. Out of 106 research participants 89.6% (n= 95) reported to having children. There was no difference between the cases and control at $p < 0.05$ with regard to parity (p-value = 0.02). Table 4.3 below depicts data of parity distribution in the research participants.

TABLE 4.3: FREQUENCY DISTRIBUTION OF THE PARITY OF PARTICIPANTS (N = 106)

	CASES		CONTROL	
Did/do you have children	Frequency	Percent	Frequency	Percent
Yes	53	92.98%	42	85.71%
No	4	7.02%	7	14.29%
TOTAL	57	100%	49	100%

4.3.2.3 Age at birth of first child

The researcher also explored the age of research participants at birth of the first child. The mean age for birth of first child in the breast cancer group was found to be 22 years whilst that of other types of cancer group was 21 years. The p-value for the variable age at birth of first child was p=0.17. Therefore there was no statistical difference between the cases and control group. Table 4.4 below shows the mean, median and standard devetion calculations for age at birth of first child.

TABLE 4.4: STATISTICAL CALCULATIONS OF AGE AT BIRTH OF FIRST CHILD (N = 94)

	Breast cancer Group	**Other types of cancer control group**
Mean	22.0000	21.4878
Variance	15.3846	17.2061
Standard deviation	3.9223	4.1480
Maximum	15.0000	15.0000
Median	21.0000	20.0000
Maximum	30.0000	33.0000
Mode	25.0000	20.0000

4.3.2.4 History of breastfeeding

Beside age at birth of first child, the researcher also explored the breastfeeding history among research participants. About 71.4% (n= 40) of research participants in the breast cancer group have reported to have breastfed their children; whilst 72.1% (n= 31) of participants other types of cancer group reported to have breastfed their children. Statistical calculations showed no significant difference between cases and control with regard to breastfeeding.Table 4.5 below depicts the response of research participants with regard to the history of breastfeeding their children.

TABLE 4.5: CONTINGENCY TABLE OF BREASTFEEDING VARIABLE (N=99)

Did you breastfeed	Breast cancer	Other types of cancer
Yes	40	31
No	16	12

4.3.2.5 Genetic predisposition

About 57% (n=60) of all interviewed research participants reported a history of cancer in their family. 40% (n= 23) of breast cancer cases reported having a family history of breast cancer whilst 24% (n=15) of breast cancer cases reported having family history of other types of cancer. Of the the research participants with other types of cancer 16% (n=8) reported having a family history of breast cancer whilst 29% (n=14) reported a family history of other types of cancer. Table 4.6 shows the distribution of family history of cancer.

TABLE 4.6: GENETIC PREDISPOSITION VARIABLE (N = 60)

	TYPE OF CANCER		
History of	**Cases**	**Control**	**Total**
Breast cancer	23 (19.63) [0.58]	8 (11.37) [1]	31
Other types of cancer	15 (18.37) [0.62]	14 (10.63) [1.07]	29
Total	**38**	**22**	**60**

4.3.2.6 Employment history

82% (n=87) of women in the study reported a history of being employed. Table 4.7 shows the distribution of employment history among the research participants.

TABLE 4.7 FREQUENCY DISTRIBUTION OF THE EMPLOYMENT HISTORY (N= 106)

	CASES		**CONTROL**	
Have you ever been employed	Frequency	Percent	Frequency	Percent
Yes	47	17.54%	40	81.63%
No	10	82.46%	9	18.37%
Total	57	100%	49	100%

4.3.2.7 Exposure to light at night

About 14% of beast cancer cases reported sleeping with lights on at night, whilst 20% of control reported sleeping with lights on at night. The researcher then calculated both the odds ratio and Chi-square. The odds ratio is calculated to be 0.637 with a Chi-square calculation of 0.759 (95% CI=0.2295 to 1.7665). The p-value is 0.384. This result is not statistically significant at $p< 0.05$

TABLE 4.8 CONTINGENCY TABLE OF LIGHT EXPOSURE AT NIGHT (N = 106)

Do you sleep with lights on at night	Cases	Control	Total
Yes	8	10	28
No	49	39	78
Total	57	49	106

4.3.2.8 Age at first employment

A total of 86 women in the study reported having been employed, the majority of which started working at the age of between 17 and 20 years. The age at first employment was similar between the two groups (p=0.676). Table 4.8 shows the distribution of research participants according to age when they started working.

TABLE 4.9: FREQUENCY DISTRIBUTION OF AGE AT FIRST EMPLOYMENT (N = 86)

	CASES		CONTROL	
Age	**Frequency**	**Percent**	**Frequency**	**Percent**
15	1	2.13%		
16	1	2.13%	1	2.56%
17	1	2.13%	5	12.82%
18	5	10.64%	6	15,38%
19	6	12.77%	5	12.82%
20	10	21.28%	4	10.26%
21	1	2.13%	1	2.56%
22	2	4.26%	3	7.69%
23	1	2.13%	2	5.13%
24				
25	1	2.13%	5	12.82%
26	11	23.40%	1	2.56%
30	2	4.26%	3	7.69%
35	4	8.51%	1	2.56%
36	1	2.13%	1	2.56%
37			1	2.56%
TOTAL	47	100%	39	100%

4.3.3 Shift-work and breast cancer development

4.3.3.1 Night-shift work and the development of breast cancer

The researcher was interested to see whether there was a relationship between night-shift working and the development of breast cancer. Nearly a third, 31.58% (n=18) of research participants in the breast cancer group indicated ever having worked night-shift, while 27.08% of the other types of cancer group also reported having ever worked night-shift. Figure 4.2 below shows the number of research participants who reported to having ever worked night-shift.

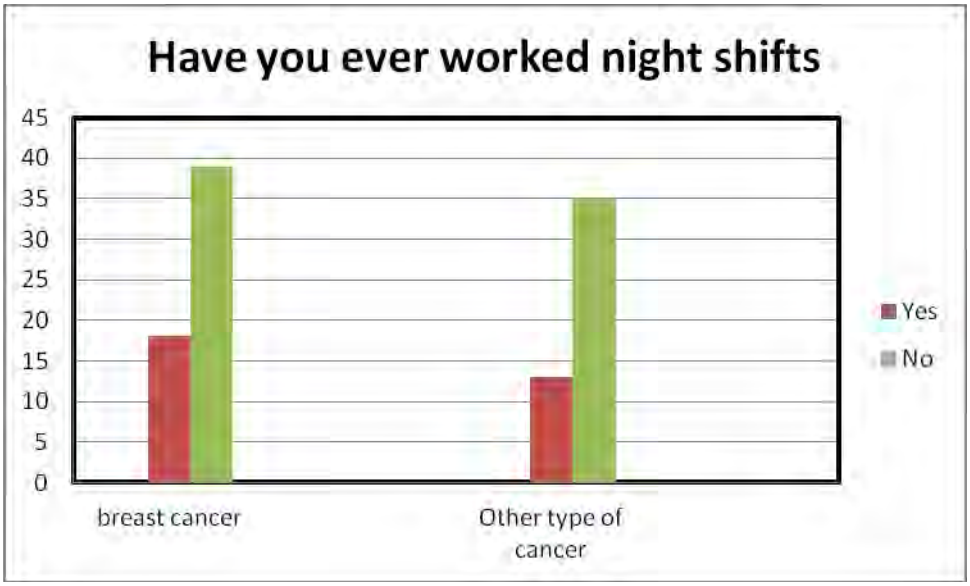

Figure 4.2 Frequency distribution of night-shift work

The researcher then used contingency tables for statistical tests. The calculated odds ratio is 1.24. Thus, women who work night-shift have a 24% higher chance of developing breast cancer than the participants with other types of cancer. We are 95% confident that the true odds ratio is between 0.5328 and 2.8982. Because this value spans 1 the increased odds (OR 1.2426) of working night-shift among research participants with breast cancer do not reach statistical significance. This is further indicated by Chi-square calculations which show a p value of 0.6149. This value is very low. Hence, the relationship between exposure to working night-shift was not considered to be statistically significant. Thus, working night-shift probably does not lead to a higher risk for the development of breast cancer. Table 4.9; table 4.10 and table 4.11 below show statistical calculations performed.

TABLE 4.10: CONTINGENCY TABLE OF NIGHT-SHIFT WORK (n = 105)

History of working night-shift	Breast cancer	Other types of cancer	Total
Yes	18	13	31
No	39	35	74
Total	57	48	105

TABLE 4.11 ODDS RATIO CALCULATIONS OF NIGHT-SHIFT WORK

PARAMETERS	POINT ESTIMATE	95% CONFIDENCE INTERVAL	
		Lower	Upper
Odds Ratio	**1.24**	0.52	2.89
Risk Ratio	1.08	0.72	1.63
Fisher exact		0.49	3.18

TABLE 4.12: CHI-SQUARE CALCULATIONS OF NIGHT-SHIFT WORK

	Value	*Degree of freedom*	*1 Tailed P*	*2 Tailed P*
Chi-square	0.25	1		0.61
Fisher exact			0.39	0.67
No of valid cases	105			

The researcher also compared the history of working night-shift between the black and white research participants. Figure 4.3 below depicts the responses across the two races.

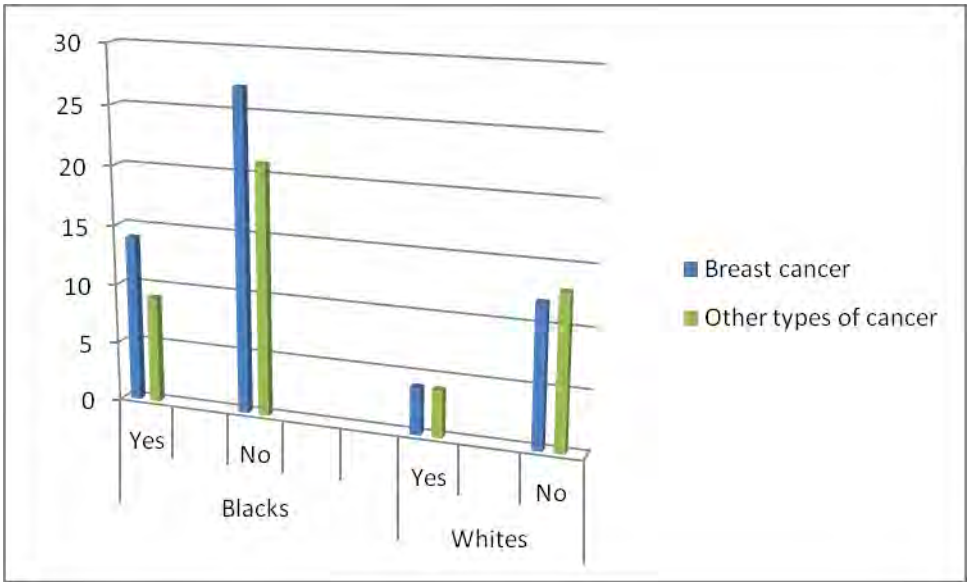

Figure 4.3 Frequency distribution of night-shift work between the races

The calculated odds ratio for black research participants is 1.325 with CI at 95% of 0.439 to 3.323. The point estimate of OR=1.325. The odds of breast cancer in black women with night-shift exposure are 1.325 times greater than the odds of other types of cancer in black women without night-shift exposure. This is not statistically significant, because the 95% interval includes the null value (OR=1). The computed Chi-square p value is 0.582, whilst among white research participants the odds ratio was 1.083 with CI at 95% of 0.220 to 5.326 with p value 0.922. Table 4.12, table 4.13, table 4.14 and table 4.15 shows the odds, Chi-square and Fisher exact calculations of the realtionship between night-shift working and the devlopment of breast cancer amongst the two races participating in this study.

TABLE 4.13: ODDS RATIO AMONGST BLACK PARTICIPATNTS

PARAMETERS	*POINT ESTIMATE*	*95% CONFIDENCE INTERVAL*	
		Lower	Upper
Odds Ratio	**1.325**	0.484	3.621
Risk Ratio	1.127	0.744	1.708
Fisher exact		0.436	4.152

TABLE 4.14: CHI-SQUARE CALCULATIONS AMONGST BLACK PARTICIPANTS

	Value	**Degree of freedom**	**1 Tailed P**	**2 Tailed P**
Chi-square	0.302	1		0.582
Fisher exact			0.385	0.621
No of valid cases	73			

TABLE 4.15 ODDS RATIO AMONGST WHITE PARTICIPANTS

PARAMETERS	POINT ESTIMATE	95% CONFIDENCE INTERVAL	
		Lower	Upper
Odds Ratio	**1.083**	0.220	5.326
Risk Ratio	1.0821	0.7168	1.6336
Fisher exact		0.161	7.253

TABLE 4.16 CHI-SQUARE CALCULATIONS AMONGST WHITE PARTICIPANTS

	Value	*Degree of freedom*	*1 Tailed P*	*2 Tailed P*
Chi-square	0.009	1		0.921
Fisher exact			0.619	1.000
No of valid cases	33			

The researcher then calculated the Odds ratio and risk ratio performed Chi-square test to establish the relationship between having ever worked night-shift and the development of breast cancer. The Chi-square was was performed and calculated to be 0.2531at df= n-1, two-tailed p-value of 0.6149. This value is very low. Hence, the relationship between exposure to working night shift was considered to be not statistically significant. Thus, working night-shift probably does not increase the risk of the development of breast cancer.

4.3.3.2 Rotating-shifts and development of breast cancer

The relationship between working rotating-shift and the development of breast cancer was explored by the researcher. 19% of the research particpants reported a history of working rotating-shift which included night-shift working. Figure 4.4 below depicts the relationship between working rotating-shifts and the development of breast cancer.

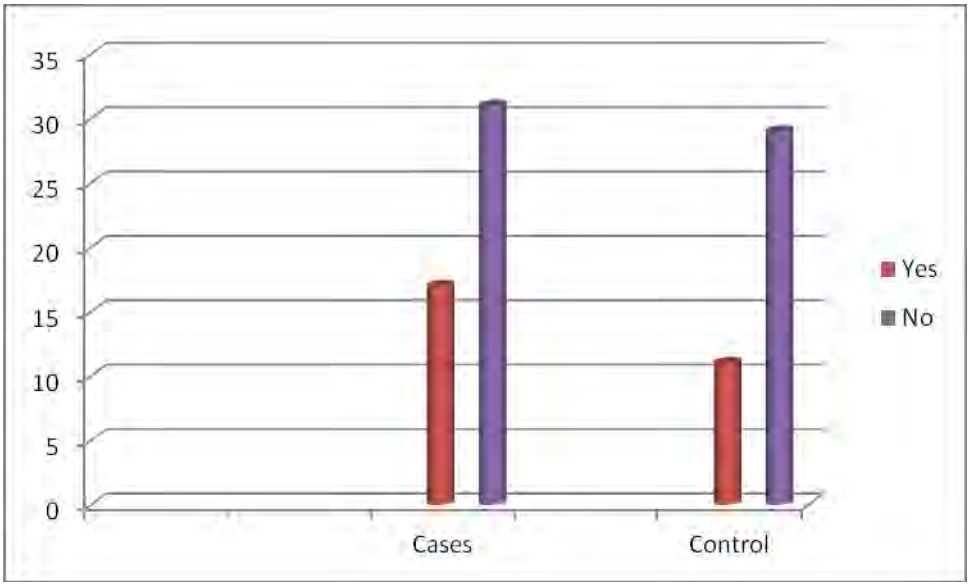

Figure 4.4 Frequency distribution of rotating-shifts work

The researcher then used a contingency table to calculate the odds ratio of research participants who worked rotating-shifts. Table 4.16 below shows the contingency table for working rotating-shifts.

TABLE 4.17: CONTINGENCY TABLE OF ROTATING-SHIFT WORK (N = 88)

Have you ever worked rotating shift	Breast cancer	Other types of cancer	Total
Yes	17	11	28
No	31	29	60
Total	48	40	88

The researcher explored the relationship between working rotating-shifts and the development of breast cancer further by calculating the odds ratio to be 1.445, which was found to small to ascertain statistical significance of the relationship. Chi-square was also computed to ascertain the relationship between the two variables. Chi-square calculation yielded a value 0.630 at df=n-1, with a two tailed p-value of 0.427. This value showed no statistical significant relationship between working rotating-shifts and the development of breast cancer. Table 4.17 and table 4.18 depicts data on the odds ratio and Chi-square calculations of the relationship between the two variables.

TABLE 4.18: ODDS RATIO OF ROTATING-SHIFT WORK

PARAMETERS	*POINT ESTIMATE*	*95% CONFIDENCE INTERVAL*	
		Lower	Upper
Odds Ratio	**1.445**	0.580	3.599
Risk Ratio	1.175	0.799	1.728
Fisher exact		0.531	4.024

TABLE 4.19: CHI-SQUARE CALCULATIONS OF ROTATING-SHIFT WORK

	Value	Degree of freedom	1 Tailed P	2 Tailed P
Chi-square	0.630	1		0.427
Fisher exact			0.287	0.495
No of valid cases	88			

The odds ratio of working rotating-shift among breast cancer and other types of cancer participants was also calculated to be 1.445. Thus, the odds of working night-shift is 1.445 higher in breast cancer research participants compared to research participants diagnosed with other types of cancer. Since the 95% CI of 0.580 to 3,598 spans 1.0, the increased odds (OR 1.44) of working night-shift among research participants with breast cancer does not reach statistical significance. This is indicated by Chi-square calculations which show a p value of 0.427.

4.3.3.3 Regular night-shift work and the development of breast cancer

The relationship between regular night-shift and development of breast cancer was measured using a contigency table to determine odds and risk ratio. Table 4.19 below shows the data collected.

TABLE 4.20: CONTINGENCY TABLE OF REGULAR NIGHT-SHIFT WORK (N = 88)

Have you ever worked regular night-shift	Breast cancer	Other types of cancer	Total
Yes	1	0	1
No	47	40	87
Total	48	40	88

The researcher calculated the odds ratio for regular night-shift work within the research participants. Table 4.20 and 4.21 below shows the calculated odds ratio and Chi-square respectively.

TABLE 4.21: ODDS RATIO OF REGULAR NIGHT-SHIFT WORK

PARAMETERS	POINT ESTIMATE	95% CONFIDENCE INTERVAL	
		Lower	Upper
Odds Ratio	**undifined**	Undifined	Undifined
Risk Ratio	1.185	1.524	2.247
Fisher exact		0.021	-1.000

TABLE 4.22: CHI-SQUARE CALCULATIONS OF REGULAR NIGHT-SHIFT WORK

	Value	*Degree of freedom*	*1 Tailed P*	*2 Tailed P*
Chi-square	0.849	1		0.359
Fisher exact			0.545	1.000
No of valid cases	88			

4.3.3.4 Regular evening-shift work and the development of breast cancer

The research lastly explored the relationship between working regular evening-shift and the development of breast cancer. Table 4.22 below show the contingency table for regular evening-shift.

TABLE 4.23: CONTINGENCY TABLE OF REGULAR EVENING-SHIFT

Have you ever worked regular evening-shift	Breast cancer	Other types of cancer	Total
Yes	2	1	3
No	46	39	85
Total	48	40	88

The odds ratio was further calculated to be 1.696, with a risk ratio of 1.232. Table 4.23 and table 4.24 below depicts statistical calculations.

TABLE 4.24: ODDS RATIO OF REGULAR EVENING-SHIFT WORK

PARAMETERS	*POINT ESTIMATE*	*95% CONFIDENCE INTERVAL*	
		Lower	Upper
Odds Ratio	**1.696**	0.148	19.418
Risk Ratio	1.232	0.541	2.808
Fisher exact		0.085	102.564

TABLE 4.25: CHI-SQUARE CALCULATIONS OF REGULAR EVENING-SHIFT

	Value	**Degree of freedom**	**1 Tailed P**	**2 Tailed P**
Chi-square	0.184	1		0.668
Fisher exact			0.569	1.000
No of valid cases	88			

The odds ratio of regular evening-shift among breast cancer and other types of cancer research participants was calculated to be 1.69. Thus, the odds of working regular evening-shift is 1.69 in breast cancer research participants compared to research participants diagnosed with other types of cancer. Since the 95% CI of 0.1481 to 19,4177 spans 1.0, the increased odds (OR 1.6957) of working night-shift among research participants with breast cancer does not reach statistical significance. This is indicated by chi-square calculations of 0.184 with a p value of 0.668.

4.4 OVERVIEW OF RESEARCH FINDINGS

For the purpose of this study, data was collected and analysis from 106 interviewed research participants in the Vaal Triangle area in the period between April and July 2013. A number of factors that influence the development of breast cancer were explored as well as biographical data.

The relationship between night-shift work and the development of breast cancer was analysed and compared between the cases and control. About 68% (n=72) who were interviewed were black women, while 33% (n=35) were white women. Of the 106 research participants, 82% (n=87) of participants have a history of being employed, while 18% (n=19) have never been employed. Analysed data shows that 29% (n=31) of women have

a history of working night-shift. Of the 31 research participants that reported having worked night-shift 90% (n=28) have actually worked rotating-shift work rather than regular night-shift work.

The odds ratio of working night-shift was found to be 1.24 higher in breast cancer research participants as compared to research participants diagnosed with other types of cancer for which is 0.80 (p=.61). Although this study showed no statistical significance in the relationship of night-shift work and the development of breast cancer, the odds ratio for breast cancer development in women who work rotating-shift was higher than in participants who reported regular night-shift work.

4.5 CONCLUSION

Chapter 4 presented the analysis and data collected from 106 interviewed research participants in the Vaal Triangle area. The demographic data and factors that influence the development of breast cancer were analysed in this chapter. The researcher calculated the odds ratio as well as Chi-square to determine the relationship between night-shift work and the development of breast cancer. The next chapter discusses the result, limitations, recommendations, and conclusion of the study.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

In this chapter the researcher will discuss the research findings in detail, then describe the limitations of this study, and lastly make recommendations based on the research findings.

5.2 RESEARCH DESIGN AND METHOD

An observational analytical case-control study was conducted between the months of April and July 2013, using the following variables: age, race, employment status, genetic predisposition and air pollution exposure, to assess the association of night-shift working with the development of breast cancer.

Structured questionnaires were used for this study. The finalisation of the questionnares include a consultative process with breast cancer and methodological experts. The non-probability sampling approach was adopted for the purposes of this research. A sample of 96 research participants was calculated based on 95% confidence level and a confidence interval of 6. 10% was added to the sample size for non-response. So the final sample size for the study was 106. A sample size of 106 research participants was recruited from a site population of 150 female cancer patients between the ages of 18 and 80 who are registered with the CANSA office in the Vaal Triangle area.

5.3 SUMMARY AND INTERPRETATION OF RESEARCH FINDINGS

The study was carried out to describe the relationship between night-shift work and the development of breast cancer. For the purposes of the study 106 women were interviewed. Of the 106 research participants interviewed, 57 were patients with breast cancer and 49 with other types of cancers (forming the control group). 71 were black women and 35 were white women. About 39% (n=41) of women diagnosed with breast cancer were black and 15% (n=16) were white. For other types of cancer, 28% (n=30) of the women were black

whilst 17% (n= 18) were white. 67% (n=71) of the research participants were aged between 36 and 65 years .

Looking at variables which influence the development of breast cancer, it is apparent from the data in chapter 4 that the distribution of these variables was similar across the cases and control. The distribution of variables such as age at first menses, age at birth of first child, history of breast feeding and parity were similar across the cases and control group. Testing of genetic predisposition variables followed the expected normal finding with 40% of breast cancer cases reporting having had a family history of breast cancer as compard to only 16% of the control group.

Scheer and co-workers (2009:4453- 4458) demonstrate that shift work is a risk factor for many health problems. In order to maintain the demand for an improved efficiency in some industries, there has been an increasing drive towards the use of shift-workers. Costa (2001:1359-1360) also indicates that women can be more vulnerable to shift-work as regards their complex circadian rhythm and extra demands related to family life. Further, studies in the literature have analysed the relationship of shift-work and the development of breast cancer.

Among research participants in this study who reported having worked night-shift (n=31), the majority [(90%) (n=28)] had worked rotating-shift, while only 10% (n=3) reported to having worked either regular night or evening shift. The odds of having ever worked night-shift are 1.24 higher in breast cancer cases as compared to research participants diagnosed with other types of cancer for whom it was 0.80 (p=.61).

About 32% (n=18) of breast cancer cases reported working night-shift. In terms of best describing the hours that participants worked night-shift, the study found that about 30% of breast cancer cases actually worked rotating-shift rather than regular night-shift. Only 1.7% of breast cancer cases reported regular night-shift work. In the control group this was more evenly distributed with 22% of the control group reporting night-shift working, whilst 24% (n=12) reported rotating-shift work.

The odds of working rotating-shift are 1.4 greater in breast cancer research participants than in research participants with other types of cancer for whom it is 0.79 (p=42). Even though a larger number of research participants reported working rotating-shift than night-shift, it seems that working rotating-shift is not statistically strongly related to the development of breast cancer, even though the odds in favour of development of breast cancer in women who worked rotating-shift were greater than those with other types of cancer. There was also no statistically significant relationship between working regular night- and evening-shifts and the development of breast cancer. The odds ratio of this study is slightly lower than that reported by Megdal and co-workers (2005:2023-2032) who found a summary relative risk of (RR) 1.48 (95% confidence interval {CI} 1.36- 1.91) in a meta-analysis of the data on night-shift work and breast cancer.

The study demonstrated that there was no statistically significant association seen between women employed in night-shift work and the development of breast cancer. However, the odds of working night-shift among breast cancer cases is 1.24 greater as compared to (OR= 0.80) among the control group. While the estimated odds ratio in this study is larger for breast cancer cases there was no statistical significant difference between the breast cancer cases and the control group as supported by Chi-square 0.25 (p-value=0.61). When classifying night-shift work as a 'probable carcinogen' the IARC working group noted that a number of existing studies in humans were limited to nurses (Straif et al., 2007:1065-1066). This study was not limited to nurses or health workers as the relationship between night-shift work duration and breast cancer risk was similar for those employed in both health and non health occupations (Grundy, Richardson, Burstyn, Lohrisch, SenGupta, Lai, Lee, Spinelli and Aroson 2013:1-7). This study did not consider occupational exposure to be a confounder.

A study conducted by Lie and co-workers (2011:39-44) has found that there was an increase in the risk of breast cancer among those women working more than 30 years night-shift. This study tested the relationship between night-shift work and breast cancer in women who worked night-shift between 5 and 20 years. Schernhammer and co-workers(2001:1563-1568) have reported an increased breast cancer risk for postmenopausal women following more than 30 years of rotating-shift work whilst Schernhammer and co-worker (2006:108-111) have reported a breast cancer risk in

premenopausal women working rotating-shift for more than 20 years. Therefore, the results of this may be inconsistent with results of other studies due to the length of occupation where the exposure took place (Schernhammer et al., 2001:1563-1568; Schernhammer et al., 2006:108-111). The findings of the current study are, however, consistent with a population-based case-control study which showed a non-significant increased risk for engaging in shift work for over 20 years (Pesch et al., 2010:134-141). The inconsistency of findings from these studies may be explained, in part, by variations in definition of shift-work and study design, potential recall bias, focus on a single profession versus multiple professions, and incomplete adjustment for confounding factors (Anjoeka et al., 2010:953-959).

In conclusion, the results of this study, demonstrate no statistically significant relationship between night-shift work and the development breast cancer. This finding is consistent with other studies that seem to support the association of breast cancer development and night-shift work as reported mainly in women who work rotating-shift for more than 20 years in premenopausal and more than 30 years in postmenopausal women (Schernhammer et al., 2001:1563-1568; Schernhammer et al., 2006:108-111). As most industries improve their efficiency by an increasing drive towards using rotating-shift and also with added vulnerability of women to shift-work (e.g women getting more involved in industries and work previously reserved for men) in relation to their health, an understanding of which patterns increase the risk for breast cancer risk and how night-shift work influences the breast cancer pathway is needed to inform policy makers about possible preventative and even curative measures in the fight against this potentially fatal condition.

5.4 CONCLUSION

Since breast cancer is becoming a major cause of death, prevention or limiting exposure to known carcinogens appears to be a logical way to reduce the incidence of breast cancer and cancer in general. With the increasing incidence of breast cancer there is a real need to consider all appropriate and effective measures regarding proven links to breast cancer, with the aim of reducing the burden on healthcare systems (Martijn, Rob, Carin, Uyl-de, Benjamin and Gabriel 2005). The aim of this study was to describe the relationship between night-shift working and the development of breast cancer. The study has revealed

that women who work night-shift are 1.24 times more likely to develop breast cancer than women who do not work night-shift. Based on these results the researcher would recommend that the relasionship between night-shift exposure and breast cancer risk be further explored through other sensitive research designs and pathways.

5.5 RECOMMENDATIONS

Due to the scope of the study it is not possible to make generallisation regarding shift-work, the main recommendation is related to further research on rotational-shifts.

5.5.1 Recommendation regarding night- and rotating-shift work variables

As the majority of participants reported rotating-shift work rather than regular night-shift work, it is necessary that future studies be designed to explore rotating-shift work even further. Specific occupations could be studied or investigated.

5.5.2 Recommendation regarding the sample size

It is recommended that a larger sample (from a larger geographical area) be used at provincial or national level to determine the relationship between breast cancer development and night- and rotating-shift work. Since some studies shows the relationship of night-shift working and breast cancer risk for women who worked night-shift for over 30 years, it is recommended that future studies concentrate on women who worked night- and rotating-shift for more than 30 years.

5.5.3 Recommendation on study design

More sensitive research design such as cohort and cross-sectional studies should be employed to further determine the association of shift-work and breast cancer risk.

5.5.4 Recommendation on age

It is recommended that for future studies women be separated into premenopausal and post menopausal groups to compare the prevalence of breast cancer in women working shifts.

5.6 CONTRIBUTIONS OF THE STUDY

Although the results of this study do not show a statistically significant relationship between night-shift work and breast cancer risk, it does, however, support other studies which have showed a moderate increase in the risk for breast cancer in women who worked rotating shift for 1-14 years (RR=1.08, 95% CI= 0.99-1.18) but higher risk for women who worked rotating-shift for more than 30 years (RR=1.36, 95% CI=1.04-1.78) (Schernhammer et al., 2006:1164-1124). Therefore, since breast cancer is a public health concern; and since there is a drive to shift-work for women it will be necessary that any potential carcinogen be investigated with the aim of reducing the morbidity and mortality of this condition.

5.7 LIMITATIONS OF THE STUDY

This study encountered some limitations. The main limitations for this study as identified by the researcher include, representativeness of the research participants, and the data-collection instrument used by the researcher.

For the purposes of this study the researcher used a non-probability sampling method, as it was difficult to use probability sampling and select research participants randomly in a case-control design. Because the study population consisted of women at one CANSA office, the results may not be generalisable to all breast cancer women in Gauteng, however, they can be used as a foundation for more sensitive research designs.

Even though the researcher included perception testing, the data-collection instrument, which was a structured questionnaire with closed-ended questions, might have limited research participants' personal views. However, after conducting a literature review, the researcher incoporated a number of questions that provided research participants with a broader choice of responses.

5.8 CONCLUDING REMARKS

The findings from this study show there is no statistically significant relationship between night-shift work and the development of breast cancer. However, these results, in combination with results from other studies, support the notion that the relationship may probably be more evident in those who were exposed to more than 30 years of shift work. More observational and experimental research are required explore further, factors that contributes to the risk of breast cancer development in women working rotating-shifts.

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Annexure A

The association of night-shift work with the development of breast cancer in women

QUESTIONNAIRE

Ref:

To be completed by the research assistant interviewing the participant.

Interviewer:……...Date:……

SECTION A: Biographical data

1) Age:

Age category	
Younger than 18	
18-25	
26-35	
36-45	
46-55	
56-65	
66-75	
Older than 75	

2) Race

Racial group	**Tick**
Black	
Coloured	
Indian	
White	
Other	
	Specify:

3) Marital status

Marital status	**Tick**
Single	
Married	
Widowed	
Divorced	

SECTION B: Factors influencing development of breast cancer

i) Cancer history

1) What year were you diagnosed with cancer?…….

2) How old were you when you were first diagnosed?…….

3) What type of cancer were diagnosed with?

Group	**Tick**
Breast cancer	
Other cancer (control group)	

4) Do you **think** anything specifically caused your cancer (perception of patient)? No( ), Yes( ).

5) If yes in question 4; what do you think specifically caused your cancer?.....

ii) Medical history

1) Have you ever or do you: (circle the appropriate answer)

- Do you smoke Yes No
- Have you ever drunk alcohol Yes No
- Do you drink alcohol Yes No
- Have you ever been overweight Yes No
- Are you overweight Yes No
- Have you ever been employed Yes No

- Are you employed Yes No
- Have you ever worked night-shifts Yes No
- Are you working night shifts Yes No

2) Do you suffer from any other medical condition? Yes No

3) If yes please specify ……..

4) Are you on any medication at the present time? Yes No

5) If yes please specify……

6) What is your weight?.....

7)Have you noticed any weight loss in the past 10 to five years?.....

iii) Family History

1) Breast cancer Yes[ ] No[ ] Unknown[ ]

2) Other types of cancer Yes[ ] No[ ] Unknown[ ]

3) Specify type of cancer in family (i):……..Relationship to participant.....

(ii)……Relationship to participant…….

(iii)…….Relationship to participant……...

iv) Social History

1 Have you ever smoked? **Yes No**

2) If Yes:

(a) How old were you when started smoking……..

(b) How many cigarettes did / do you smoke per day? ……...

3) How often do you drink alcohol?.....

(a) How often per week?…….

(b) How many units (beer, glasses of wine or tots)?.....

4) Have you ever exercised? **Yes No**.

5) If Yes:

(a) how many times per week?.....

6) Do you exercise? **Yes No**

7) If yes how many times per week?.....

8) In the past, have you ever slept with the lights on at night? Please tick the answer

Answer	Tick
Always	
Frequently	
Seldom	
Never	

9) Do you currently sleep with lights on at night? **Yes No**

v) Employment History

1) Have you ever been employed? **Yes No** (if No then skip to section G)

2) How old were you when you starting working?……..

3) Please list all full time or part time jobs you have had, starting with the earliest one and finishing with your current job.

Type of job	How long in the job (in months)

4) Have you ever worked more than 40 hours or more per week……

5) What kind of business or industry was/is your current job…….

6) Which of the following best describes the hours you usually/used to work at the job you worked the longest period time? (Tick the most appropriate)

(a) Regular day time (Between 6am and 6pm)

(b) Regular evening shift (Between 2pm and 12pm)

(c) Regular night shift (Between 6pm and 6am or 9pm and 8am)

(d) Rotating shift

7) In any of your jobs, have you ever been exposed to dust from rocks, sand, concrete, coal, asbestos, silica, or soil. **Yes [ ] No [ ]**

7b) If yes, please give the total number of years for all jobs where this has happened……

8) In any of your jobs, have you ever been exposed to exhaust fumes from trucks, buses, heavy machinery, or diesel engines. **Yes [ ] No [ ]**

8b) If yes, please give the total number of years for all jobs where this has happened……..

9) At job that you worked the longest period of time, have you ever been exposed to tobacco smoke from other people's cigarrettes or pipes…….

10) Please give the total number of years for all jobs where this happened……..

vi) Gynaecological and obstetric history

1) Age at first menses……

2) Have you ever used family planning/ contraceptives? **Yes No**

3) Do you currently use contraceptives? **Yes No**

4) Did/ do you have any children? **Yes [ ] No [ ]**

5) If Yes:

(a) How many…….

(b) Age at birth of first child…….

(c) Did you breast feed your children? **Yes No**

(d) How many children did you breast feed?.....

(e) How long did you breastfeed each child 1)……

2)……..

3)……..

4)……..

5) In total how many pregnancies did you have……..

6) Were you ever diagnosed with any other breast diseases before the diagnosis of your cancer? **Yes [ ] No [ ]**

7) If Yes:

►When were diagnosed with this disorder?.....

►Which disorder?.....

►What was the prognosis?.....

THANK YOU FOR TAKING TIME TO PARTICIPATE IN THIS STUDY.

Annexure B

PARTICIPANT CONSENT AND INFORMATION FORM

Dear participant

My name is Dr Phaswane Isaac Justice Moukangoe and I am doing my Masters in Public Health at the University of South Africa. I am currently conducting a research study to determine the prevalence of breast cancer in women working night-shifts or who experienced circadian rhythm disturbances.

Breast cancer constitutes more than 20% of all cancers in women and is the commonest cause of death in women 35-55 age group (Underwood 2000). One in 29 South African women is diagnosed with breast cancer each year, a significant number that translates to thousands of cases annually. Most terminal cases occur among black women, the majority of whom seek medical help after the disease has developed into its late stages (CANSA 2010).

Exposure to light at night over long periods may lead to the disturbance of the circadian rhythm and this has been suggested as a contributing cause of breast cancer. This exposure is of public health concern, since shift- and night-time work is prevalent and increasing in modern societies, and contributes to the continuing elevation in breast cancer risk (Hansen, 2006).

If you are a female between the ages of 18 and 80 years diagnosed with breast and any other type of cancer, you are invited to take part in the study. If you are not diagnosed with cancer, you will not be able to take part in the study. Structured interview will be conducted. Participation is free and the study will be for 8 weeks. There will be no follow-up. The employee of CANSA will schedule an appointment to come see you and help answer some of questions that might arise during the collection of information.

You are kindly requested to sign this consent and information form at your first visit. You will then be requested to answer the questionnaire given to you. If you are included in the study, you will be placed into one of the two groups consisting of 48 participants each. One group will be those with diagnosed with breast cancer, and the other group will be those

diagnosed with any other type of cancer. You will be requested to answer the questionnaire and after that there will be no follow-up consultation.

At the end of the study your results will be used for statistical analysis. If you wish to have feedback with regard to the study results, they will be made available to you. Confidentiality and anonymity will be maintained throughout the study and no personal details will be revealed.

Participation in the study is voluntary and you are free to refuse to participate or withdraw your consent and to discontinue participation at any time. Such refusal or discontinuance will not affect your relationship with CANSA in any way.

I, the participant, have been fully informed of the procedure of the study. In signing this consent form, I agree to participate in the study and understand that I am free to withdraw my consent and discontinue with the study at any time. I understand that if I have any questions at any time, the researcher will answer them.

Date: …….. Signature (Participant):……

I, the researcher, have fully explained the procedures and purpose of the study. I have asked if there are any questions and have answered them to the best of my ability.

Date: ……. Signature (Researcher): ……

0735529158
Supervisor: Dr M Jansen van Rensburg
0824035758

Annexure C

P O Box 14321
Zuurfontein
1912
22 August 2012

The Manager
CANSA Vaal

RE: Application to Conduct a Research Study

Dear Sir/ Madam

I am wrtiting to request a permission to conduct a research study at your institution. I am currently enrolled for the Master Degree in Public Health (MPH) with the University of South Africa; and I am expected to conduct a research study as a requirement for the degree. May I therefore, request your permission to conduct this study in CANSA Vaal.
The topic for my research is **'' THE ASSOCIATION OF NIGHT-SHIFT WORK WITH THE DEVELOPMENT OF BREAST CANCER IN WOMEN" (copy of proposal enclosed).**

This is a quantitativde analytical Case-contro study as it uses the structured questionnaire to collect data retrospectively. I hope to recruite women with diagnosed with all types of cancer to anonymously complete their questionnaire (copy enclosed) and return to the researcher. Women who volunteer to participate will also be given consent forms to be signed and returned to the researcher (copy enclosed).

If approval is grated, CANSA volunteers will be trained and employed as field workers. They will conduct structured interview with the participants on agrred time. The questionnaire results will be pooled for the derssitation and individual results of this study will remain absolutely confidential and anonymous. The study process should take no longer than eight weeks. No costs will be incurred by either your association or the individual participants.

Your approval to conduct this study will be hioghly appreciated. You may contact me on my email address: drphasoane@live.co.za or cellphone: 0735529158.

Thanking you in anticipation.
Yours truly
Phaswane Isaac Justice Moukangoe

CANSA
Cancer Association of South Africa
Research • Educate • Support

Toll-Free 0800 22 66 22
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GAUTENG
Vaal Region

016 423 3506 Tel
016 423 3582 Fax

Three Rivers Retirement Village Phase 2 Address
65 Bashee Str. Three Rivers, 1939

P O Box 264248 Postal
Three Rivers, 1935

Dear Dr Phaswane

This letter serves as permission granted to you to work with our volunteers to conduct your research on; **The association of night-shift work with the development of breast cancer in women**. CANSA Vaal Triangle volunteers will be trained and employed as field workers. They will conduct structured interviews with the participants on agreed time. The questionnaire results will be pooled for the dissertation and individual results of this study will remain absolutely confidential and anonymous. The study process should take no longer than eight weeks. No costs will be incurred by CANSA Vaal Triangle or the individual participants.

Participants are to sign consent forms and participate at a voluntery bases. CANSA Vaal Triangle will not be responsible for any damage or harm done.

All the best with the research

Regards

Lesang Moholobela
Acting Regional Manager

UNISA university of south africa

UNIVERSITY OF SOUTH AFRICA
Health Studies Higher Degrees Committee
College of Human Sciences
ETHICAL CLEARANCE CERTIFICATE

HSHDC/153/2013

Date: 6 March 2013 Student No: 3475-117-3

Project Title: The association of night shift work on the development of breast cancer in women.

Researcher: Phaswane Isaac Justice Moukangoe

Degree: Masters in Public Health Code: DLMPH495

Supervisor: Dr MS Jansen van Rensburg
Qualification: PhD
Joint Supervisor: -

DECISION OF COMMITTEE

Approved [√] **Conditionally Approved** [ ]

Prof L Roets
CHAIRPERSON: HEALTH STUDIES HIGHER DEGREES COMMITTEE

Prof MM Moleki
ACTING ACADEMIC CHAIRPERSON: DEPARTMENT OF HEALTH STUDIES

PLEASE QUOTE THE PROJECT NUMBER IN ALL ENQUIRES