# The Impact of Chemotherapy for Breast Cancer
# on Managing Daily Tasks: A Longitudinal Study of Cognitive,
# Psychosocial and Safety Outcomes in the
# Home and Workplace

by

Catherine Louise Lawrence

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# Abstract

**BACKGROUND.** Breast cancer is the most common type of cancer in women in the UK and is often treated with chemotherapy. Psychosocial side effects (anxiety, depression and fatigue) and cognitive side effects (memory and concentration difficulties) are frequently reported by breast cancer patients. Following recent advances in screening and treatment technology for the disease, survivorship rates have increased. Therefore, women are able to continue or resume their daily tasks during and following treatment. The impact of chemotherapy-related psychological side effects on quality of life and work ability are documented, however the impact on safety outcomes has currently been overlooked in this patient population. Evidence from other research fields suggests that anxiety, depression, fatigue and cognitive difficulties are associated with increased risk of accidents and injuries. **OBJECTIVES.** This research provides longitudinal self-report data on psychosocial well-being, cognitive function, quality of life, work ability and accident frequency outcomes. **METHOD.** A mixed-methods, prospective, longitudinal approach was employed. Breast cancer patients about to undergo chemotherapy treatment ($n = 60$) completed questionnaires at pre-treatment baseline, and again four months (follow-up time 1), eight months (follow-up time 2), and twelve months (follow-up time 3) later. A treatment control group of breast cancer patients receiving radiotherapy ($n = 56$), and an age-matched healthy control group ($n = 58$) were assessed at comparable intervals. In addition, a subsample of participants from the chemotherapy group ($n = 11$), radiotherapy group ($n = 6$), and healthy control group ($n = 15$) kept personal solicited diaries for a four-month period to capture the lived experience of managing daily tasks. The diary data were examined using thematic analysis. The combination of the quantitative and qualitative approaches added breadth and depth to the study with the aim of obtaining a realistic and comprehensive understanding of the impact of chemotherapy for breast cancer on patients' daily lives. **RESULTS.** Chemotherapy patients reported a subtle decline in psychosocial well-being, cognitive function and quality of life, and encountered more accidents, particularly at mid-chemotherapy. **CONCLUSION.** It is important that healthcare professionals, breast cancer patients, relatives and employers are aware of the temporal fluctuations associated with chemotherapy-related side effects, particularly potential safety outcomes. Interventions could be developed to help patients manage their daily tasks in the home and in the workplace safely.

**KEYWORDS.** Breast cancer; chemotherapy; psychosocial well-being; cognitive function; safety; quality of life; work ability; self-report.

# Acknowledgements

# Conferences

Lawrence, C., McDermott, H., Munir, F., Esler, C., Boiangiu, I., Ahmed, S., Khan, S., & Morgan, D. (2011, July). *A longitudinal study of the psychosocial and cognitive side effects of chemotherapy for breast cancer: Safety implications in the home and workplace.* Oral presentation at the Psychology Postgraduate Affairs Group conference, Bangor, UK.

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# Table of Contents

## Chapter Four
## A Review of the Literature on Safety Outcomes associated with Anxiety, Depression, Fatigue and Cognitive Difficulties

## Chapter Five
## Methods: Questionnaire Survey

## Chapter Nine
## The Impact of Chemotherapy for Breast Cancer on Patients' Daily Lives During and Shortly Following Treatment

## Chapter Ten
## Discussion

## References

# List of Tables

# List of Figures

# List of Appendices

# Chapter One

# Introduction

## 1.1    The Research Problem

Breast cancer is a disease in which cells in the breast tissue grow at an abnormal and uncontrollable rate. It is one of the most common types of cancer in the UK and is particularly prevalent in women, with approximately 46,100 diagnoses annually, but is rare in men, with only 400 diagnoses per year[1] (Office for National Statistics, 2012). Following recent advancements in cancer screening technology and treatment regimens, the survival rate for breast cancer has increased. Subsequently, research has shifted from extending patients' survival (*quantity* of life) to understanding and enhancing their *quality* of life during and following treatment (Bakitas, Lyons, Hegel, & Ahles, 2012; Reid-Arndt, Hsieh, & Perry, 2010).

Chemotherapy is one of the main conventional treatments for breast cancer, yet it is associated with a number of adverse biological and psychological side effects. Over the past 30 years, research has examined the impact of chemotherapy on cognitive function. There have been reports of cognitive impairment in up to 90% of breast cancer patients undergoing chemotherapy (Pullens, De Vries, & Roukema, 2010). The types of cognitive difficulties that characterise chemotherapy-related cognitive impairment, or 'chemo brain' as coined by breast cancer patients, include deficits in memory and concentration abilities. A number of studies have documented impairment enduring up to ten years post-treatment (Ahles et al., 2005). Since cognitive difficulties can have a profound impact on breast cancer patients' quality of life (Ahles & Saykin, 2001; Tannock, Ahles, Ganz, & van Dam, 2004), it is important to recognise the implications of this side effect on daily functioning. In turn, this could facilitate the development of appropriate support to enable breast cancer patients to better manage their daily tasks in the home and in the workplace, and thereby improve their quality of life during and beyond treatment.

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[1] Male breast cancer patients were excluded from the current research due to this low incidence rate.

Despite increasing evidence supporting the existence of chemotherapy-related cognitive impairment in the breast cancer population, a handful of studies document otherwise (Donovan, Small, Andrykowski, Schmitt, Munster, & Jacobsen, 2005; Mehlsen, Pedersen, Jensen, & Zachariae, 2009; Tager et al., 2010). This discrepancy in findings may be linked to methodological differences across studies, such as the sample characteristics (variability in the type and dosage of chemotherapeutic agents administered), measures (objective neuropsychological tests and/or subjective self-report measures), definition of cognitive impairment (pre-determined cut-off levels or comparisons with treatment controls and/or healthy controls), study design (cross-sectional, longitudinal, retrospective, prospective), and timing of assessment(s) (baseline measure present/absent, weeks, months or years following chemotherapy administration). Further inconsistencies in the psycho-oncology literature include strong evidence for a disassociation between objective cognitive difficulties and subjective cognitive difficulties (Castellon, Ganz, Bower, Petersen, Abraham, & Greendale, 2004; Hermelink et al., 2007; Jansen, Dodd, Miaskowski, Dowling, & Kramer, 2008; Jenkins et al., 2006). These findings could be interpreted as evidence for a lack of ecological validity associated with neuropsychological tests. Moreover, since the vast majority of neuropsychological tests were designed for, and validated in, other clinical populations (e.g. patients with stroke and head injury), these measures may not be sufficiently sensitive to detect the types of subtle cognitive changes experienced by the breast cancer population (Jansen, Miaskowski, Dodd, Dowling, & Kramer, 2005).

Consequently, there has been a call for research to examine breast cancer patients' subjective accounts of their cognitive function. In particular, there have been recommendations for further research to adopt longitudinal designs (including pre-treatment baseline) with both treatment control groups and healthy control groups in order to address the limitations associated with previous work, and to establish the severity and onset of cognitive change (Vardy et al., 2008). Since self-report measures are often significantly correlated with psychosocial factors (e.g. anxiety, depression and fatigue) (Hermelink et al., 2007), it is important that studies take into account the complexity of this when designing and analysing cognitive change. Furthermore, breast cancer patients' descriptions of their lived experience of psychosocial well-being and cognitive function may provide rich data relating to the impact of chemotherapy-related

side effects on daily functioning and quality of life, an area which is currently understudied.

In other research fields, anxiety, depression, fatigue and cognitive difficulties have been documented in a number of clinical and non-clinical populations, and evidence suggests that these have associated safety implications. For example, Lach and Chang (2007) found that 94.9% of caregivers reported difficulties regarding safety, such as motor vehicle crashes, falls and cooking difficulties, in individuals with dementia. Furthermore, research has found that employees who are fatigued are more likely to experience accidents in the workplace (Åkerstedt, Fredlund, Gillberg, & Jansson, 2002). However, the potential safety outcome relating to cognitive and psychosocial difficulties has not currently been addressed in the breast cancer population. This is a particular concern since the survivorship rate is currently increasing and individuals aim to successfully continue or resume pre-diagnosis levels of daily functioning in the home and workplace (Steiner, Cavender, Main, & Bradley, 2004). Therefore, it is important that future research examines the accident proneness of this population. It is vital that breast cancer patients, their family members, health professionals, support groups and employers are provided with comprehensive information regarding the impact of chemotherapy treatment on daily functioning. This could facilitate the decision-making process for breast cancer patients regarding the most suitable treatment by considering the known potential benefits and side effects. In addition, support tailored to the individual could be provided in the home and in the workplace to improve the successful management of daily tasks, thereby enhancing quality of life and work ability.

## 1.2    The Aims of this Research

The current research addresses two main issues: (a) the need for further longitudinal research to examine chemotherapy-related cognitive impairment in an attempt to verify its onset and change over time (Vardy et al., 2008), and (b) the current gap in the psycho-oncology literature regarding potential safety implications associated with anxiety, depression, fatigue and subjective cognitive difficulties following chemotherapy for breast cancer. The specific objectives of the current study were to:

1. Examine the impact of chemotherapy for breast cancer on psychosocial well-being and subjective cognitive function.

2. Examine the impact of chemotherapy for breast cancer on safety outcomes in the home and workplace.

3. Examine the impact of chemotherapy for breast cancer on quality of life and work ability.

4. Explore the impact of chemotherapy for breast cancer on patients' daily life during and shortly following treatment.

In order to address these objectives, a patient-focussed, mixed-methods, longitudinal approach was adopted. In addition to a cohort of breast cancer patients undergoing chemotherapy, a treatment control group comprising breast cancer patients undergoing local therapy (radiotherapy pre- or post-surgery) was included in order to separate the potentially confounding psychosocial impact of breast cancer diagnosis from chemotherapy-related side effects (Aapro & Cull, 1999). Radiotherapy patients experience similar diagnostic procedures but fewer treatment-related side effects due to the localised nature of this treatment. A healthy control group, age-matched to the chemotherapy group, was included as an additional comparison group. These control groups have been included in other psycho-oncology research in an attempt to map out the impact of chemotherapy more clearly and accurately (e.g. Jenkins et al., 2006; Quesnel, Savard, & Ivers, 2009).

The current research comprised two methods of data collection: questionnaires and diaries. The questionnaire consisted predominantly of self-report rating-style and closed-ended questions that measured the frequency and severity of psychosocial difficulties, cognitive failures and accidents, as well as perceptions of quality of life and work ability (for those in employment) that could be analysed quantitatively (see Appendix 12). In addition, several open-ended questions were included that requested contextual information that could be analysed qualitatively. The questionnaire was administered at baseline (pre-chemotherapy) and follow-up time-points at 4 months, 8 months and 12 months to measure change over time. The questionnaire was either posted to participants or accessed online. A subgroup of participants from each participant group also kept a diary for a four-month period between follow-up time-points (see Appendices 13 & 14). Diary data were analysed qualitatively to provide in-

depth information about the lived experience of psychosocial functioning, cognitive difficulties and accidents during daily tasks. The diary was available in paper form (participants handwrote entries in four monthly booklets), electronic form (participants typed their entries into four monthly booklets that were emailed to them), or audio form (participants made verbal entries on a digital recorder).

## 1.3     The Approaches Toward Breast Cancer

The dominant approach to healthcare in Western countries is the biomedical model, which focuses on the biological account of illness with a limited emphasis on the psychosocial dimensions (Engel, 1977). This is a traditional paradigm based on a dualistic approach to the individual that conceptualises the mind and body as functioning independently from each other (Engel, 1977). The biomedical framework is often implemented within the UK National Health Service (NHS), as evidenced when breast cancer patients are offered a wealth of information on the biological side effects of breast cancer and its treatment, but relatively little on the psychological impact, despite increasing research addressing these concerns. Although the application of this reductionist model has been crucial in the progression of medical understanding and advancements in treatment technology leading to increased survivorship, it is not well-suited to understanding the quality of life of breast cancer survivors, which is an important focus for current research.

Engel (1977) is credited as one of the first to consider a more holistic approach to medicine. The biopsychosocial model adopts a holistic approach to disease and treatment in relation to the individual and values the interaction between the psychological, social and economic concerns as well as the biological symptoms. It takes into account the quality of the individual's survival. Following greater awareness of the benefit of adopting a holistic view in a complementary approach, psycho-oncology has emerged as a relatively new scientific discipline that combines the study of the biological and psychological aspects associated with cancer and its treatment (Kidman & Edelman, 1997). Such an approach towards breast cancer within the healthcare setting needs to be further established and research can facilitate this by examining the psychological impact of the disease and its associated treatment. Consequently, this thesis adopts a biopsychosocial approach to understanding the

experiences of breast cancer patients to ascertain a more comprehensive understanding of the impact of chemotherapy on daily life.

In light of the advantages of this holistic biopsychosocial model of breast cancer, this research project employed a mixed-methods approach. This approach can be defined as "the collection or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially" (Creswell, Clark, Gutmann, & Hanson, 2003, p. 212) and is considered valuable in applied health psychology research. The following section discusses the main research approaches within the applied health psychology research field. It considers the limitations of employing quantitative or qualitative methods in isolation and justifies the need for a holistic mixed-methods approach to the study of chemotherapy-related side effects in the breast cancer population.

## 1.4     The Research Approach

There are a range of ontological and epistemological positions that researchers can hold within Psychology, each with related research methods. The quantitative paradigm is based on positivism. This empirical approach involves measuring and quantifying phenomena that leads to deductive reasoning and the generalisation of findings that support or disprove hypotheses. Sample sizes tend to be large so that statistical analyses have adequate power to detect differences between groups and the strength of association between variables. Due to the ability to take precise measures and control for extraneous variables, advantages of this approach include high levels of internal validity and reliability, and data from the recruited sample can be generalised to the population as a whole. A weakness, however, is that it can oversimplify the complexity of human nature and decontextualise data (Janesick, 1994), thereby reducing external validity.

In contrast, the qualitative paradigm is based on interpretivism and constructivism and focuses on meanings and context (Hayes, 1997). This approach is idiographic in nature, whereby analysis focuses on the in-depth lived experience of individuals in small, purposeful samples (Castro, Kellison, Boyd, & Kopak, 2010). Although traditional notions of validity, reliability and generalisability cannot always be applied to the data

(due to the typically small sample sizes and lack of experimental condition controlling variables) the qualitative approach can generate rich, detailed accounts of human experience (Castro et al., 2010).

Traditionally, researchers adopt a particular ontological and epistemological position that stipulates whether quantitative or qualitative research methods are to be employed. Indeed, some researchers argue that quantitative and qualitative methods represent two different paradigms that make them incommensurate since fundamentally the two paradigms study different phenomena (Sale, Lohfeld, & Brazil, 2002). However, using a single research method can lead to a limited understanding of the phenomena of interest (Bowling, 1997). Furthermore, from a health research perspective, Casebeer and Verhoef (1997) argue that separating the research perspectives can lead to incomplete results and understanding about an illness. It has been noted that integrating quantitative and qualitative methods (known as methodological pluralism) can be useful for effectively capturing the complexities of human experience (Neumann, Kreps, & Visser, 2011), and thereby enabling a more comprehensive understanding of the issue under investigation.

Adopting a mixed-methods research approach is a popular strategy within applied healthcare research (e.g. Casebeer & Verhoef, 1997). In addition, this approach supports the national service frameworks (NSFs). These are currently established across a number of NHS services with the aim of ensuring that care is delivered in a patient-focussed manner and that effort is taken to listen to the 'expert patient' (Department of Health, 2009). The combination of quantitative and qualitative methods is a valid, complementary approach since both strive to acquire a better understanding of different aspects of the same phenomena: qualitative methods can facilitate the understanding of human experience while quantitative methods can facilitate the measuring of this experience (Sale, Lohfeld, & Brazil, 2002). Indeed, employing methodological pluralism in longitudinal research can facilitate understanding of the trajectory of patients' experiences during treatment (Casebeer & Verhoef, 1997).

Taking into consideration the benefits of methodological pluralism, the current research adopted a pragmatic, mixed-methods approach. A summary of the research process is shown in Figure 1.1. Questionnaires were administered to produce quantifiable data

from which statistical inferences could be generalised to the female breast cancer patient population receiving chemotherapy. In addition, a subsample of participants kept a diary to produce rich data with the aim of obtaining a detailed understanding of the nature and context surrounding the lived experience of psychosocial and cognitive difficulties as well as hazardous events. This exploration of personal accounts supplemented and complemented the examination of large group differences between breast cancer patients undergoing chemotherapy and two control groups.

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**LITERATURE REVIEW**

A review of the relevant literature provided an understanding of the existing research and the identification of current methodological weaknesses and research gaps. The questionnaire and diary materials were developed.

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**ETHICAL APPROVAL**

Ethical approval was obtained from the Loughborough University Ethical Approval Committee, the NHS Research Ethics Committee, and Research and Development departments at two NHS recruitment sites.

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**RECRUITMENT AND DATA COLLECTION**

Breast cancer patients about to receive chemotherapy ($n = 67$) and breast cancer patients about to receive radiotherapy ($n = 61$) were recruited from five local NHS cancer clinics and through support groups across the UK.

Healthy controls ($n = 122$) were recruited from newspaper and radio advertisements following a press release.

Questionnaires were administered at baseline (pre-treatment) and follow-up time-points at 4 months, 8 months and 12 months.

Diaries were kept for a four-month period between follow-up time-points by a subgroup of participants in the chemotherapy group ($n = 11$), radiotherapy group ($n = 6$), and healthy control group ($n = 15$).

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**ANALYSES AND CONCLUSIONS**

Questionnaire data (from rating-style and closed-ended questions) were entered into PASW and analysed using descriptive and inferential statistics.

Diary data and questionnaire data (from open-ended questions) were entered into an Excel Spreadsheet and analysed using thematic analysis.

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**PARTICIPANTS THANKED AND THESIS COMPLETION**

*Figure 1.1.* An overview of the research process.

## 1.5   The Structure of this Thesis

This thesis is presented over ten chapters. The current chapter introduces the research programme. Subsequent chapters are arranged as follows:

**Chapter Two** introduces key facts regarding breast cancer including its incidence, diagnosis and treatment. This chapter also presents a review of the published research examining the biological side effects associated with the treatment of the disease.

**Chapter Three** discusses the literature on the psychological side effects of chemotherapy treatment for breast cancer. In particular, studies examining psychosocial and cognitive side effects experienced by the breast cancer population are reviewed.

**Chapter Four** consolidates research conducted in other fields that have considered the link between anxiety, depression, fatigue, cognitive impairment and safety outcomes. This final literature review chapter concludes with a clear argument for the need to address the association between these factors in the breast cancer population, and closes with the research aims and hypotheses examined in this thesis.

**Chapter Five** presents details of the mixed-methods approach used in the current research and includes a description of the procedure involved in collecting the questionnaire data. Details are also provided about the measures, recruitment strategies, and ethical considerations relevant to the current study.

**Chapter Six** reports the results from the quantitative analysis of the questionnaire data relating to Objective One. This chapter begins with a description of the sample characteristics and proceeds to examine the impact of chemotherapy for breast cancer on psychosocial well-being and subjective cognitive function.

**Chapter Seven** reports the results from the quantitative analysis of the questionnaire data relating to Objective Two. This chapter examines the impact of chemotherapy for breast cancer on safety outcomes in the home and in the workplace.

**Chapter Eight** reports the results from the quantitative analysis of the questionnaire data relating to Objective Three. This chapter examines the impact of chemotherapy for breast cancer on quality of life and work ability.

**Chapter Nine** begins with a description of the procedures involved in collecting the diary data and presents the results from the qualitative analysis. This chapter explores

the context and temporal patterns of psychosocial difficulties, cognitive failures and accidents reported by breast cancer patients undergoing chemotherapy.

**Chapter Ten** discusses the principal findings and acknowledges the strengths and limitations of this research. This chapter also considers the implications of the findings in the context of breast cancer care and identifies practical recommendations for future research. The chapter closes with consideration of the contributions to current knowledge that this thesis has to offer.

## 1.6    Chapter Summary

Following improved prognosis of breast cancer, survivors aim to continue or resume daily tasks during and following treatment. However, a number of breast cancer patients undergoing chemotherapy experience anxiety, depression, fatigue and cognitive difficulties that can impact upon daily functioning, and which can persist for several years post-treatment. Evidence suggests that these psychological side effects are associated with increased accident risk; however, this safety outcome has not currently been examined in the breast cancer population. This could have major implications for breast cancer patients, their families, employers, and society at large. Therefore, it is important that this current research gap is addressed and that further work on the biopsychosocial impact of chemotherapy is undertaken. This will enable more comprehensive information to be available to breast cancer patients regarding the impact of chemotherapy on daily functioning. A mixed-methods approach was considered valuable to provide a detailed understanding of breast cancer patients' lived experiences and perceptions of managing chemotherapy-related side effects over a 12-month period. Figure 1.2 summarises the hypothesised relationship between treatment-related side effects and the outcomes being examined in the current study. This research is of clinical importance considering the increasing survival rate of breast cancer as well as the use of progressively more aggressive chemotherapy dosages in this population (Taillibert, Voillery, & Bernard-Marty, 2008).
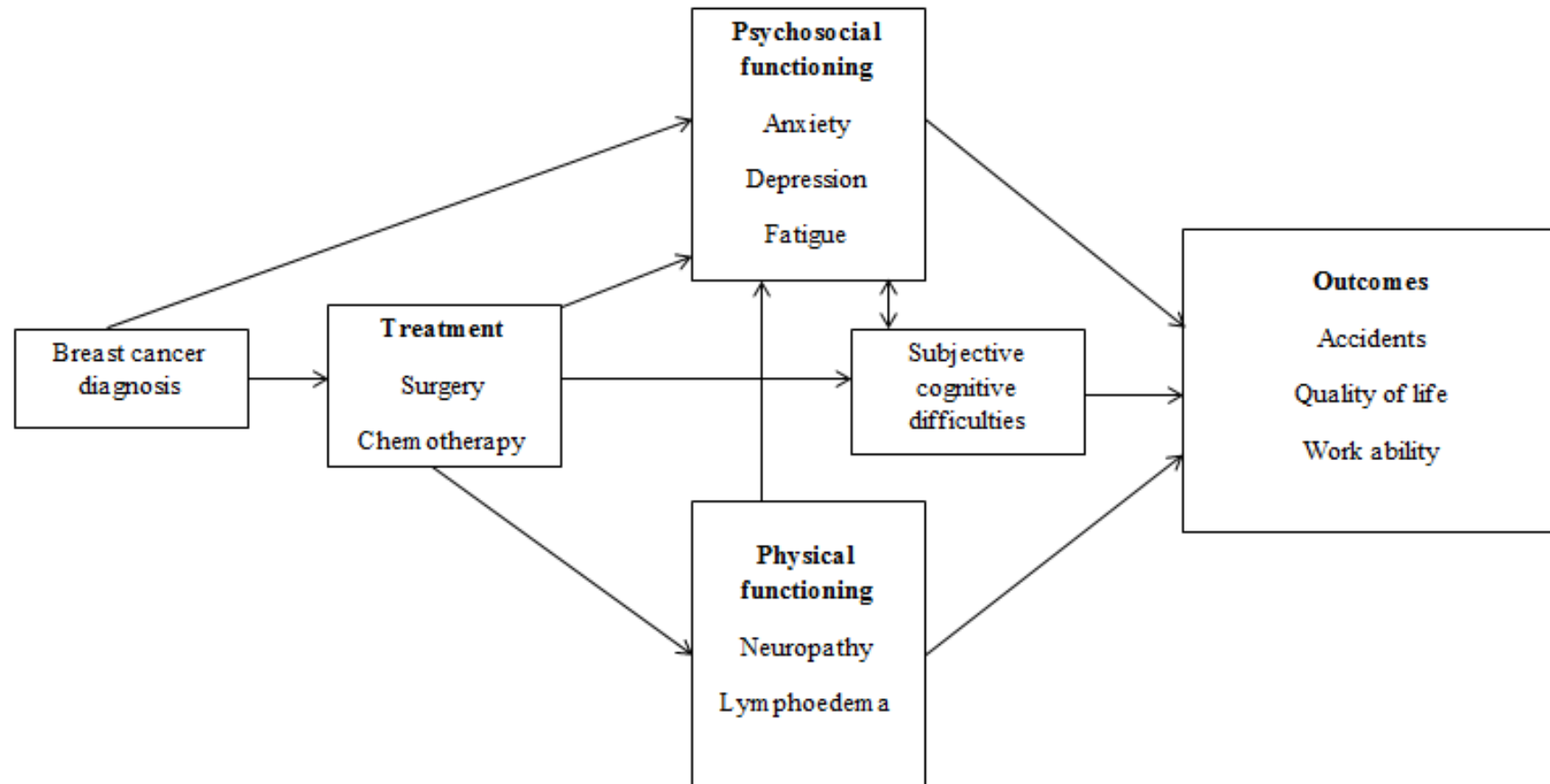
*Figure 1.2.* Theoretical model of chemotherapy-related side effects impacting upon breast cancer patients' management of their daily tasks.

# Chapter Two

# A Review of the Literature on Breast Cancer, its Treatment and Biological Side Effects

## 2.1   Chapter Introduction

The aim of this first review chapter is to provide relevant background information relating to breast cancer, its treatment and biological side effects. The chapter begins by highlighting the key statistics on the incidence and recent increase in the survival of breast cancer in the UK. In order to offer an insight into the general experiences of breast cancer patients, the conventional methods of diagnosis and treatment are considered. The chapter concludes with a description of the biological side effects associated with each treatment.

## 2.2   Breast Cancer Incidence

Cancer is a collective name for a heterogeneous group of diseases in which cells divide abnormally and uncontrollably. Worldwide, an estimated 1,643,000 women were diagnosed with cancer in 2010 (Forouzanfar et al., 2011). In the UK, there are approximately 315,200 new cases of cancer annually (Office for National Statistics, 2012). One in three individuals will develop cancer during their lifetime. Although over 200 different types of cancer have been identified, breast, prostrate, lung and large bowel cancers account for approximately 42% of all new cases (Office for National Statistics, 2011a). Table 2.1 illustrates the current incidence rates of these four common cancers in males and females in England.

Table 2.1

*Incidence of the Most Common Cancers in England (Office for National Statistics, 2011a)*

| Cancer type | Incidence rates in 2010 | | |
|---|---|---|---|
| | Males (*n*) | Females (*n*) | Proportion of total cancer population (%) |
| Breast | 375 | 46,075 | 13.20 |
| Prostate | 34,892 | N/A | 9.92 |
| Lung | 18,756 | 15,062 | 9.61 |
| Colorectal | 18,590 | 14,628 | 9.44 |

As shown in Table 2.1, breast cancer is currently the leading cause of malignancy in women in England. One in nine women will develop the disease in their lifetime (Steward & Thomas, 2006). Historically, breast cancer was often terminal. However, following recent advances in medical technology and increased public awareness surrounding the disease (e.g. self-examination of the breasts), there have been improvements in the detection and treatment of breast cancer. Subsequently, survival rates have increased dramatically due to earlier detection and improved prognosis for these patients (Skeel, 2003). For example, between 1971 and 2007, the incidence rate of breast cancer increased by approximately 84% while the mortality rate fell by 35% (Office for National Statistics, 2011a). Recently published figures estimate that the five-year survival rate of breast cancer is now 85.1% (Office for National Statistics, 2011a). As a result of the rise in survival of this disease, female breast cancer patients represent one of the largest and growing groups of cancer survivors. Many of these women look to continue or resume pre-diagnosis levels of daily functioning (e.g. employment, domestic, social and academic) during and following treatment, which can provide a sense of 'normality' for patients (Steiner, Cavender, Main, & Bradley, 2004). In response to this, the outcome of treatment has shifted from survival to quality of life (Bakitas, Lyons, Hegel, & Ahles, 2012; Reid-Arndt, Hsieh, & Perry, 2010). Subsequently, understanding the lived experiences of breast cancer patients during and beyond treatment is now an important research area. Although advances in treatment have greatly improved survival rates, some treatment regimens are

associated with a number of adverse side effects, which can endure several years following treatment completion (see section 2.7).

Figure 2.1 shows that breast cancer incidence generally increases with age, with approximately 55% of new cases being of working age (18 to 65 years). In response to the anticipated increase in life expectancy in the future, the UK Government has announced an increase in State Pension to 67 years between 2026 and 2028, with further increases to State Pension aimed to reflect increases in life expectancy (Directgov, 2012). Accordingly, there may be more breast cancer diagnoses in the working population in the near future. It is therefore important to understand the impact of breast cancer treatment and the associated side effects on return to work and work ability issues so that appropriate support can be provided to those in the workplace, as stipulated by the Equality Act 2010. This legislation supersedes the Disability Discrimination Act and includes an amendment to protect individuals who have, or who have had, cancer from discrimination at the workplace. It also states that employers should make reasonable adjustments for employees diagnosed with cancer. A number of studies have examined the impact of breast cancer and its treatment on return to work and work ability issues. These are discussed in more detail in Chapter Three, section 3.7.

Although this thesis is concerned with the psychological aspects of breast cancer and its treatment, it is first necessary to provide some background information on what breast cancer is and how it can manifest. This is provided in the following section and will facilitate understanding of how treatment for this disease works and how biological side effects can develop, details of which are presented later in this chapter (sections 2.6 and 2.7).
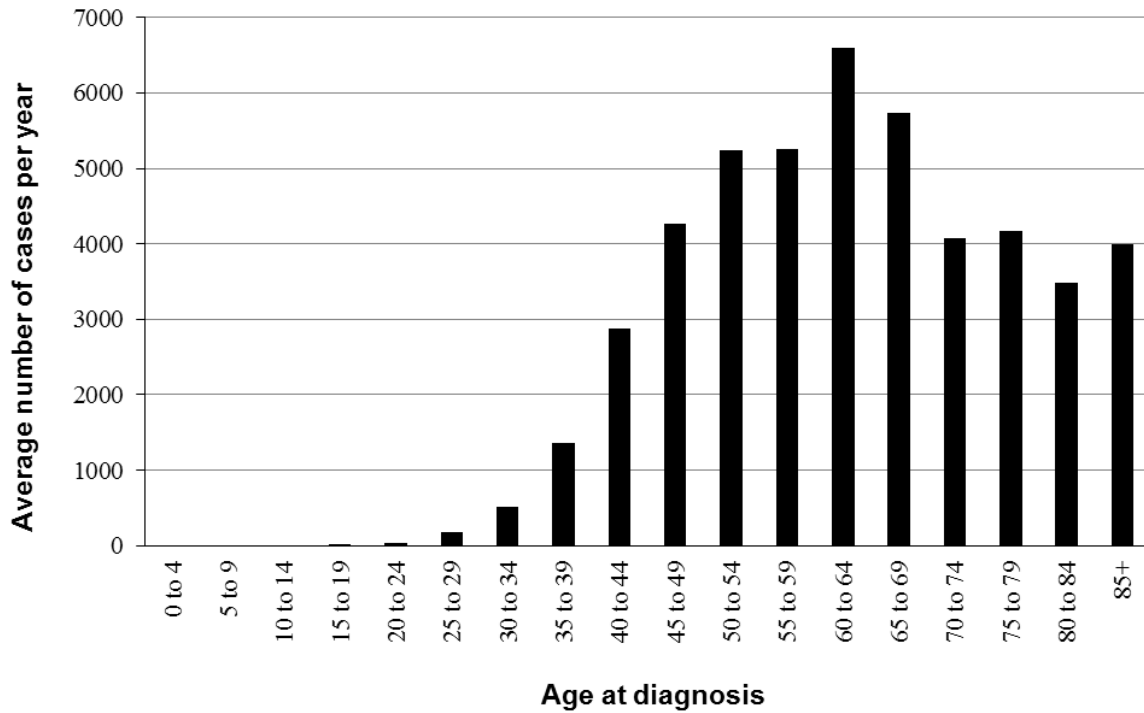
*Figure 2.1*. Number of new female breast cancer cases in the UK (Cancer Research UK, 2011).

## 2.3    A Brief Biological Account of Breast Cancer

Cells contain genetic material (deoxyribonucleic acid [DNA]) that instructs the cell how to behave, including when to reproduce, by dividing, and when to die (Blows, 2005). Mutations can occur in the cell DNA, sometimes causing the cell to behave differently, such as dividing abnormally and uncontrollably. Since successive cell divisions contain the same cell DNA, abnormal cell division can result in the development of a tumour over time. There are two main types of tumours: benign and malignant. Benign tumours are non-cancerous and tend not to invade or cause damage to neighbouring tissues. These may be fluid-filled sacs (cysts) or fibrous glandular tissue (fibroadenoma), which are not usually harmful to the body. However, malignant tumours are cancerous and can be detrimental to the body due to their ability to metastasise (spread to other parts of the body) through the bloodstream and lymphatic system, thus causing secondary cancer (Pelengaris & Khan, 2006). Since the body's immune system does not detect cancerous cells as foreign, there is

no natural defence from within the body. Consequently, a number of treatments have been developed to target and destroy the cancerous cells (see section 2.6).

The development of breast cancer is complex but can be simplified into four main phases:

(a) hyperplasia (occurs when normal cells multiply excessively causing the tissue to thicken and develop into a mass);

(b) dysplasia (occurs when hyperplasic cells undergo further genetic mutation, further increasing the rate of cell division as well as abnormal cell appearance);

(c) carcinoma in situ (occurs when dysplastic cells continue to divide abnormally and develop into a tumour that stops responding to the body's growth hormones), and

(d) invasive carcinoma (occurs when the malignant tumour metastasises and enters the blood and lymph vessels, causing secondary tumours elsewhere in the body) (Blows, 2005).

At diagnosis, the phase of the tumour's development is an important prognostic factor and is considered when determining the best course of treatment (see section 2.5).

The human body is composed of millions of cells (Pelengaris & Khan, 2006), which can be grouped into approximately 200 types. Cancer can originate in any type of cell, giving rise to just as many different types of cancer. Thus, cancer has great heterogeneity with a range of diagnoses, treatment regimens and prognoses. These different cancer types can be broadly classified by their biological origin and include:

(a) carcinoma that originate in epithelial cells in the skin or in tissues that line or cover internal organs (e.g. the breast);

(b) sarcoma that originate in bone, cartilage, fat, muscle, blood vessels, or other connective tissue;

(c) leukemias that originate in bone marrow and blood cells, and

(d) lymphomas that originate in the lymphatic system (Pelengaris & Khan, 2006).

Since there are different cells within the breast, there are also different types of breast cancer, depending upon the location of the tumour. The breast is primarily composed of fatty tissue, as shown in Figure 2.2. A tumour often originates in the lobes (lobular

carcinoma), which contain milk glands in females, or in the ducts (ductal carcinoma), which transport milk from the lobes to the nipple. Non-invasive (in situ) breast cancer includes lobular carcinoma in situ (LCIS) or ductal carcinoma in situ (DCIS). If these tumours spread then this is known as invasive (metastatic) breast cancer and includes invasive lobular carcinoma and invasive ductal carcinoma. Metastatic breast cancer typically involves more complex treatment regimens and consequently patients may experience a greater number of side effects. The exclusion of metastatic breast cancer patients with a secondary tumour is common within the literature examining treatment-related side effects due to the interaction between the side effects associated with multiple treatment courses (e.g. Schagen, Muller, Boogerd, & van Dam, 2002a).
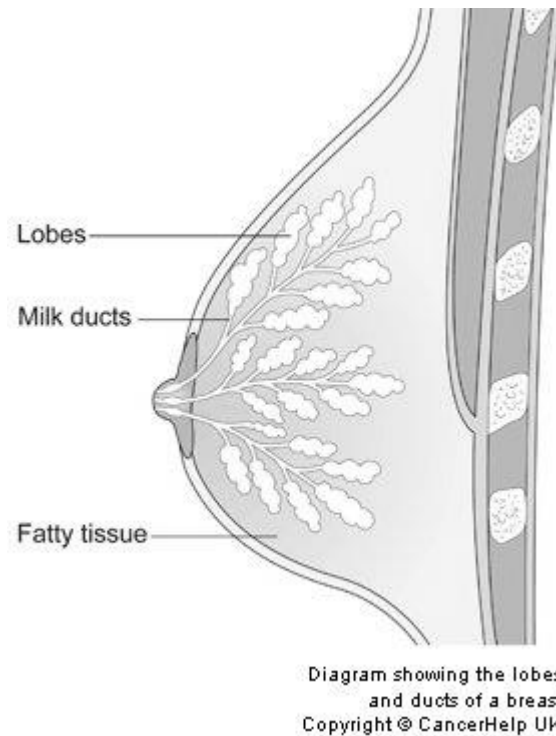


*Figure 2.2.* The biology of a female breast.

The breast is also composed of blood vessels that transport blood to the cells, providing nourishment, and lymph vessels that connect to the lymph nodes, helping the body to combat contagion by draining waste products into the veins and eventually out of the body (lymphatic system). Cells are immersed in tissue fluid that drains into the lymphatic system. Although vital to keep the body alive, this cyclical process allows metastasised tumours to travel via the tissue fluid to the lymph glands. Consequently, the lymph glands

in the armpit may be examined during diagnosis to determine whether the cancer has metastasised. Although biologists have an understanding of how breast cancer develops, the precise mechanisms involved in women developing breast cancer are largely unknown. However, researchers have identified a number of potential contributory factors involved in the development of breast cancer and these are identified in the following section (section 2.4).

## 2.4     Risk Factors for Breast Cancer

The risk factors for developing breast cancer are thought to involve a combination of lifestyle, geographic and genetic factors. Since a detailed account of the evidence and reasoning for these factors is out of the scope of this thesis, only the key risk factors are listed in this section.

One of the main risk factors for breast cancer is older age (as illustrated in Figure 2.1). Geographical location can also be influential, as evidenced by a higher incidence of breast cancer reported in Western countries compared to Eastern countries (McPherson, Steel, & Dixon, 2000). A previous history of the disease can also increase the risk of its development. Lifestyle factors such as obesity, high alcohol consumption, the use of hormone replacement therapy (HRT) and hormonal contraceptives have been shown to increase the risk (Murray, 2010). More full-term pregnancies, young age at first childbirth, breastfeeding, late menarche, and early menopause have all been shown to decrease the risk of developing breast cancer (McPherson, Steel, & Dixon, 2000; Murray, 2010).

A family history of breast cancer can increase the lifetime risk of developing the disease (Murray, 2010). This is because breast cancer susceptibility can be inherited through the Breast Cancer 1 (BRCA1) and Breast Cancer 2 (BRCA2) genes, which are located on the long arms of chromosomes 17 and 13, respectively. These genes may be transmitted by either parent and account for approximately 2% of all breast cancers (Murray, 2010). However, possessing one of these genes does not necessarily lead to the development of the disease, which suggests that both genetics and lifestyle are influential. Research has also shown that women are three or more times likely to develop breast cancer if they:

(a) have one first degree relative (e.g. mother, sister or daughter) with bilateral breast cancer or breast and ovarian cancer;

(b) have one first degree relative with breast cancer diagnosed under the age of 40 years or one first degree male relative with breast cancer diagnosed at any age;

(c) have two first or second degree relatives (e.g. grandmother, granddaughter, aunt or niece) with breast cancer diagnosed under the age of 60 years or ovarian cancer at any age on the same side of the family, or

(d)  have three first or second degree relatives with breast and ovarian cancer on the same side of the family (McPherson, Steel, & Dixon, 2000).

It is clear that breast cancer can develop as a result of a complex interaction between a number of factors, which makes establishing the aetiology of the disease difficult. Research in this area is active with frequent reports in the media of newly identified potential risk factors; however, the validation of results is likely to take some time. Meanwhile, it is important to understand the experiences of those with the disease, and the next section (section 2.5) describes the processes involved in diagnosing breast cancer. These processes enable the breast cancer patient's general practitioner (GP) to determine the prognosis of the disease and the most suitable treatment regime for the patient.

## 2.5    Diagnosing Breast Cancer

Since cancer can metastasise, it is important that the disease is detected at the earliest stage to increase the likelihood of a successful prognosis for the patient (Pelengaris & Khan, 2006). Breast cancer can be detected symptomatically via self-examination or following a mammography through the NHS breast cancer screening programme. One of the main biological symptoms that may be identified during self-examination includes an isolated, painless lump in the breast (Skeel, 2003). However, as outlined in section 2.3, there are several stages in cancer development, thus it can take some time before cancerous cells develop into a tumour that can be physically detected by hand. Further developments can lead to the tumour becoming attached to the skin or chest wall, ulcerated, painful or inflamed and there may be discharge or bleeding from the nipple (Skeel, 2003). Typically, upon recognition of these symptoms, a woman may seek medical advice from her GP and

be invited to undergo a mammography (an x-ray of the breasts). However, not all women are aware of, or choose not to perform, self-examination of the breasts. If left undetected, the tumour will become more advanced and could metastasise and lead to the development of a secondary tumour elsewhere in the body.

Alternatively, breast cancer may be detected following attendance at the NHS breast screening programme. The programme was established in 1988 with the aim of reducing the number of breast cancer-related deaths by detecting breast cancer at an earlier stage (when the tumour is too small to be detected by hand) and thus improving prognosis (Cheung, Greenway, Lagord, Williams, Kearins, & Lawrence, 2009). It involves inviting asymptomatic women aged 50 to 70 years for a mammography every three years. More than 1,500,000 women aged 50 to 70 years are screened annually through the programme and the Government is currently extending the range of women eligible for breast cancer screening to those aged 47 to 73 years (Cheung et al., 2009). Consequently, it is expected that there will soon be more diagnoses of breast cancer at an earlier stage with favourable prognoses, enabling survivors to continue or resume daily activities, such as within employment, academic and domestic settings, during and/or following cancer treatment. However, there are a number of side effects associated with cancer treatments, and these could have implications for patients' daily functioning and quality of life (see Chapter Three, section 3.6).

Treatment for breast cancer is tailored to the individual. Typically, a biopsy of the cancer cells is examined under a microscope by a pathologist, who evaluates how much the cells resemble normal cells in terms of the size and shape of the nucleus. The grade of the cancer refers to the appearance of the cancer cells and provides information about the potential for the cancer cells to metastasise. When the biopsied cells appear similar to healthy cells, the grade of the cancer is deemed relatively low, whereas the more abnormal the cells appear, the higher the grade of the cancer. Breast cancer can be graded as I (low grade), II (intermediate grade) or III (high grade). This information informs treatment decisions, for instance tumours with a higher grade are faster-growing and metastasise more quickly and may require more complex invasive treatment. The stage of the cancer refers to how

advanced the cancer is and can be used to estimate a patient's prognosis. Staging can range from Stage 0 (an early in situ cancer) to Stage IV (a tumour that has metastasised). Pathologists also detect the presence of receptors on the breast cancer cells that enable endogenous oestrogen or protein to attach to them, which activates growth signals to increase the development of the tumour. Cancerous tumours with these proteins are called oestrogen-receptor positive (or ER positive) and hormone therapy is typically administered in these cases. In contrast, cancerous cells with many progesterone receptors (PGR positive) do not respond well to hormone treatment (Cancer Research UK, 2009).

To summarise, the prognosis of breast cancer is a vital factor in determining the most appropriate course of treatment. In turn, this can have a significant impact on the experiences of the breast cancer patient as some types of treatment, particularly chemotherapy, are associated with a number of adverse biological side effects (see section 2.7) and psychological side effects (see Chapter Three). An overview of the conventional treatments available to breast cancer patients (with curative intent) is presented in the next section (section 2.6).

## 2.6    Treatments for Breast Cancer

Following a diagnosis of breast cancer, most patients undergo treatment, usually within a month following diagnosis. Conventional treatment can be complex and include any one of a combination of the following treatments:

    (a) local therapy, which targets specific areas of the body (e.g. the breast), such as surgery and radiotherapy,

    (b) systemic therapy, which affects the whole body, such as chemotherapy and hormone therapy, and/or

    (c) biological therapy, which uses naturally occurring substances in the body.

The stage and grade of the tumour, as well as other prognostic factors (outlined in section 2.5), determine the most favourable treatment course. For example, to treat carcinoma in situ (localised to the breast region) the purpose of treatment is to remove the tumour and prevent recurrence. However, for those with metastatic cancer that is often incurable, the purpose of treatment is palliative.

Chemotherapy, radiotherapy and hormone therapy can be administered pre-surgery (known as neo-adjuvant therapy) with the aim of shrinking the tumour thus making surgery more effective. Alternatively, and more commonly, these therapies can be administered post-surgery (known as adjuvant therapy) as a preventative measure with the aim of targeting potential remaining cancerous cells. Some breast cancer patients may also choose to receive complementary medicine - defined as therapies that tend to lie beyond the official health sector (British Medical Association, 1993). Complementary medicine includes herbal medicine, acupuncture, massage, aromatherapy, relaxation and meditation (Rees, Feigel, Vickers, Zollman, McGurk, & Smith, 2000). The prevalence of complementary medicine usage amongst breast cancer patients has been reported in only a handful of studies with estimates of 16% and 36% (e.g. Downer et al., 1994; Molassiotis et al., 2005). Due to the scarce research on complimentary medicine and the relatively limited usage by breast cancer patients, this type of treatment is considered out of the scope of this thesis. A summary of the main conventional medical treatments for breast cancer follows in the next sections (see sections 2.6.1 to 2.6.5).

### 2.6.1   Surgery

The purpose of surgery is to remove the tumour. There are different types of surgery depending on the prognosis. For example, breast conserving surgery is offered to patients with a lower stage of breast cancer (Stage II or lower) and includes lumpectomy (removal of the tumour and a small portion of healthy breast tissue), partial mastectomy (removal of the tumour and a larger portion of healthy breast tissue), and quadrantectomy (removal of the tumour and a quarter of the breast). Following advances in treatment technology, breast conserving surgery can target the cancerous cells and leave healthy tissue intact. This may help to reduce some of the adverse biological and psychological impacts of treatment. Reconstructive surgery can be offered to some breast cancer patients during or following the removal of the tumour, with the aim of helping to restore the appearance of the breast, thus improving quality of life, for example in terms of body image (White, 2000). A mastectomy is offered to patients with a higher stage of breast cancer, for example when the tumour is advanced and located in different parts of the breast. This procedure can be

further classified as a total mastectomy (removal of the entire breast tissue) or a radical mastectomy (removal of the entire breast tissue, lymph nodes and muscle behind the breast tissue). Statistics from an NHS report of surgically treated breast cancer patients in England in 2006 showed that the majority of operations (68%) were undertaken on invasive ductal carcinomas, while far fewer were on DCIS (10%) and LCIS (10%) (Cheung et al., 2009). The report also highlighted that of all surgically treated breast cancer patients, 43% of patients with invasive breast cancer and 35% of non-invasive breast cancer had a mastectomy. Breast conserving surgery was more prevalent in younger patients (aged less than 50 years) (Cheung et al., 2009). Only 27% of older patients (over 70 years old) did not have surgery and those who did were more likely to undergo a mastectomy (Cheung et al., 2009). Breast cancer patients who underwent a mastectomy were more likely to have chemotherapy than radiotherapy, compared to patients treated with breast conserving surgery (Cheung et al., 2009).

### 2.6.2   Radiotherapy

Radiotherapy uses ionising radiation to penetrate tissue and change the DNA of the cell, which affects the growth and reproduction of the cell. Although healthy cells can recover following this damage, cancerous cells cannot. Since large radiation doses can be harmful, it is used to destroy in situ tumours so that the radiation damage is localised to a small area to minimise the damage to healthy cells. Radiotherapy treatment varies depending on the type of cancer, its location, stage and grade. It can be administered pre-surgery to reduce the tumour's size, thus increasing the effectiveness of surgery. Typically, a dose (known as a fraction) is given each day or on alternate days over several weeks. Patients can receive radiotherapy to reduce the risk of cancerous cells returning following a lumpectomy or to target potential remaining cancerous cells following a mastectomy.

### 2.6.3   Hormone Therapy

Some breast cancer cells are oestrogen-sensitive, which means that oestrogen, a female hormone naturally produced by the ovaries prior to the menopause, facilitates their growth. Following the menopause, the adrenal glands (situated above the kidneys) produce smaller levels of oestrogen. Hormone therapy (also known as endocrine therapy) works by

reducing the levels of oestrogen and progesterone and blocking their effects (Cancer Research UK, 2009). This type of treatment targets breast cancer cells that have oestrogen receptors (ER) (Schilder, Schagen, & van Dam, 2008). There are three types of hormone therapy and they each work differently:

(a) anti-oestrgoens, for example tamoxifen (Nolvadex), bind to ER+ cells to block the attachment of endogenous oestrogen thus stunting cell growth,

(b) aromatase inhibitors, such as anastrozole (Arimidex), exemestane (Aromasin) and letrozole (Femara), prevent the production of oestrogen in post-menopausal women, and

(c) luteinising hormone releasing hormone (LHRH) blockers, such as goserelin (Zoladex), block a hormone in the pituitary gland which stimulates the release of oestrogen (Cancer Research UK, 2009).

Hormone therapy can be administered pre-surgery to shrink tumours with ER+ cells. However, it is more commonly administered up to five years post-surgery to help prevent the risk of the cancer returning. Statistics from an NHS report showed that, in 2006, younger breast cancer patients (less than 70 years) were more likely to be diagnosed with node positive tumours and thus less likely to have hormone therapy (Cheung et al., 2009).

### 2.6.4   Monoclonal Antibody Therapy (Biological Therapy)

Monoclonal antibody therapy is a type of biological therapy that involves the use of naturally occurring substances in the body to inhibit tumour growth. Trastuzumab (Herceptin) is the most common type of biological therapy and is successful in 20% to 25% of early-stage breast cancer patients. It works by binding to the Human Epidermal growth factor Receptor-2 (HER2), present in excessive quantities on cancerous cells, which subsequently prevents cell growth. Herceptin activates the immune system and destroys only the cancerous cells. It is administered intravenously once a week or once every three weeks for 12 months.

### 2.6.5    Chemotherapy

Chemotherapy is a drug treatment involving chemicals that are poisonous (cytotoxic) to cancerous cells. The chemotherapeutic agents disrupt the cell division process by damaging the control centre of the cell, such as proteins or DNA. There are several methods of delivering chemotherapy and include injection into a vein (intravenous bolus) or through a drip (intravenous infusion), infusion pumps or orally in tablet form. These chemotherapeutic agents then circulate around the body in the bloodstream and target fast-dividing cells, destroying them or prohibiting them from spreading. The systemic nature of this therapy means that it is effective at targeting cancerous located cells anywhere in the body, including potential metastases. However, healthy fast-dividing cells are also targeted. These include bone marrow cells, immune cells and hair follicle cells and subsequently this can lead to a number of adverse side effects. Chemotherapy is often administered in cycles where one cycle can last between one and five days, followed by a break of three to four weeks. In total, chemotherapy can last for up to eight cycles. Chemotherapy can be administered pre-surgery to shrink a tumour or post-surgery to destroy any remaining cells. In 2006, approximately 72% of younger patients (less than 50 years) received chemotherapy, which is partly due to the greater proportion of Grade 3, node positive cancers in this age group, whereas only 16% of older patients (over 70 years) received chemotherapy in England in 2006 (Cheung et al., 2009).

There are more than 50 different types of chemotherapy drugs (also known as anti-cancer drugs or antineoplastics) and there are several factors that determine the type of chemotherapy administered to the patient, such as the type of cancer, its stage and grade. A chemotherapy drug may be administered in isolation, but more frequently in various combinations (called combination chemotherapy) in order to maximise the effectiveness of the treatment, as each drug works in a different way. Some of the most commonly administered regimes include:

    (a) FEC (fluorouracil, epirubicin and cyclophosphamide);

    (b) FEC-T (FEC followed by taxotere);

    (c) CMF (cyclophosphamide, methotrexate and fluorouracil);

    (d) E-CMF (epirubicin followed by CMF);

(e) AC (doxorubicin and cyclophosphamide);

(f) MMM (methotrexate, mitozantron and mitomycin), and

(g) CTC (cyclophosphamide, thiotepa and carboplatin).

Currently, there is no consensus regarding the most effective chemotherapy regime and further clinical trials are required to address this. Clinical trials endeavour to find the most effective combination of chemotherapeutic agents that destroy cancerous cells while minimising the damage to healthy cells. Blood tests are taken prior to each chemotherapy cycle to provide information about liver and kidney function as well as an indication of the number of red cells, white cells and platelets in the blood. This is important since chemotherapy can affect bone marrow, which is involved in the production of these cells. Chemotherapy treatment can be delayed if the blood count has not resumed to normal levels following the previous chemotherapy cycle.

Establishing the best treatment course for breast cancer is a complex task. It requires the oncologist to consider a range of prognostic factors to select a treatment regime that will remove the cancerous cells from the body, to prevent metastasis and potential reoccurrence. In short, survival is an important endpoint. However, survival rates have increased following recent advances in treatment technology, and so attention has turned to the patient's experience of the side effects related to breast cancer treatment. The common biological side effects associated with breast cancer treatment are reviewed in the following section (see section 2.7).

## 2.7    The Biological Side Effects of Breast Cancer Treatment

Although conventional treatments for breast cancer are frequently effective in their curative intent, patients have reported a number of adverse biological and psychological side effects. Although the biological side effects of breast cancer treatments are well-documented (e.g. see meta-analysis by Tsai, Dennis, Lynch, Snetselaar, Zamba, & Scott-Conner, 2009), research has recently focussed on the psychological side effects. These can be divided into psychosocial side effects (such as anxiety, depression and fatigue) as well as cognitive side effects (such memory and concentration impairment). This thesis is concerned with the psychological impact of treatment and Chapter Three discusses the

relevant literature in detail. However, in order to understand the complete experience of breast cancer patients, particularly since biological side effects can have an impact on psychological well-being, the key biological side effects are reviewed in this section.

It is important to note that since an individual's genetic material is unique, breast cancer can originate and develop in many ways. Therefore, treatment is tailored to the individual in response to the tumour's particular characteristics (e.g. grade and stage) as well as the individual's characteristics (e.g. age). In turn, this means that the impact of treatment can vary between individuals due to differences in the body's capacity to tolerate side effects and so there is great heterogeneity in the range and severity of side effects experienced within the breast cancer population. Furthermore, a breast cancer patient may experience different side effects following each chemotherapy cycle, which may result from the cytotoxic accumulation of several cycles of chemotherapy leading to cumulative or synergistic side effects (Guill & Raynor, 2008). In addition, these side effects are often experienced in combination rather than in isolation and may interact negatively with each other (Meyers & Perry, 2008). For example, a patient may experience concentration difficulties that require greater mental effort to complete tasks, which in turn may increase fatigue, and subsequently may contribute to cognitive decline. It is clear that understanding the impact of treatment can be a difficult task; however, it is important that research does so in order to inform health professionals and future breast cancer patients so that appropriate support can be implemented.

*Surgery.* There are relatively few biological side effects associated with surgery compared to other breast cancer treatments. Short-term pain and tenderness in the localised area is often experienced, which can be relieved by opioid analgesics. During surgery, breast cancer patients may be anaesthetised to prevent feeling pain during the operation. However, breast cancer patients who undergo a mastectomy may experience long-term pain (post-operative pain syndrome). Fatigue and sleep disturbance can be induced by opioids (Kehlet & Wilmore, 2002; Rubin & Hotopf, 2002). Lymphoedema (the chronic swelling caused by an accumulation of fluid) can occur when the lymph nodes have been damaged or removed and the lymph ducts are unable to drain waste products into the veins.

Approximately 1 in 5 breast cancer patients will develop lymphoedema of the arm (Cancer Research UK, 2009).

*Radiotherapy.* Although radiotherapy is painless during the treatment itself, cumulative doses can produce side effects, such as short-term pain and tenderness in the localised area. Some breast cancer patients may develop anaemia, which can result in fatigue. Breast cancer patients may also experience a change in skin colour (red or darker in colour), swallowing difficulties, sickness, weight loss and breathlessness.

*Hormone therapy.* The biological side effects of hormone therapy depend on the type of therapy administered. However, breast cancer patients commonly report digestive difficulties, nausea, diarrhoea, increased or decreased appetite, hair thinning, headaches and joint pain. Hormone therapy can also induce temporary or permanent menopause (including in post-menopausal patients) resulting in hot flushes, sweating and vaginal dryness.

*Biological therapy.* Similarly, the biological side effects of biological therapy depend on the type of monoclonal antibodies administered. The most common side effect is associated with an allergic reaction, which may induce chills, fever, an itchy rash, nausea, breathlessness, headaches, flushes, faintness, and changes in blood pressure.

*Chemotherapy.* As previously described, chemotherapeutic agents target all rapidly proliferating cells in the body, which includes cancerous cells as well as healthy cells (e.g. situated in the skin, hair, mouth, lining of the digestive system, bone marrow, and red blood cells). This can produce a number of adverse side effects, such as alopecia, nail loss, stomatitis (inflammation of the mucous tissue of the mouth), changes in taste, mucositis (inflammation of the digestive tract tissue lining), diarrhoea, constipation and nausea (Boehmke & Dickerson, 2005). The range of side effects experienced is dependent upon the agents administered, the dose and format of administration (e.g. intravenously or orally). Side effects tend to commence two to three weeks following the start of chemotherapy administration. Antiemetic drugs can be administered before or after

chemotherapy to help manage nausea and vomiting (Hesketh, 2009). The reduction in bone marrow can leave breast cancer patients highly susceptible to infection and so antibiotics are often prescribed. The reduction in red blood cells can induce anaemia and subsequent breathlessness and fatigue (O'Shaughnessy, 2003; Kayl, Wefel, & Meyers, 2006). In the psycho-oncology literature, fatigue is generally considered to be a psychosocial side effect due to its impact upon daily functioning and quality of life (Curt et al., 2000), and so is addressed separately in Chapter Three. Chemotherapy may also damage the visual system (Raffa & Tallarida, 2010), affect fertility by inducing premature menopause, and reduce the production of platelets in the blood (thrombocytopenia). Since the role of platelets is to help the blood to clot, breast cancer patients may develop a tendency to bruise and bleed more easily and experience nosebleeds following treatment. Breast cancer patients may also experience numbness and weakness in the muscles of the hands and feet as well as loss of proprioception due to nerve damage (peripheral neuropathy), which can lead to accidents and falls (Tofthagen, Overcash, & Kip, 2012) (see Chapter Four for further details). Furthermore, chemotherapy can cause or worsen osteoporosis due to the negative effect on bone mineral density (Mincey, Moraghan, & Perez, 2000). It is clear that there are a number of potential biological side effects of chemotherapy, which can have a profound detrimental impact on daily life.

## 2.8    Chapter Summary

This section has presented a biological background of breast cancer, the conventional treatments for this disease, and the associated biological side effects. The incidence and survival rate of breast cancer is high, as well as the prevalence of treatment-related side effects. Therefore, it is important that appropriate information and support are available to breast cancer patients so that the impact on daily tasks and quality of life is minimal. The biological side effects are part of the traditional biomedical approach (see Chapter One). Since there is a current trend to adopt the holistic biopsychosocial model in medicine and health research, it is also important to consider the psychological impact of breast cancer and its treatment upon daily functioning and quality of life. Psycho-oncology researchers have documented numerous psychological side effects associated with chemotherapy for breast cancer and this literature is discussed in the following chapter (see Chapter Three).

# Chapter Three

# A Review of the Literature on Psychosocial Well-Being and Cognitive Function in Breast Cancer Patients

## 3.1    Chapter Introduction

In addition to the biological side effects described in Chapter Two (see section 2.7), breast cancer and its treatment are associated with a number of adverse psychological side effects. Increasing evidence suggests that some breast cancer patients experience anxiety, depression, fatigue and cognitive difficulties, particularly following chemotherapy treatment. The current chapter begins by defining these psychological domains. This is followed by a critical evaluation of the relevant key studies that have examined psychosocial and cognitive side effects in breast cancer patients undergoing chemotherapy. The postulated causes of chemotherapy-related cognitive impairment are then summarised, followed by the impact of this side effect on quality of life and work ability. The chapter concludes with a summary of the current gaps in this research area.

## 3.2    Psychosocial Side Effects

Historically, cancer care has focussed on the biomedical approach to treating the disease, such as improving the effectiveness of treatment and addressing the associated biological side effects. Psychosocial side effects, such as anxiety, depression and fatigue, associated with cancer and its treatment are often overlooked (Artherholt & Fann, 2012). These psychosocial side effects can have a negative impact upon the effectiveness of healthcare and subsequently the health of the cancer patient (Adler & Page, 2008). For example, psychosocial difficulties can "cause additional suffering, weaken adherence to prescribed treatments, and threaten patients' return to health" (Adler & Page, 2008, p. 1). Following improvements in the prognosis and survival of breast cancer, many women are now able to resume their daily tasks following treatment while some continue their daily tasks during treatment (Steiner, Cavender, Main, & Bradley, 2004). Therefore, it is important that the psychosocial impact of breast cancer and its treatment is understood so that this can be appropriately managed.

This need has recently been acknowledged by a number of organisations, including the Institute of Medicine (Adler & Page, 2008) and the International Psychosocial Oncology Society (Holland, Watson, & Dunn, 2011), which have recommended further research into the psychosocial impact of cancer on the individual. The commonly reported psychosocial difficulties reported by breast cancer patients are described below.

### 3.2.1   Anxiety

Anxiety is "a state of uneasiness, accompanied by dysphoria and somatic signs and symptoms of tension, focused on apprehension of possible failure, misfortune, or danger" (Colman, 2009, p. 46). The prevalence of anxiety in the general adult population is estimated at 12.6% (Crawford, Henry, Crombie, & Taylor, 2001). In breast cancer patients undergoing chemotherapy, the prevalence is estimated much higher at 35% (Maly, Umezawa, Leake, & Silliman, 2005).

Anxiety can develop in the breast cancer population for several reasons. Firstly, the diagnosis of a life-threatening disease can be a stressful event and influence the emotional well-being of the individual (Vardy & Tannock, 2007; Minisini, Atalay, Bottomley, Piccart, & Biganzoli, 2004). Secondly, treatment for breast cancer may be related to anxiety and studies have shown increased levels of anxiety in breast cancer patients undergoing chemotherapy compared to other treatments (Schreier & Williams, 2007). Thirdly, following successful treatment for the disease, the transition in identity from cancer *patient* to cancer *survivor* can be challenging and can create psychosocial adjustment disturbances (Dolbeault et al., 2009). For example, anxiety may result from attending follow-up medical examinations as well as coping with physical and psychological changes (Stanton et al., 2005). This might include a change in body image and fears regarding recurrence of the disease. Anxiety may exist for several years following diagnosis and treatment completion (Spiegel, 1997).

Schreier and Williams (2007) examined anxiety in breast cancer patients receiving chemotherapy ($n = 31$) or radiotherapy ($n = 17$). A self-report measure of anxiety (Speilberger's State-Trait Anxiety Inventor; STAI) was administered at the start of treatment and at 4 and 12 weeks later. Results suggested that trait anxiety was significantly higher in breast patients undergoing chemotherapy and state anxiety was

significantly higher at all three time-points for this treatment group. Schreier and Williams also reported that higher anxiety at the start of treatment was associated with decreased quality of life at the start of treatment and post-diagnosis. Although the relatively small sample size makes it difficult to generalise these findings, the study's longitudinal design provides evidence for temporal changes in anxiety over the course of chemotherapy.

Anxiety can have a negative impact on quality of life and is related to reduced compliance to treatment (Buccheri, 1998). Furthermore, strong evidence suggests an interaction between anxiety and/or depression and perceived cognitive impairment (van Dam et al., 1998; Castellon et al., 2004). Prolonged feelings of anxiety can also lead to fatigue (Bower et al., 2006).

### 3.2.2   Depression

Depression can be described as feelings of sadness, fear, anger and grief (Aapro & Cull, 1999). The prevalence of depression in the general adult population is estimated at 3.6% (Crawford, Henry, Crombie, & Taylor, 2001). Burgess, Cornelius, Love, Graham, Richards, and Ramirez (2005) reported the prevalence of depression among early-stage breast cancer patients ($n = 222$) to be approximately 50% in the first year after diagnosis, but with a decline to 15% in the fifth year post-diagnosis. This finding suggests that psychosocial support for breast cancer patients is necessary, particularly in the first year following diagnosis.

Brennan (2001, p. 3) describes "the diagnosis, treatment and aftermath of cancer involves a long process of adaptation to multiple threats and novel experiences". Furthermore, research findings suggest that the duration of time since diagnosis predicts adjustment to cancer (Deshields, Tibbs, Fan, & Taylor, 2006). Symptoms of depression include fatigue, sleep difficulties, and appetite loss (Artherholt & Fann, 2012). However, these may not be reliable indicators of depression in breast cancer patients due to the overlap with cancer treatment-related side effects (Artherholt & Fann, 2012). A number of studies have found that breast cancer patients receiving chemotherapy report higher levels of depression compared to breast cancer patients who receive local therapy (e.g. Schagen et al., 1999). Furthermore, depression can have an adverse impact

on quality of life in breast cancer patients (Badger, Braden, Mishel, & Longman 2004; Deshields, Tibbs, Fan, & Taylor, 2006).

### 3.2.3    Fatigue

Fatigue can be described as "a subjective and multidimensional concept with several modes of expression: physical (e.g. diminished energy, need to rest), cognitive (e.g. diminished concentration or attention), and affective (e.g. decreased motivation or interest)" (Servaes, Verhagen, & Bleijenberg, 2002b, p. 27). It is prevalent in the general population with approximately 20% of men and 30% of women reporting feelings of fatigue (Hjermstad, Fayers, Bjordal, & Kaasa, 1998). It can act as a response to physical or psychological stress and help to maintain a balance between rest and activity (Servaes, Verhagen, & Bleijenberg, 2002b). In healthy individuals, fatigue typically diminishes following adequate sleep (Servaes, Verhagen, & Bleijenberg, 2002b). However, researchers have suggested that there is a difference in the aetiology of fatigue experienced by cancer patients compared to the general population in terms of severity (Cella, Lai, Chang, Peterman, & Slavin, 2002). For example, cancer-related fatigue can be a distressing symptom, is not relieved by increased rest or sleep, and can limit daily activity (Iop, Manfredi, & Bonura, 2004). As a result of this disparity, cancer-related fatigue has been accepted as a diagnosis in the International Classification of Diseases 10th Revision-Clinical Modification (Portenoy & Itri, 1999).

Cancer-related fatigue is one of the most extensively researched psychosocial side effects and has been reported to affect up to 91% of breast cancer patients undergoing chemotherapy (Gaston-Johansson, Fall-Dickson, Bakos, & Kennedy, 1999; Jacobsen, Hann, Azzarello, Horton, Balducci, & Hyman, 1999). Furthermore, cancer-related fatigue may persist for up to 10 years post-radiotherapy and/or chemotherapy in an estimated 34% of breast cancer survivors (Bower et al., 2006). Fatigue has complex and interactive underlying aetiologies - such as sleep, mood and cognitive disturbance, depression, anxiety, pain, anaemia, weight loss, and impaired nutritional status – which are not currently fully understood (Yellen, Cella, Webster, Blenowski, & Kaplan, 1997). Fatigue can impair daily functioning and reduce quality of life in cancer patients (Cella, Peterman, Passik, Jacobsen, & Breitbart, 1998).

Servaes, Verhagen, and Bleijenberg (2002a) found that in disease-free breast cancer survivors, those who reported severe fatigue experienced more cognitive difficulties, such as memory and concentration impairment, than breast cancer patients without severe fatigue and non-cancer participants. The persistence of fatigue post-treatment in breast cancer patients is currently debated. A systematic review by Minton and Stone (2008) identified 18 studies that measured fatigue in cancer patients between four months and 10 years following treatment. Fourteen of these studies documented fatigue and/or a difference in levels of fatigue in cancer patients compared to a control group up to five years post-treatment (Minton & Stone, 2008).

Curt et al. (2000) found that 76% of cancer patients experienced fatigue for several days each month during chemotherapy and 30% experienced fatigue daily. Ninety-one percent of cancer patients who experienced fatigue reported that it prevented a 'normal' life (e.g. difficulty participating in social activities and performing cognitive tasks) and changed their daily routine (88%). In relation to employment, 75% of employed cancer patients altered their employment status due to fatigue. Interestingly, a study by Vogelzang et al. (1997) found that 74% of cancer patients considered that fatigue should be tolerated as a side effect and only 50% of cancer patients discussed this side effect with a health professional (Bower, 2008). It is important to note that fatigue may have psychological or biological causes and may be linked to other symptoms such as depression and insomnia (Curt, 2001; Respini, Jacobsen, Thors, Tralongo, & Balducci, 2003).

Some of the predisposing factors of cancer-related fatigue include: underlying disease; treatment; inter-current systemic disorders (e.g. anaemia, infection, dehydration); sleep disorders; chronic pain; use of opioids; anxiety disorders, and depressive disorders (Portenoy & Itri, 1999). Treatment for cancer-related fatigue include: changing the treatment regime; correcting metabolic disorders; addressing depression and insomnia, and engaging in exercise (Iop, Manfredi, & Bonura, 2004). Dimeo, Schwartz, Wesel, Voigt, and Thiel (2008) report that cancer patients experiencing fatigue may be advised to rest and reduce activity levels; however, extended rest can perpetuate fatigue as inactivity can induce muscular catabolism. This contradiction in alleviators for fatigue highlights the complexity surrounding cancer-related psychological side effects.

## 3.3    An Overview of Cognitive Function and Cognitive Failures

Cognition is a generic term that refers to brain-based or mental processes, including memory, concentration, communication, reasoning and decision-making, which are necessary for daily functioning. A wealth of research has been conducted on the processes involved in cognitive function. Table 3.1 provides an overview of the commonly studied cognitive domains in psycho-oncology research. Cognitive impairment, or cognitive failure, occurs when an error is present in one or more of these cognitive domains. This is also referred to as human error (see Chapter Four, section 4.3). Incidences of cognitive failure are common in the general population and are part of everyday life, for example going from one room to the other and forgetting why, and typically the impact is merely an inconvenience. Shallice, Burgess, Schon, and Baxter (1989) proposed the model of action, which suggests that during routine tasks when little cognitive effort is required, a contention scheduling system is used, similar to *auto-pilot* (or skill-based performances – see Chapter Four, section 4.3). This has the advantage of using few cognitive resources and is therefore an efficient method. However, when task demands or goals are altered, distraction, boredom and cognitive failures can occur (Broadbent, Cooper, FitzGerald, & Parkes, 1982).

Increasing evidence suggests that breast cancer patients undergoing chemotherapy experience cognitive impairment more frequently and more severely compared to the general population, particularly in the domains of memory, attention, executive function and psychomotor function (Mar Fan et al., 2005; Tannock, Ahles, Gazna, & van Dam, 2004). The prevalence of cognitive impairment in breast cancer patients undergoing chemotherapy has been reported to be up to 75% (Wieneke & Dienst, 1995), and can endure several years post-treatment in 17% to 34% of patients (Ahles & Saykin, 2007). The term *chemotherapy-related cognitive impairment* refers to changes in cognitive ability associated with the onset of chemotherapy treatment (Cull, Hay, Love, Mackie, Smets, & Stewart, 1996). It is important to recognise that cognitive impairment in this population is not as severe and as long-lasting as found in other patient populations, such as in individuals with dementia (Jenkins et al., 2006). However, subtle cognitive difficulties can still have a profound impact on daily functioning and quality of life (Steiner, Cavender, Main, & Bradley, 2004). This includes employment, academic and social activities (Wefel, Lenzi, Theriault, Buzdar, Cruickshank, & Meyers, 2004a).

Although the existence of chemotherapy-related cognitive impairment has become almost universally accepted (Shilling, Jenkins, & Trapala, 2006), there are inconsistencies in the literature. For example, reports relating to the prevalence and severity of chemotherapy-related cognitive impairment vary widely, resulting from methodological variations across studies, such as study design, timing of assessment and the definition impairment (Shilling et al., 2006). Furthermore, the mechanism(s) involved in chemotherapy-related cognitive impairment are currently unclear (see section 3.5 for a discussion). Consequently, further research examining chemotherapy-related cognitive impairment in the breast cancer population is required. A review of the research is included in this chapter.

Table 3.1

*Cognitive and Motor Domains Commonly Assessed in Neuropsychological Testing (adapted from Rich & Troyer, 2008)*

| Domain | Definition |
| --- | --- |
| **Cognitive domain** | |
| Attention/concentration and processing speed | The ability to focus on incoming information. Includes a) *selective attention:* the ability to focus on information relevant to the current task and filter out irrelevant information; b) *sustained attention:* the ability to maintain focus on a task over a prolonged period of time; c) *divided attention:* the ability to focus on several tasks simultaneously; d) *alternating attention:* the ability to shift focus between several sources of information; e) *working memory:* the ability to manipulate information held in memory for a short period; f) *processing speed:* the ability to rapidly process and respond to information. |
| Visual ability | Includes a) *object perception:* the ability to recognise items; b) *spatial perception:* the ability to understand the physical location of objects; c) *visual constriction:* the ability to merge individual parts to make a clear whole. |
| Language | Includes a) *receptive language:* the ability to comprehend orally or visually presented verbal information, and b) *expressive language:* the ability to produce words or sentences. |
| Memory | The ability to encode, store and retrieve information. Includes a) *short-term memory:* the ability to remember information presented seconds ago; b) *long-term memory:* the ability to remember information presented hours ago; c) *remote memory:* the ability to remember events from years ago; d) *prospective memory:* the ability to remember to carry out intentions at a future time-point; e) *episodic memory:* the ability to remember novel information; f) *semantic memory:* the ability to remember known general facts; g) *verbal memory:* the ability to remember lists of words; h) *non-verbal memory:* the ability to remember geometric information or new faces. |
| Executive function | Includes higher order cognitive abilities, such as a) *planning:* the ability to formulate and consider different approaches to a task and to conduct an effective approach to achieve a goal; b) *abstract thinking:* the ability to create generalised concepts from discrete instances; c) *response inhibition:* the ability to produce an uncommon response instead of an automatic response; d) *switching:* the ability to alternate between different types of information or different response categories. |
| **Motor domain** | |
| Sensorimotor ability | Includes a) *sensory ability:* the ability to detect visual, auditory or tactile stimuli, and b) *motor ability:* the ability to produce movement. |

## 3.4    Measuring Chemotherapy-Related Cognitive Impairment

Over the past 30 years, there have been many developments in the approach to examining chemotherapy-related cognitive impairment, including neuropsychological assessment, neuroimaging and self-report. This section is structured to reflect these developments. First, the use of neuropsychological tests is introduced in section 3.4.1. These are commonly used in psycho-oncology research and involve the administration of standardised tests to obtain an objective behavioural measure of cognitive domains, such as memory, attention, language, and psychomotor speed, and visuospatial skills. Until recently they were regarded as the gold standard tool for measuring cognitive changes in the breast cancer population. Next, the pivotal cross-sectional studies are discussed in section 3.4.2. Although these early studies provided evidence on the existence of a subgroup of cognitively-impaired breast cancer patients, the inherent shortcoming of this between-group design prevented researchers from identifying the onset of cognitive impairment or temporal fluctuations in cognitive change. Longitudinal studies were later conducted in response to the limitations of previous research and generally provided further support for the existence of cognitive impairment in breast cancer patients undergoing chemotherapy. The seminal longitudinal studies are discussed in section 3.4.3. More recently, the value of subjective measures has become widely recognised and contemporary research has focussed on findings from self-report measures. The relevant studies are described in more detail in section 3.4.4. Neuroimaging techniques, such as magnetic resonance imaging (MRI), functional MRI (fMRI) and positron emission tomography (PET), have revealed differences in the structure and function of the brain, such as neural activity, between cancer patients who have received chemotherapy and those who have not (Saykin, Ahles, & McDonald, 2003; Silverman et al., 2007). A comprehensive summary of the published research examining cognitive impairment following chemotherapy for breast cancer is presented in Table 3.2 (see p. 47; a note explaining the acronyms used in the table is on p. 54).

### 3.4.1    Neuropsychological Measures
The majority of studies that have examined the cognitive impact of chemotherapy in breast cancer patients have done so using objective neuropsychological measures

(Pullens, De Vries, & Roukema, 2010). These measures provide scores of cognitive performance relating to specific cognitive domains, such as those described in Table 3.1. Typically, several neuropsychological measures are included in a battery of tests that the patient is asked to work through, often using a laptop and lasting several hours (Freeman & Broshek, 2002). Neuropsychological tests are useful because of the standardised administration and scoring of data, such as comparing scores against normative data adjusted for factors including age and education (Smith & Wefel, 2008).

However, a limitation of neuropsychological tests is their lengthy administration, which may contribute to fatigue and thus provide unreliable cognitive function scores (Jansen, Dodd, Miaskowski, Dowling, & Kramer, 2008; Mehnert et al., 2007). More than 50 neuropsychological tests have been used in psycho-oncology research (Jansen, Miaskowski, Dodd, Dowling, & Kramer, 2005), and so it can be difficult to compare findings across studies and ascertain a clear understanding of the impact of chemotherapy on different cognitive domains. Furthermore, neuropsychological tests can sometimes map on to a range of cognitive domains, and two tests that measure the same cognitive domain may yield different levels of cognitive impairment due to variation in the specified cut-off levels. This may be a contributing factor to the inconsistent findings relating to the prevalence, severity and onset of cognitive decline in breast cancer patients undergoing chemotherapy.

As shown in Table 3.2, studies often include both an objective and subjective measure of cognitive function. Interestingly, only a handful of studies have found a significant correlation between these measures in the breast cancer population (e.g. Castellon, Ganz, Bower, Petersen, Abraham, & Greendale, 2004). The majority of studies report no association between objective and self-report measures (e.g. Cull, Hay, Love, Mackie, Smets, & Stewart, 1996; Klepstad, Hilton, Moen, Fougner, Borchgrevink, & Kaasa, 2002). Instead, subjective cognitive function is often related to anxiety and depression (Iconomou, Mega, Koutras, Iconomou, & Kalofonos, 2004; Jenkins, Shilling, Fallowfield, Howell, & Hutton, 2004; Jenkins et al., 2006; Schagen, van Dam, Muller, Boogerd, Lindeboom, & Bruning, 1999; van Dam et al., 1998). Subsequently, self-report measures of cognitive function have been criticised and neuropsychological tests are seen as the gold standard (Wagner, Sweet, Butt, Lai, & Cella, 2009). It may be that subjective cognitive function is indicative of psychosocial functioning. The

following section discusses the pivotal cross-sectional studies that have focused on findings from neuropsychological measures as well as self-report measures to assess cognitive ability in breast cancer patients undergoing chemotherapy.

### 3.4.2    Cross-Sectional Design: The Key Studies

The first studies investigating cognitive side effects in breast cancer patients were cross-sectional in design and consistently found greater cognitive impairments in women who had received chemotherapy compared to controls (Schagen, van Dam, Muller, Boogerd, Lindeboom & Bruning, 1999; van Dam et al., 1998; Wieneke & Dienst, 1995). As shown in Table 3.2, studies have included a range of control group types, for example a treatment control group (i.e. breast cancer patients with a comparable diagnosis and thus exposed to similar associated psychosocial impact, but undergoing different treatment), a healthy control group, or normative data from published norms. The pivotal cross-sectional studies are discussed below.

Wieneke and Dienst (1995) conducted one of the first cross-sectional studies using comprehensive neuropsychological tests to measure objective cognitive ability in breast cancer patients ($n = 28$). The participants were female, aged 28 to 54 years, diagnosed with Stage I or II breast cancer, and received standard-dose adjuvant chemotherapy (mainly cyclophosphamide, methotrexate and fluorouracil; CMF). Hormonal therapy with tamoxifen was also administered to some participants. Neuropsychological tests were administered between 5 to 12 months following the receipt chemotherapy. Findings suggested that 75% of breast cancer patients experienced moderate cognitive impairment in at least one measure compared to published normative data. Cognitive deficits were discovered in concentration, mental flexibility and processing speed, verbal and visual memory, visuospatial ability and motor function, suggesting a generalised pattern of cognitive impairment. Wieneke and Dienst found that the duration of chemotherapy (range 3 to 18 months) was significantly associated with cognitive impairment ($p < .01$). However, no significant association was found between cognitive decline and chemotherapy type, time since last treatment, or depression.

Although Wieneke and Dienst's (1995) study has been criticised for its relatively small sample size, retrospective design and lenient definition of impairment (cut off set at two standard deviations required on only one test), this research has provided some of the

first scientific evidence for chemotherapy-related cognitive changes in a cohort of breast cancer patients. Later studies employed more stringent definitions of cognitive impairment and have generally not replicated this high prevalence of cognitive impairment (Vardy & Tannock, 2007).

van Dam et al. (1998) conducted the first randomised study comparing breast cancer patients treated with standard-dose chemotherapy (FEC; $n = 36$) or high-dose chemotherapy (FEC-CTC with peripheral blood stem cell transplant; $n = 34$), followed by radiotherapy and tamoxifen. A control group of Stage I breast cancer patients treated with local therapy (surgery plus local radiotherapy; $n = 34$) was also included. Neuropsychological tests plus self-report measures of anxiety, depression and quality of life were administered on average two years post-treatment. In addition, semi-structured interviews were conducted to ascertain cognitive difficulties encountered in daily life. Cognitive impairment was defined as at least two standard deviations below the control group mean for individual tests and below the fifth percentile of controls overall. Results showed that 32% of breast cancer patients assigned to high-dose chemotherapy were cognitively impaired, compared to 17% of breast cancer patients assigned standard-dose chemotherapy, and 9% of breast cancer patients in the control group ($p = .043$). In comparison with controls, breast cancer patients treated with high-dose chemotherapy were at 8.2 times higher risk of cognitive impairment, while breast cancer patients treated with standard-dose chemotherapy were at 3.5 times higher risk. No significant association between objective cognitive measures and subjective cognitive measures was found. Breast cancer patients in the high-dose chemotherapy group scored higher on self-report measures of fatigue and depression. This study was one of the first to identify a potential dose-dependent link between adjuvant chemotherapy and cognitive difficulties, suggesting greater central nervous system toxicity in the higher dose group, as well as to report the enduring cognitive side effects associated with chemotherapy (van Dam et al., 1998).

A year later, the same research group as above (Schagen, van Dam, Muller, Boogerd, Lindeboom, & Bruning, 1999) compared lymph node positive breast cancer patients who had received standard-dose adjuvant chemotherapy (CMF; $n = 39$) with an age-matched control group of lymph node negative breast cancer patients ($n = 34$) who had received surgery and radiotherapy. Twenty of the chemotherapy patients had completed

six courses of CMF followed by three years of hormonal therapy with tamoxifen, while 19 participants did not receive hormonal therapy. The same neuropsychological tests as before were employed at an average of 1.9 years following chemotherapy or 2.4 years following local therapy in the control group. Across all domains, results suggested that breast cancer patients who received chemotherapy showed higher cognitive impairment compared to the control group (28% vs. 12%), suggesting late effects of chemotherapy. There was no significant difference between those who did and did not receive tamoxifen. Age, time since treatment, anxiety, depression and fatigue were not found to be significant predictors of cognitive ability. Multivariate analyses showed that only IQ and adjuvant chemotherapy significantly impacted test scores. Breast cancer patients who received chemotherapy self-reported significantly more memory difficulties compared to controls (21% vs. 3%) and concentration difficulties (31% vs. 6%) during daily life ($p < .05$) when interviewed about the extent of cognitive complaints. Those in the chemotherapy group also scored significantly lower on the self-report EORTC-QLQ-C30 in relation to physical function ($p < .035$) and cognitive function ($p < .01$). No correlation was found between self-report and objective cognitive function; however, self-report cognitive function was significantly associated with anxiety, depression and quality of life. This study demonstrated that although both participant groups had received a diagnosis of breast cancer and experienced the psychosocial impact of this (although a difference in the staging of breast cancer was noted), there were significant differences in the prevalence of cognitive impairment between the treatment groups. The study also suggested late effects of chemotherapy, approximately two years post-treatment, which impacted upon quality of life.

In one of the largest studies conducted to date, Tchen et al. (2003) found moderate to severe cognitive impairment in 16% of breast cancer patients currently receiving adjuvant chemotherapy (mainly anthracycline-based; $n = 100$) compared to 4% in age-matched healthy controls ($n = 100$) ($p = .008$). The High Sensitivity Cognitive Screen (HSCS) was used to measure cognitive ability. Highly significant differences were also found in fatigue and menopausal status between the participant groups. There was a strong correlation between these factors and quality of life, but no significant association was found with cognitive decline.

In a recent study, Von Ah et al. (2009) examined cognitive function in breast cancer survivors ($n = 52$) and age- and education-matched healthy controls ($n = 52$). Breast cancer survivors were found to be significantly impaired in one or more neuropsychological tests (36%), particularly related to learning and delayed recall abilities.

In contrast to these reported findings, several studies have found no evidence of cognitive impairment following chemotherapy in breast cancer patients (e.g. Donovan, Small, Andrykowski, Schmitt, Munster, & Jacobsen, 2005; Scherwath et al., 2006). For example, a cross-sectional study conducted by Donovan et al. (2005) found no significant differences in objective cognitive function in breast cancer patients treated with standard-dose adjuvant chemotherapy plus radiotherapy ($n = 60$) and radiotherapy treatment alone ($n = 83$) in relation to episodic memory, attention, motor performance and language. However, this study has been criticised for the lack of control between patient groups as breast cancer patients in the radiotherapy group were significantly older compared to those in the chemotherapy group and so may have experienced age-related cognitive decline (Charlton et al., 2006). This may have masked the impact of chemotherapy-related cognitive impairment in the chemotherapy group. Inconsistencies in findings may be attributed to variations in methodological approach across studies, such as definition in cognitive impairment, sensitivity of neuropsychological measures, type of chemotherapy regimen, timing of assessment, study design, small sample sizes, and type of comparison control group.

Despite these inconsistencies, the findings from published cross-sectional studies generally suggest that breast cancer patients undergoing chemotherapy experience cognitive impairment during and following treatment. However, these studies are characterised by several methodological shortcomings inherent to their cross-sectional design. In particular, the lack of opportunity to measure cognitive ability over time offers a limited insight into cognitive impairment, such as its onset. Furthermore, a pre-treatment baseline would be advantageous in order to account for pre-existing or pre-treatment cognitive differences between participant groups (Donovan, Small, Andrykowski, Schmitt, Munster, & Jacobsen, 2005). Following recognition of these limitations, a wave of prospective longitudinal studies was conducted. In general, these studies found cognitive impairment in breast cancer patients undergoing chemotherapy,

although to a lesser extent than found in cross-sectional research. The key longitudinal studies are discussed in the following section.

Table 3.2

*Summary of Research Examining Chemotherapy-Related Cognitive Impairment in Breast Cancer Patients*

| Author (year) | Design (Timing of assessment) | Sample | Objective measures | Subjective measures | Summary of findings |
|---|---|---|---|---|---|
| Ahles et al. (2008) | Cross-sectional (Post-surgery; pre-CT, RT or HT) | Invasive BC ($n = 110$); non-invasive BC ($n = 22$); matched HC controls ($n = 45$) | Neuropsychological test battery | Cognitive function (MASQ); anxiety (STAI); depression (CES-D); fatigue (FSI) | OCD scores within normal range. Lower overall cognitive performance in invasive BC (22%) compared to non-invasive BC patients (0%) and healthy controls (4%). |
| Ahles et al. (2010) | Longitudinal (Pre-treatment; 1, 6 & 18 months post-treatment) | CT ($n = 60$); non-CT ($n = 72$); HC ($n = 45$) | Neuropsychological test battery | Cognitive function (MASQ); anxiety (STAI); depression (CES-D); fatigue (FSI) | Age and pre-treatment cognitive reserve associated with post-treatment decline in processing speed. CT had a short-term impact on verbal ability. |
| Ahles & Saykin (2002a) | Cross-sectional (5 years post-diagnosis) | CT (BC, $n = 35$; lymphoma, $n = 36$); LT (BC, $n = 35$; lymphoma, $n = 22$) | Neuropsychological test battery | Cognitive function (SSRQ); anxiety (STAI); depression (CES-D); fatigue (FSI) | Survivors treated with CT had significantly poorer performance, particularly relating to verbal memory and psychomotor functioning, as well self-reporting more SCD. |
| Bender et al. (2006) | Longitudinal (0, 6 & 18 months) | CT ($n = 19$); CT plus tamoxifen ($n = 15$); controls (DCIS no CT or tamoxifen, $n = 12$) | Neuropsychological test battery | Cognitive function (PAOF); anxiety (POMS); depression (BDI-II) | CT plus tamoxifen patients had lower performance on visual memory and verbal working memory measures and reported more SCD. No association between OCD and SCD. |

| Author (year) | Design (Timing of assessment) | Sample | Objective measures | Subjective measures | Summary of findings |
|---|---|---|---|---|---|
| Bender et al. (2008) | Cross-sectional (2 years post-treatment) | CT ($n = 30$); CT with tamoxifen ($n = 50$); DCIS no-CT/tamoxifen ($n = 48$) | Neuropsychological test battery | Cognitive function (PAOF); anxiety & fatigue (POMS); depression (BDI-II) | CT patients reported significantly more memory deficits (25%) than HC (6%). No differences in memory difficulties between patients receiving tamoxifen (28%) and exemestane (24%). SCD correlated with anxiety, depression, fatigue and menopausal symptoms, but not with OCD. |
| Brezden et al. (2000) | Cross-sectional (2 years post-treatment) | Receiving adjuvant CT ($n = 31$); completed adjuvant CT ($n = 40$); HC ($n = 36$) | HSCS | Anxiety & depression (POMS) | Cognitive impairment in 48% of patients receiving adjuvant CT, 50% completed adjuvant CT, and 11% HC. |
| Castellon et al. (2004) | Cross-sectional (2 - 5 years post-diagnosis) | CT (sometimes with HT, $n = 36$); local therapy ($n = 17$); HC ($n = 19$) | Neuropsychological test battery | Cognitive function (CFQ); anxiety (STAI); depression (BDI-II) | CT patients had poorer cognitive function. No relationship between objective and self-report measures. Self-report measures associated with depression, anxiety and fatigue. |
| Collins et al. (2009) | Longitudinal (Pre-treatment baseline; 1 month post-CT; 12 months later) | CT ($n = 53$); HT ($n = 40$) | Neuropsychological test battery | Anxiety, depression & fatigue (POMS) | At 1 month post-treatment, more cognitive decline in CT patients than HT patients; after 12 months, cognitive decline was the same in both groups (11% and 10%, respectively). |
| Debess et al. (2010) | Longitudinal (Pre-CT; 6 months later) | CT ($n = 120$); age-matched HC ($n = 208$) | Neuropsychological test battery | Cognitive function (ISPOCD); anxiety; depression & fatigue (POMS); QOL (EORTC-QLQ-C30); self-efficacy (GPS) | No significant difference in OCD between BC patients post-CT and HC. Significant correlation between OCD and SCD. |

| Author (year) | Design (Timing of assessment) | Sample | Objective measures | Subjective measures | Summary of findings |
|---|---|---|---|---|---|
| Donovan et al. (2005) | Cross-sectional (6 months post-treatment) | CT plus RT ($n = 60$); RT ($n = 83$) | Neuropsychological battery | Cognitive function (MASQ) | No significant differences in OCD or SCD between CT plus RT patients and RT patients. The sample as a whole reported SCD occurring 'frequently'. |
| Downie et al. (2006) | Cross-sectional (2 - 6 weeks post-CT) | CT ($n = 21$) | Neuropsychological test battery | Semi-structured interview; fatigue (FACT-F); QOL (FACT-G) | Fatigue was common in all patients. Majority of patients experienced concentration difficulties that impacted on daily functioning. |
| Hermelink et al. (2007) | Longitudinal (Baseline pre-neoadjuvant CT, toward the end of neoadjuvant CT) | Neoadjuvant CT ($n = 101$) | Neuropsychological test battery | Cognitive function (FEDA & EORTC-QLQ-C30); anxiety & depression (HADS) | OCD in 27% of BC patients at end of neoadjuvant CT. No correlation between OCD and SCD, anxiety, depression, and menopausal state. SCD was significantly correlated with anxiety and depression. Significant increase in SCD at the end of CT compared to baseline. |
| Hurria et al. (2006) | Longitudinal (Baseline; 6 months post-CT) | CT patients aged $\geq 65$ years ($n = 45$; 76% HT) | None | Cognitive function (SSRQ) | BC patients who self-report more memory difficulties at baseline reported further memory difficulties post-CT (63%). Ability to learn new information was the most affected cognitive domain (49%). |
| Iconomou et al. (2004) | Longitudinal (Baseline; post-CT) | CT ($n = 102$) | MMSE | Cognitive function (EORTC-QLQ-C30) | Significant correlation between OCD and SCD. |

| Author (year) | Design (Timing of assessment) | Sample | Objective measures | Subjective measures | Summary of findings |
|---|---|---|---|---|---|
| Jansen et al. (2008) | Longitudinal (Pre-treatment baseline; 1 week after completion of four CT cycles) | CT ($n = 30$; treated with AC only) | Neuropsychological test battery | Cognitive function (AFI); anxiety (STAI); depression (CES-D); fatigue (LFS) | Cognitive impairment found in 13% of BC patients at pre-chemotherapy baseline. Significant decrease in visuospatial ability, but a significant improvement in executive function. SCD (attention) significantly decreased over time. No significant correlations between SCD and OCD. Significant correlation between SCD and depression. |
| Jenkins et al. (2004) | Cross-sectional | HT ($n = 94$; 67% combined with RT); CEF ($n = 36$; 53% combined with HT); HC ($n = 35$) | Neuropsychological test battery | Cognitive function (CFQ); depression (BDI); general health (GHQ-12) | High depression scores significantly associated with SCD, although no correlation between SCD and OCD. |
| Jenkins et al. (2006) | Longitudinal (Baseline; post-treatment; 12-months post-treatment) | CT ($n = 85$); HT and/or RT ($n = 43$); HC ($n = 49$) | Neuropsychological test battery | Cognitive function (CFQ); fatigue (FACT-F); QOL (FACT-B); general health (GHQ-12) | No correlation between OCD and SCD. QOL and SCD significantly correlated. No differences in SCD between patients and HC. CT patients reported significantly more SCD post-treatment compared to the baseline. |
| Mar Fan et al. (2005) | Longitudinal (Post-CT; 1 year post-CT; 2 years post-CT) | CT ($n = 104$); HC ($n = 102$) | Neuropsychological test battery | Fatigue (FACT-F); QOL (FACT-G); menopausal symptoms (FACT-ES) | Moderate-severe cognitive impairment decreased in CT patients from 16.0% to 4.4% and 3.8%, and in HC from 5.0% to 3.6% and 0%. |

| Author (year) | Design (Timing of assessment) | Sample | Objective measures | Subjective measures | Summary of findings |
|---|---|---|---|---|---|
| Mehlsen et al. (2009) | Longitudinal (CT group: baseline; 2 - 4 weeks post-CT; 24 weeks post-T1; cardiac group: baseline; 3 months post-T1; HC: interval 12 - 16 weeks) | CEF ($n = 34$; 53% combined with HT); cardiac patients ($n = 12$); HC ($n = 12$) | Neuropsychological test battery | Cognitive function (interview; rated on 5-point Likert scale); stress (PSS); depression (BDI); fatigue (POMS); social support (SSQT); life satisfaction (SLS) | No significant differences in cognitive ability over time between CT group, cardiac group and healthy control group. Results suggest no impact of CT on cognitive function. |
| Mehnert et al. (2007) | Cross-sectional (5 years post-treatment) | High-dose CT ($n = 24$); standard-dose CT ($n = 23$); RT ($n = 29$) | Neuropsychological test battery | Cognitive function EORTC-QLQ-C30; attention (FEDA); fatigue (MFI-20) | No association between OCD and SCD. |
| Mulrooney (2007) | Longitudinal (Median 39 months post-CT; 4 – 8 weeks later) | Post-CT ($n = 10$) | None | Cognitive function (interview) | Three themes were identified: 'I just don't feel like me', 'trying my best to live with it', and 'I am alive' to describe BC patients' lived experience of cognitive difficulties. |
| Myers (2010) | Cross-sectional (Within 6 – 12 months of completing CT) | CT ($n = 18$) | None | Cognitive function (interview) | SCD relating to short-term memory, word finding ability, reading, and driving, for which coping strategies were employed. BC patients wanted more information about SCD. |
| Prokasheva et al. (2011) | Cross-sectional (18 months post-CT) | CT ($n = 20$); Tamoxifen only ($n = 20$) | Neuropsychological test battery | Dutch cognitive problems in daily life checklist | OCD in 40% of patients. SCD in 69% of patients. No correlation between OCD and SCD. |

| Author (year) | Design (Timing of assessment) | Sample | Objective measures | Subjective measures | Summary of findings |
|---|---|---|---|---|---|
| Quesnel et al. (2009) | Longitudinal (Baseline, post-treatment, 3 months post-treatment) | CT ($n = 41$); RT ($n = 40$); matched controls ($n = 45$) | Neuropsychological test battery | Cognitive function (CFQ; EORTC-QLQ-C30) | CT patients reported more SCD than RT patients at post-treatment. At the 3-month follow-up assessment, SCD returned to baseline levels. CT patients reported less SCD compared to matched healthy controls. |
| Reid-Arndt et al. (2010) | Longitudinal (6 months & 12 months post-CT) | CT ($n = 33$) | Neuropsychological test battery | Confusion (POMS-SF) | OCD correlated with scores on the POMS. |
| Schagen et al. (1999) | Cross-sectional (2 years post-CT) | CT ($n = 39$; 51% CT plus HT); age-matched local therapy (RT & S; $n = 34$) | Neuropsychological test battery | Cognitive function (semi-structured interview; 5-point Likert scale, EORTC-QLQ-C30; HSCL-25) | CT patients reported significantly more memory difficulties (21% vs. 3%) and concentration difficulties (31% vs. 6%) compared to controls. No relationship between OCD and SCD. SCD was associated with anxiety and depression. |
| Schagen et al. (2002b) | Cross-sectional (3.5 years post-CT) | CMF ($n = 31$); CTC ($n = 22$); FEC ($n = 23$); RT & S ($n = 27$) | Neuropsychological test battery | Cognitive function (semi-structured interview & EORTC-QLQ-C30) | OCD in 14% high-dose, 9% - 13% standard-dose, and 11% HC. Overall OCD scores significantly correlated with SCD interview. |
| Schagen et al. (2006) | Longitudinal (Pre-treatment & 6 months post-treatment) | High-dose CT ($n = 28$); standard-dose CT ($n = 39$); no CT ($n = 57$); HC ($n = 60$) | Neuropsychological test battery | None | No significant between-groups differences at the first assessment. High-dose CT experienced greater cognitive impairment over time. |
| Scherwath et al. (2006) | Cross-sectional (5 years post-treatment) | High-dose CT ($n = 24$); standard-dose ($n = 23$); early-stage BC ($n = 29$) | Neuropsychological test battery | None | Slightly, but not significantly, more OCD in standard-dose CT group than high-dose CT group. |

| Author (year) | Design (Timing of assessment) | Sample | Objective measures | Subjective measures | Summary of findings |
|---|---|---|---|---|---|
| Schilder et al. (2009) | Cross-sectional (2 years post-CT) | BC patients post-menopausal CT plus HT ($n = 80$) | Neuropsychological test battery | Cognitive function (CFQ) | OCD in 3% of tamoxifen users and 6% of exemestane users. SCD in 25% of patients. Significant correlation between OCD and SCD. |
| Shilling et al. (2005) | Longitudinal (Baseline; 6 months post-CT) | Early stage BC CT ($n = 50$); HC ($n = 43$) | Neuropsychological test battery | Cognitive function (CFQ); fatigue (FACT-F); QOL (FACT-B); general health (GHQ-12) | Decline in 34% CT group compared to 19% HC. |
| Shilling et al. (2007) | Longitudinal (Baseline, 1 month, 12 months) | CT (sometimes with HT and/or RT; $n = 93$); no CT ($n = 49$) | Neuropsychological test battery | Structured interview | 78% to 83% reported SCD at 1 month; 45% to 60% at 12 months. |
| Stewart et al. (2008) | Longitudinal (Baseline; 2 months post-CT) | CT ($n = 61$); HT ($n = 51$) | Neuropsychological test battery | Anxiety, depression & fatigue (POMS) | CT patients 3.3 times more likely than HT patients to show reliable cognitive change (31% and 12% respectively). |
| Tchen et al. (2003) | Cross-sectional (2 - 6 weeks post CT administration) | Adjuvant CT ($n = 100$); HC ($n = 100$) | Neuropsychological test battery | Fatigue (FACT-F); QOL (FACT-G); menopausal symptoms (FACT-ES) | Significant correlations between subjective measures. No significant association between subjective measures and OCD. |
| van Dam et al. (1998) | Cross-sectional ($\geq$ 6 months post-CT) | High-dose CT ($n = 34$); standard-dose CT ($n = 36$); LT ($n = 34$) | Neuropsychological test battery | Cognitive function (semi-structured interview; cognitive problems in daily life checklist; EORTC-QLQ-C30) | OCD in 32% high-dose CT, 17% standard-dose CT, and 9% LT. SCD in 12% - 38% of high-dose CT, 11% - 31% of standard-dose CT, and 6% LT. No significant relationship between overall OCD score and SCD from interview. |

| Author (year) | Design (Timing of assessment) | Sample | Objective measures | Subjective measures | Summary of findings |
|---|---|---|---|---|---|
| Vardy et al. (2006) | Longitudinal (3 assessments, 7 – 90 days apart) | BC ($n$ = 27) and colorectal cancer ($n$ = 2) reporting SCD | Neuropsychological test battery | Cognitive function (FACT-COG) | Significant correlation between OCD and SCD. |
| Von Ah et al. (2009) | Cross-sectional (Between 1.2 & 15.8 years post-treatment) | BC ($n$ = 52); HC ($n$ = 52) | Neuropsychological test battery | Memory (SRS); depression (CES-D) | BC group reported more SCD and scored worse on learning and delayed recall measures than healthy controls. |
| Wefel et al. (2004b) | Randomised longitudinal trial (Baseline; 6 months post-CT; 18 months post-CT) | BC ($n$ = 18) | Neuropsychological test battery | Anxiety & depression (MMPI); QOL (FACT-B) | 33% of BC patients exhibited OCD at pre-treatment. The first longitudinal study to report an association between CT and cognitive impairment in the BC population. |
| Weis et al. (2009) | Longitudinal (9 months post-treatment) | CT (sometimes with RT or HT, $n$ = 90) | Neuropsychological test battery | Attention (FEDA); anxiety & depression (HADS); fatigue (MFI-20); QOL (EORTC-QLQ-C30) | OCD in 21% of patients. SCD in 36% of patients. |
| Wieneke & Dienst (1995) | Cross-sectional (5 – 12 months post-CT) | CT ($n$ = 28) | Neuropsychological test battery | Depression (BDI) | OCD in 75% of patients. |

**Key. AC:** doxorubicin and cyclophosphamide; **AFI:** Attentional Function Index; **BDI:** Beck Depression Inventory; **CEF:** cyclophosphamide, epirubicin, fluorouracil; **CES-D**: Center for Epidemiological Study-Depression scale; **CFQ:** Cognitive Failures Questionnaire; **CMF:** cyclophosphamide, methotrexate, fluorouracil; **CT**: chemotherapy; **CTC:** cyclophosphamide, thiotepa, carboplatin; **DCIS:** ductal carcinoma in situ; **EORTC-QLQ-C30:** European Organization for Research and Treatment of Cancer – quality of life core questionnaire; **FACT-B/COG/ES/F/G:** Functional Assessment of Cancer Therapy-Breast(QOL)/Cognitive Function/Endocrine Symptoms/Fatigue/General (QOL); **FEC:** fluorouracil, epirubicin and cyclophosphamide; **FEDA:** Questionnaire of Experienced Attention Deficits; **FSI**: Fatigue Symptom Inventory; **GHQ:** General Health Questionnaire; **GPS:** General Perceived Self-Efficacy; **HADS:** Hospital Anxiety and Depression Scale; **HC:** healthy controls; **HSCL:** Hopkins Symptom Checklist; **HSCS:** High Sensitivity Cognitive Screen; **HT**: hormone therapy; **ISPOCD:** International Study of Postoperative Cognitive Dysfunction; **LFS:** Lee Fatigue Scale; **LT:** local therapy; **MASQ**: Multiple Ability Self-Report Questionnaire; **MFI:** Multidimensional Fatigue Inventory; **MMPI:** Minnesota Multiphasic Personality Inventory; **OCD**: objective cognitive difficulties; **PAOF:** Patient's Assessment of Own Functioning; **POMS:** Profile of Mood States; **PSI:** Pittenburgh Sleep Inventory; **PSS:** Perceived Stress Scale; **QOL:** quality of life; **RT**: radiotherapy; **S:** surgery; **SCD:** subjective cognitive difficulties; **SLS:** Satisfaction with Life Scale; **SRS:** Squire Self-Report Scale; **SSQT:** Social Support Questionnaire of Transactions; **SSRQ:** Squire Memory Self-Rating Questionnaire; **STAI**: Spielberger State Anxiety Inventory.

### 3.4.3   Longitudinal Design: The Key Studies

The longitudinal design enables researchers to collect data at several time-points and to identify temporal changes. This is important in psycho-oncology research so that the onset of cognitive change can be identified, thus adding evidence regarding potential causes of impairment. This section discusses the key published research that has adopted a longitudinal design.

The first prospective study examining chemotherapy-related cognitive impairment in breast cancer patient ($n = 18$) was conducted by Wefel et al. (2004b), with measures taken prior to the administration of chemotherapy, 6 months later (3 weeks post-chemotherapy), and 18 months later. An important finding was that 33% of breast cancer patients demonstrated cognitive impairment prior to starting treatment. Cognitive deficits increased to 61% at the 6-month assessment, and by 18 months 50% of breast cancer patients who experienced cognitive decline showed improvement whereas 50% remained stable. Although this study is limited by its relatively small sample size and lack of comparison groups, findings from this ignited the debate relating to co-morbid factors impacting upon cognitive function, the onset of cognitive impairment, and the extent to which chemotherapy was responsible for changes to cognition. In addition, this finding highlighted the limited insight gained from cross-sectional research, as well as the importance of including a pre-chemotherapy baseline measure in longitudinal research.

Bender et al. (2005) compared the cognitive ability of breast cancer patients undergoing chemotherapy ($n = 19$), breast cancer patients undergoing chemotherapy plus tamoxifen ($n = 15$), and DCIS patients undergoing no systemic therapy ($n = 12$). Measurements were taken at baseline (post-surgery; pre-chemotherapy), 6 months and 18 months later. They found that breast cancer patients receiving chemotherapy only showed impairment on verbal working memory, whereas breast cancer patients receiving chemotherapy plus tamoxifen experienced a decline in verbal and visual working memory. DCIS patients showed improvement in cognitive scores, suggesting practice effects.

Jenkins et al. (2006) examined the cognitive function of breast cancer patients receiving chemotherapy ($n = 35$; mainly FEC) with breast cancer patients receiving hormone therapy and/or radiotherapy ($n = 43$) and healthy controls ($n = 49$) at baseline, post-

chemotherapy (or at 6 months) and at 18 months. After controlling for age and intelligence, no significant interactions or main effects were found, suggesting that age and education can have independent effects on cognitive functioning. Only a non-significant minority of breast cancer patients experienced cognitive deficits following chemotherapy. Individual declines in cognitive ability were found in 20% of breast cancer patients treated with chemotherapy, 26% of breast cancer patients treated with hormone therapy, and 18% of healthy controls at 6 months. By 18 months, cognitive impairment decreased to 18%, 14% and 11%, respectively. Jenkins and colleagues reported no correlation between objective and self-report measures of cognitive ability. There was an association between quality of life, psychological distress and self-report cognitive ability.

Currently, the evidence relating to the prevalence and severity of chemotherapy-related cognitive impairment is inconsistent. Indeed, the justification for the association between chemotherapy treatment and cognitive impairment is not without question since some evidence suggests that cognitive difficulties are present prior to the commencement of chemotherapy in 13% to 64% of breast cancer patients (Jansen, Dodd, Miaskowski, Dowling, & Kramer, 2008; Wefel et al., 2004b; Hurria et al., 2006). It could be that the diagnosis of breast cancer impacts upon cognitive function or that the subgroup of breast cancer patients scoring lower on cognitive measures simply represents heterogeneity of cognitive function that may also be present in the general population. Furthermore, the cognitive decline in breast cancer patients who may have scored to a high level above a defined normal range at pre-treatment and then scored lower but within the normal range at post-treatment is not captured for this subgroup, and neither for those who scored below the norm at pre-treatment and who were not affected by chemotherapy (Ahles et al., 2002c; Vardy & Tannock, 2007). Consequently, these studies should be interpreted with caution.

As Table 3.2 shows, not all longitudinal studies include a pre-treatment baseline assessment. The interval between assessments also varies, ranging from months to years. Generally, a shorter interval between assessments enables the onset of cognitive change to be identified more accurately. This lack of consensus highlights the current ambiguity in what constitutes a clinically meaningful cognitive impairment (Chaytor & Schmitter-Edgecombe, 2003). Furthermore, inconsistencies in findings may be due to

the definition of cognitive impairment, as previously described in this chapter. In contrast, there are standardised diagnostic criteria for cognitive impairment in other patient groups such as dementia. Therefore, there is a need for an agreed standardised definition of cognitive impairment to diagnose clinically meaningful changes in cognitive functioning in breast cancer patients (Hess & Insel, 2007). Meta-analyses by Anderson-Hanley, Sherman, Riggs, Agocha, and Compas (2003), and Jansen, Miaskowksi, Dodd, Dowling, and Kramer (2005) found that the number of neuropsychological measures included in the reviewed literature ranged from three to ten (with a mean of six measures) and some studies used the same test as a measure of different cognitive domains. For example, the Rey Auditory Verbal Learning Test has been used to assess the ability to learn and remember new verbal information (Paraska & Bender, 2003) and also to assess immediate memory span (van Dam et al., 1998).

Neuropsychological tests are typically seen as the gold standard measurement of cognitive ability, and subjective accounts of cognitive impairment are often overlooked due to their disassociation with objective measures (Cull, Hay, Love, Mackie, Smets, & Stewart, 1996; Schagen, Hamburger, Muller, Boogerd, & van Dam, 2001; Schagen, van Dam, Muller, Boogerd, & Lindeboom, 1999; Tannock, Ahles, Ganz, & van Dam, 2004; van Dam et al., 1998). Instead, subjective measures of cognitive ability are associated with anxiety, depression and fatigue. Several plausible explanations for this have been proposed. Firstly, it may be that breast cancer patients overestimate their perceptions of cognitive difficulties. Secondly, neuropsychological tests and self-report measures may not assess the same cognitive constructs (Calvio, Peugeot, Bruns, Todd, & Feuerstein, 2010; Downie, Mar Fan, Houede-Tchen, Yi, & Tannock, 2006). For example, neuropsychological tests may lack ecological validity and may not accurately reflect the types of cognitive tasks experienced in daily life (Hermelink et al., 2010). Typically, neurocognitive testing occurs in a formal or laboratory setting that have little reference to everyday experience (Schagen, Muller, Boogerd, & van Dam, 2002a) Thirdly, neuropsychological tests may not be sufficiently sensitive to subtle changes in cognitive ability (Boykoff, Moieni, & Subramanian, 2009). Since these neuropsychological tests were initially designed and validated in other patient populations, such as individuals with dementia, they may not be appropriate to be used for assessing breast cancer patients. However, significant associations between objective cognitive difficulties and subjective cognitive difficulties have been documented in other patient populations such

as in people with chronic fatigue syndrome (Capuron et al., 2006) and mild multiple sclerosis (Matotek, Saling, Gates, & Sedal, 2001). This suggests that objective measures are sensitive to detect cognitive difficulties in these groups.

Currently, considerable work is required to develop neuropsychological tests that map on to real-life situations and that are sensitive to detect subtle cognitive difficulties experienced in the breast cancer population (Ahles & Saykin, 2007). In the meantime, researchers are recognising the value of self-report measures of cognitive functioning with the aim of better understanding the lived experiences of breast cancer patients undergoing treatment while they manage their daily tasks. The following section reviews the literature that has focused on subjective accounts of cognitive ability in breast cancer patients undergoing chemotherapy.

### 3.4.4   Self-Report Measures

Subjective measures of cognitive functioning, such as questionnaires, diaries and interviews, enable the reporting of perceived experiences of cognitive difficulties during daily tasks (Hess & Insel, 2007). Subjective accounts suggest a much higher prevalence of cognitive impairment than confirmed by objective measures (Hutchinson, Hosking, Kichenadasse, Mattiske, & Wilson, 2012), which may reflect their sensitivity to detect subtle cognitive deficits (Schagen, Muller, Boogerd, & van Dam, 2002a). In a recent systematic review of research examining subjective cognitive difficulties in breast cancer patients, Pullens, De Vries, and Roukema (2010) identified 27 studies, with findings describing a prevalence of cognitive difficulties ranging from 21% to 90%. Similar to the reasons for a large prevalence range reported using neuropsychological measures, methodological inconsistencies can contribute to this vast range in prevalence. For example, sample sizes are often small and study designs include cross-sectional, longitudinal and a randomised control trial (Pullens et al., 2010).

Subjective measures can provide valuable insight into the meaningful impact upon daily functioning and quality of life, and for this reason they have clinical relevance (Downie, Mar Fan, Houede-Tchen, Yi, & Tannock, 2006). Researchers recognise that perceived cognitive function is an important outcome due to the profound impact on quality of life (Ferguson, McDonald, Saykin, & Ahles, 2007; Scherwath et al., 2006; Wagner, Sweet,

Butt, Lai, & Cella, 2009). For example, Wefel, Lenzi, Theriault, Davis, and Meyers (2004b) outlined that individuals who are well-educated with high baseline cognitive function may perform well on neuropsychological tests throughout treatment, however they may perceive cognitive changes that impact upon their daily functioning and quality of life. Therefore, subjective measures, particularly breast cancer patients' qualitative description of their lived experience, can be useful in accurately defining the types of cognitive difficulties experienced during chemotherapy. Pullens, De Vries, and Roukema (2010) suggested that there is a need for further research to use self-report measures to enable valid conclusions about subjective cognitive decline in breast cancer patients due to the current unclear prevalence of, and factors involved in contributing to, cognitive impairment. However, there are obvious limitations associated with reporting cognitive failures, as described by the Metamemory Paradox (Rabbitt, Maylor, McInnes, Bent, & Moore, 1995). In particular, not all incidences of cognitive failures may be recalled and subsequently reported. Consequently, the accuracy of absolute frequencies of cognitive failures may be inaccurate. However, under more controlled settings with the researcher present may not provide a realistic portrayal of the problems experienced during daily life. Despite these limitations, patient-reported outcomes can provide a unique understanding of the lived experiences of breast cancer patients throughout treatment and are considered to be more indicative of real-world cognitive difficulties than neuropsychological tests.

In a focus group study examining chemotherapy-related cognitive change in multi-ethnic Asian breast cancer patients ($n = 43$), memory impairment, difficulty in decision making and speech problems were common in participants (Cheung, Shwe, Tan, Fan, Ng, & Chan, 2012). An interesting finding was that participants were averse to the term 'chemobrain'. Instead, Cheung et al. reported that participants viewed their cognitive difficulties holistically, as a by-product of the physical effects (ageing and fatigue) and psychosocial effects (anxiety and mood changes) related to chemotherapy. Participants who were married expressed frustration associated with the impact of cognitive difficulties on their ability to manage daily tasks in the home.

Support for the usefulness of self-report measures comes from a study by Ferguson, McDonald, Saykin, and Ahles (2007) who examined the cognitive function of monozygotic twins using self-report measures, neuropsychological tests and structural

and functional magnetic resonance imaging (MRI). One twin had breast cancer and underwent chemotherapy while the other had no breast cancer diagnosis. Ferguson and colleagues found small differences between the cognitive function of the twins on neuropsychological test performance; however, striking differences were reported in self-report measures and structural and functional MRI. This finding suggests that physiologic mechanisms may underlie long-term cognitive complaints in breast cancer survivors who have received chemotherapy when neuropsychological performance is scored as normal.

In sum, the literature regarding chemotherapy-related cognitive impairment report inconsistent findings. Variation in study design, such as the type and timing of objective and subjective measures of cognitive function, measurement of potentially confounding factors (e.g. anxiety, depression and fatigue) make comparisons across studies difficult. Furthermore, studies are often limited by small sample sizes and significant attrition over time. Therefore, it is difficult to identify the onset and duration of cognitive impairment.

## 3.5    Potential Factors Involved in Chemotherapy-Related Cognitive Impairment

Although the majority of the work described above suggests that cognitive change coincides with the onset of chemotherapy treatment, the specific mechanisms involved are not currently well understood. A number of factors have been associated with cognitive impairment and are thought to contribute. Myers (2010) developed a conceptual model of chemotherapy-related cognitive change in cancer patients (see Figure 3.1, p. 65).

*Chemotherapeutic agents.* A number of neurophysiological studies propose that some chemotherapeutic agents cross the blood-brain barrier and enter the cerebrospinal fluid resulting in central neurotoxic effects (Abraham, Haut, Moran, Filburn, Lemiuex, & Kuwabara, 2008; Troy et al., 2000; Verstappen, Heimans, Hoekman, & Postma, 2003). Researchers have documented structural cerebral damage, in particular damage to the white matter (Brown et al., 1998; Inagaki et al., 2007) in cancer patients compared to control groups. This has been identified through computed tomographic scanning and

MRI techniques (e.g. Asato et al., 1992; Brown et al., 1998). In addition, Saykin, Ahles, and McDonald (2003) compared MRI of long-term (at least five years post-treatment) breast cancer survivors ($n = 12$) with long-term lymphoma survivors ($n = 12$) and age-matched healthy controls ($n = 12$). Significant abnormalities were present in the grey and white matter of the brain, consistent with the pattern of cognitive deficiencies identified in the majority of previous research.

In a recent fMRI study, Kesler, Bennett, Mahaffey, and Spiegel (2009) found that breast cancer patients had significantly reduced prefrontal cortex activation during memory tasks compared with age- and education-matched healthy controls. In addition, these patients displayed significantly more neural recruitment to recall information, which Kesler and colleagues suggest could have resulted in increased cognitive fatigue and frustration. They argue that this could impact upon a negative subjective evaluation of patients' cognitive ability, which may explain the often reported association between subjective cognitive difficulties and fatigue (e.g. Bender et al., 2006; Castellon, Ganz, Bower, Petersen, Abraham, & Greendale, 2004; Jenkins et al., 2006; Tchen et al., 2003). The presence of the apolipoprotein E ε4 (APOE ε4) allele has been suggested to predispose breast cancer patients to cognitive impairment (Ahles et al., 2003). Other aetiologies of chemotherapy-related cognitive impairment include cytokine-induced inflammatory response (Ahles & Saykin, 2007), DNA damage and oxidative stress (Ahles & Saykin, 2007; Chen, Jungsuwadee, Vore, Butterfield, & St. Claire, 2007). In addition, chemotherapy-induced menopause (Jansen, Miaskowski, Dodd, Dowling, & Kramer, 2005) and chemotherapy-induced anaemia (Mancuso, Migliorino, De Santis, Saponiero, & De Marinis 2006) may contribute to cognitive impairment.

***Pre-treatment cognitive ability.*** Some studies suggest that a subset of breast cancer patients have poorer cognitive ability prior to adjuvant therapy (e.g. Ahles et al., 2008; Bender et al., 2006; Hermelink et al., 2007; Hurria et al., 2006; Mar Fan et al., 2005; Paraska & Bender, 2003; Quesnel, Savard, & Ivers, 2009; Wefel et al., 2004a). However, Jenkins et al. (2006), Schagen, Muller, Boogerd, Mellenbergh, and van Dam (2006) and Stewart, Collins, Mackenzie, Tomiak, Verma, and Bielajew (2008) did not find that a subgroup of breast cancer patients had lower cognitive ability prior to adjuvant therapy. Patients may experience adverse effects of surgery and anaesthesia (Newman, Stygall, Hirani, Shaefi, & Maze, 2007), fatigue, anxiety or depression

following cancer diagnosis, which may impact upon cognitive ability at pre-chemotherapy.

*Age and education.* Research findings have shown that younger age is associated with an increased perception of cognitive change (Cimprich, So, Ronis, & Trask, 2005). In addition, having more years in education is associated with higher cognitive functioning (Cimprich, So, Ronis, & Trask, 2005).

*Anxiety, depression and fatigue.* The diagnosis of breast cancer may cause anxiety, depression and fatigue (see section 3.2). These psychosocial factors are thought to contribute to cognitive decline. For example, a number of studies have documented an association between both mild and severe forms of depression with cognitive decline, motor, perceptual and communication tasks (Murphy, Sahakian, & O'Carroll, 1998). Evidence also suggests an association between fatigue and subjective cognitive difficulties (e.g. Bender et al., 2006; Castellon, Ganz, Bower, Petersen, Abraham, & Greendale, 2004; Jenkins et al., 2006; Schagen, van Dam, Muller, Boogerd, Lindeboom, & Bruning, 1999; Tchen et al., 2003; van Dam et al., 1998).

*Menopause.* There is also evidence that chemotherapy can damage the ovaries, which subsequently may lead to changes in oestrogen levels. It is thought that oestrogen helps to maintain normal memory function (Genazzani, Pluchino, Luisi, & Luisi, 2007) due to its role in neural plasticity and protection (Bender, Paraska, Sereika, Ryan, & Berga, 2001). Therefore, any impact on oestrogen levels may change cognitive ability. It is thought that cognitive difficulties are reported by post-menopausal women in the general population (Halbreich, Rojansky, Palter, Tworek, Hissin, & Wang, 1995). Chemotherapy-induced menopause has been shown to affect 20% to 100% of female cancer patients and is dependent upon the patient's age, the chemotherapy dosage and regime, and previous or concurrent use of radiotherapy (Molina, Barton, & Loprinzi, 2005). There is therefore a need for further research to provide a clearer picture of the pathophysiology of cognitive deficits.

*Dosage and duration of chemotherapy.* There are inconsistent findings relating to the influence of chemotherapy dosage and duration (in terms of cycles administered) on cognitive impairment. For example, van Dam et al. (1998) found that cognitive

impairment was observed in 32% of breast cancer patients who received high-dose chemotherapy (with peripheral blood stem cell transplant), 17% who received standard-dose chemotherapy (plus tamoxifen) and 9% of a local treatment control group. The randomised cross-sectional design of this study was important in ascertaining a potential chemotherapy dosage link. In contrast, Scherwath et al. (2006) found that standard-dose breast cancer patients showed greater cognitive impairment compared to high-dose patients at five years post-treatment, although this did not reach statistical significance.

An association has also been reported between cognitive impairment and treatment duration (e.g. Ahles & Saykin, 2002; Rugo & Ahles, 2003). Ahles and colleagues found that more cycles of chemotherapy was associated with poorer cognitive scores; however, the correlation was significant but low ($r = -.31$). Wieneke and Dienst (1995) found an association between cognitive impairment and increased duration of chemotherapy ($p < .01$). They used neuropsychological tests to compare cognitive impairment in breast cancer patients (3 to 18 months post-chemotherapy) receiving standard dose chemotherapy to published normative data. Seventy-five percent of breast cancer patients were reported to have cognitive impairment. They found no association between cognitive impairment and type of chemotherapy, time since last treatment, or depression. However, the use of normative data as the only means of a comparison group has its limitations.

*Other treatments.* In addition to chemotherapy, other cancer treatments (e.g. surgery, radiotherapy, and hormone therapy) can destroy or change tumour cells. In turn, this may release harmful chemicals or produce an overactive response (e.g. anti-inflammatory, immunological). For example, many breast cancer patients treated with chemotherapy also receive hormone therapy and there is increasing research on the influence of chemotherapy and hormone therapy on cognitive functioning in breast cancer patients and long-term survivors. Hormone therapy can affect the level and activity of reproductive hormones, which may in turn impact upon cognitive ability (Schilder, Schagen, & van Dam, 2008). Oestrogen can have beneficial effects on cognitive function, as identified by a number of observational studies and clinical trials. As outlined in Chapter Two section 2.6, hormone therapy (e.g. tamoxifen) works by binding to the oestrogen receptors in the breast tissue. Several studies suggest that

tamoxifen may produce additional cognitive changes from chemotherapy alone (Bender et al., 2006; Castellon, Ganz, Bower, Petersen, Abraham, & Greendale, 2004; van Dam et al., 1998), increasing the chances of cognitive decline. Several studies have shown that cancer patients who received chemotherapy plus tamoxifen demonstrated more widespread cognitive deficits compared to patients who received chemotherapy alone (e.g. Bender et al., 2006; Castellon et al., 2004). However, other studies reported no differences in cognitive ability in these two treatment groups (e.g. Brezden, Phillips, Abdolell, Bunston, & Tannock, 2000; Jenkins, Shilling, Fallowfield, Howell, & Hutton, 2004; Schagen, van Dam, Muller, Boogerd, Lindeboom, & Bruning, 1999; Tchen et al., 2003; van Dam et al., 1998). There is a need for further investigation into the role of hormone treatment on cognitive ability in breast cancer patients.
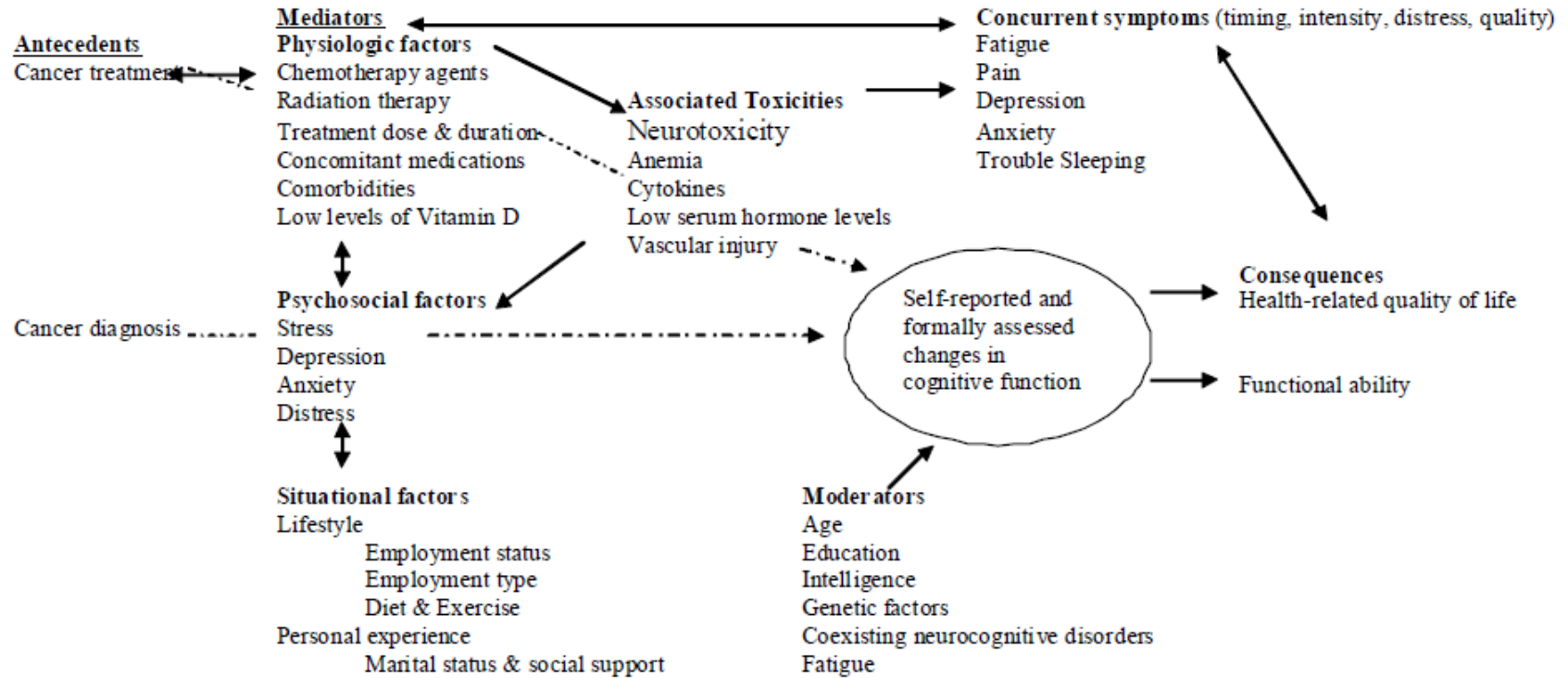
*Figure 3.1.* Conceptual model of chemotherapy-related cognitive changes (Myers, 2010).

## 3.6    The Impact of Cognitive Side Effects on Quality of Life

Quality of life is a multidimensional concept that considers "competence and health, perceived quality of existence, and psychological well-being" (Robb et al., 2007, p. 85). Traditionally, following the biomedical approach to disease, health outcomes have been assessed using laboratory or clinical tests, such as blood pressure and pulse (Higginson & Carr, 2001). While these measures provide valuable disease-related information, the personal and social context of patients are often excluded. Following recognition of the value of the biopsychosocial approach to healthcare, quality of life measures are now considered important outcome measures in clinical research (Higginson & Carr, 2001). These measures often provide an overall score of quality of life as well as scores for each dimension. Physical well-being may be influenced by disease or treatment side effects (e.g. pain). Functional well-being refers to the patient's ability to perform typical daily tasks. Emotional well-being can include states of distress to being happy and social well-being refers to relationships. A number of studies have shown that cancer patients report lower levels of quality of life compared to the general population (e.g. Robb et al., 2007). Chemotherapy-related cognitive difficulties can adversely impact on physical, functional, social and emotional well-being (Ahles & Saykin, 2002b).

The biological and psychosocial side effects experienced by breast cancer patients as a result of the tumour, diagnosis and treatment can have a profound impact on breast cancer patients' daily functioning. These can include difficulty returning to work as well as managing social activities and household chores. In turn, this can result in reduced quality of life (Ferguson & Ahles, 2003; Spelten, Sprangers, & Verbeek, 2002). Breast cancer patients may question why psychological side effects persist following the completion of treatment and why they cannot function at the same capacity of pre-diagnosis levels after being effectively cured of the cancer (Guill & Raynor, 2008). Evidence suggests that cognitive difficulties can last up to ten years post-treatment (Ahles et al., 2005). This can lead to increased psychological distress as many breast cancer patients see the end of successful treatment (i.e. the removal of cancerous cells) as being the benchmark for the transition from patient identity to survivor (Dolbeault et al., 2009). Subsequently, quality of life is an important treatment-related consideration as returning to pre-diagnosis levels of academic, employment, social and domestic

activities are thought to be a benchmark of recovery and provide a sense of 'normality' for breast cancer patients (Amir, Neary, & Luker, 2008; Steiner, Cavender, Main, & Bradley, 2004). It is important that research continues to provide a comprehensive understanding of the range of side effects experienced by breast cancer patients during and following treatment.

A number of intervention studies to improve quality of life in cancer patients have been conducted, although relatively few have addressed cognitive side effects. In fact, many studies exclude cancer patients with cognitive difficulties (Locke, Cerhan, & Malec, 2008). In contrast, cognitive rehabilitation interventions are widely applied in patients with acquired brain injury. However, it is important to recognise that breast cancer patients report relatively subtle cognitive difficulties, although their impact on daily functioning can still be profound. For some breast cancer patients, greater mental effort is required to perform routine tasks, which contributes to the often co-existing symptom of fatigue (Meyers & Perry, 2008). For example, an individual working in a high-demanding job may experience a greater impact (and thus require more adjustment to work) than an individual with fewer demands (Meyers & Perry, 2008). For the majority of breast cancer patients, these cognitive side effects diminish post-treatment; however, a subset of patients report long-term effects (Ahles et al., 2002c; Tannock, Ahles, Ganz, & van Dam, 2004). Furthermore, Bower (2008) suggested that cognitive impairment may be under-reported and under-treated because it is portrayed as an expected consequence of cancer treatment. Further research is warranted to provide a comprehensive understanding of the mechanisms involved in contributing to cognitive decline in these patients so that the short- and long-term difficulties can be predicted in individual patients (Ahles et al., 2002c). Evidence suggests that chemotherapy-related side effects can also impact upon working life and a review of the key literature is presented in the following section (section 3.7).

## 3.7    The Impact of Cognitive Side Effects on Work Ability

As previously stated in Chapter Two (section 2.2), approximately 55% of new cases of breast cancer are of working age and this proportion is likely to increase following the UK Government's plans to increase in the State Pension to 67 and above years to reflect the anticipated increase in life expectancy (Directgov, 2012). Furthermore,

improvements in the prognosis of breast cancer and subsequent increase in the survival rate has meant that the impact of breast cancer and its treatment on the workplace has become an important issue. In particular, following the introduction of the Equality Act 2010, which protects individuals who have, or have had, cancer from discrimination at the workplace, employers are expected to make reasonable adjustments for workers who have been diagnosed with cancer (Morrell & Pryce, 2005). The Equality Act covers the recruitment process, terms, conditions and benefits, as well as promotion and training opportunities, dismissal and harassment. It is therefore important that organisations are aware of the issues surrounding the work ability of cancer survivors and that appropriate policies and evidence-based guidelines are in place to support the successful transition back into the workplace (Peteet, 2000).

Returning to work following treatment is now a realistic outcome for a growing number of breast cancer survivors (Rowland, Aziz, Tesauro, & Feuer, 2001). Indeed, the ability to do so is thought to be important for quality of life. However, for some breast cancer patients, resuming employment and performing work tasks can be challenging due to treatment-related side effects. For the large proportion of breast cancer patients who are in employment, maintaining working life can be an important issue for financial (Amir, Neary, & Luker, 2008), social and psychological reasons. The return to work process may also act as a benchmark for recovery and the transition in identity from cancer *patient* to cancer *survivor* as a sense of normality resumes (Amir et al., 2008; Steiner, Cavender, Main, & Bradley, 2004). To date, the literature surrounding cancer survivors and employment has tended to focus on the return to work process. While this is an important area of research, little has been done to explore the experiences of survivors once they have returned to work. Since this research is concerned with the safety outcome that breast cancer patients may experience during their daily life, this thesis focuses on work ability issues.

In addition to experiencing absence from work (absenteeism), cancer patients may also encounter difficulties whilst at work (presenteeism) (Boles, Pelletier, & Lynch, 2004). Absenteeism and presenteeism are indicators of worker productivity (Escorpizo et al., 2007). Presenteeism is an important issue for employers as more lost productivity costs are attributed to people at work as opposed to those absent from work, for example taking sickness absence (Stewart, Ricci, & Leotta, 2004). Thomas-MacLean et al.

(2009) interviewed breast cancer patients and found that some patients were able to continue working but only with the support of co-workers, for example when performing more physical tasks such as heavy lifting. A measure of presenteeism can help to gain a better understanding of the effect of breast cancer and its treatment on the employee. Studies have found that cancer survivors with higher work ability scores are more likely to be working during or following treatment compared to those with lower scores (de Boer et al., 2008; Taskila, Martikainen, Hietanen, & Lindbohm, 2007).

Taskila and Lindbohm (2007) conducted a review of the research on the impact of cancer on employment and work ability. Work ability can be defined as how able a worker is to do his or her job with respect to the work demands, health and mental resources (Ilmarinen, Tuomi, & Seitsamo, 2005). The review revealed that a large proportion of cancer survivors experience a decreased ability to work and this is an important issue that employers need to address.

There are some interesting discrepancies in recent research on cancer and work ability. For example, some studies have found differences between cancer groups and healthy comparison groups in relation to reported impaired physical and mental work capacity (Bradley, Neumark, Luo, & Schenk, 2007; Gudbergsson, Fossa, Borgerass, & Dahl, 2006; Maunsell et al., 2004), whereas others have found no differences between work ability among these groups (Taskila, Martikainen, Hietanen, & Lindbohm, 2007). These differences may be due to the prognosis, severity and treatment course. Therefore, it is important to note that cancer survivors should be judged idiosyncratically as there may be some issues with generalisability. In another comparison study, Bradley et al. (2007) reported that female breast cancer survivors experienced impairments in mentally and physically demanding work whereas male prostate cancer survivors predominantly experienced impairments in physically demanding work. This may be due to the types of treatment received for these different cancer types.

Munir, Burrows, Yarker, Kalawsky, and Bains (2010) conducted a qualitative exploratory study to examine the awareness of chemotherapy-related cognitive change in breast cancer patients on working life. Findings from two focus groups ($n = 6$; $n = 7$) revealed that breast cancer patients experienced cognitive decline that they attributed to chemotherapy, and which negatively impacted upon their work ability as well as their

confidence. As work plays an important role in an individual's economic, social and psychological health (Waddell & Burton, 2006),  it is important that the impact of cognitive side effects on work ability is clear.

## 3.8    Chapter Summary

This chapter has demonstrated that anxiety, depression, fatigue, and cognitive difficulties are prevalent in breast cancer patients undergoing chemotherapy. However, the mechanisms involved in chemotherapy-related cognitive impairment are currently unclear. Despite a focus on findings from neuropsychological measures in the psycho-oncology literature, these measures have been criticised for their lack of sensitivity and limited ecological validity. Self-report measures are becoming more favourable and can provide an in-depth account of the lived experiences of breast cancer patients. These measures can be used to identify the subtle cognitive changes specific to the breast cancer population. In turn, findings from self-report measures can inform future breast cancer patients of what it is like to live with the side effects associated with chemotherapy. In addition, findings can help to develop neuropsychological tests that are better suited to this population.

# Chapter Four

# A Review of the Literature on Safety Outcomes associated with Anxiety, Depression, Fatigue and Cognitive Difficulties

## 4.1    Chapter Introduction

Psycho-oncology researchers have considered the impact of chemotherapy-related side effects (e.g. anxiety, depression, fatigue, and subjective cognitive difficulties) on important outcomes such as quality of life and work ability in breast cancer patients (see Chapter Three). Researchers examining the experiences of other patient populations, as well as the general population, have shown that psychosocial and cognitive difficulties are associated with safety outcomes, such as accidents and unintentional injury. To date, the impact of chemotherapy-related psychological side effects on safety outcomes has not been considered in the breast cancer population. Since the survival rate of breast cancer is increasing, many breast cancer patients aim to continue or resume pre-diagnosis levels of daily functioning during and following chemotherapy. Therefore, investigation of the safety outcomes associated with breast cancer treatment is an important research area that warrants consideration.

This chapter begins by describing the chief accident and injury statistics in the home and workplace in the UK. Since the literature on accident and injury investigation is vast and diverse, with links in industrial psychology, medicine, ergonomics and human factors engineering, safety engineering, organisation theory, environmental sciences, and law (Khanzode, Maiti, & Ray, 2012), a comprehensive review of this literature is out of the scope of this thesis. Instead, a summary of the most influential accident theories is presented. This is followed by recent evidence of an association between psychological difficulties (anxiety, depression, fatigue and cognitive failure) and safety outcomes that has been identified in various clinical and non-clinical populations. The next section reviews the literature on safety-related outcomes in the cancer population. Finally, this chapter concludes with the objectives, hypotheses and aims of the current study.

## 4.2    The Definition of Accidents and Key Statistics

The terms 'injury' and 'accident' are often used interchangeably in the safety-related literature. However, in a recent comprehensive review of occupational injury and accident research, Khanzode, Maiti, and Ray (2012) highlighted that these terms are not synonymous: "Every accident need not necessarily result in human injury, but every injury is a result of an incident that can be termed as accident" (p. 1356). Accidents and injuries occur when hazard is present, which can be described as a source of danger that has the potential to cause harm (Khanzode et al., 2012). Injury can be categorised as intentional or unintentional.

A recent report by National Statistics (2010) provides informative statistics on the number of unintentional injuries in the UK. This is a common cause for emergency hospital admissions and is one of the main causes of death in the UK. However, the report described an annual decrease in the number of unintentional injuries for both emergency hospital admissions and deaths. In 1999/2000, the number of emergency hospital admissions was 66,087, which decreased to 61,997 in 2009/2010 (National Statistics, 2010). Furthermore, from 2000 to 2009 the number of deaths resulting from unintentional injury decreased from 1,367 to 1,347. Unintentional injuries accounted for 1 in 9 emergency hospital admissions for adults and 1 in 40 deaths in adults in 2009/2010. The report identified falls as being the most common cause of emergency admission to hospital as well as the most common cause of death. Road traffic accidents, burns and scalds were also frequently reported. However, it is difficult to establish the true incidence of unintentional injuries in the UK since the majority are treated by General Practitioners (GPs) or in the outpatient unit in Accident and Emergency departments (National Statistics, 2010), which is not included in the previously reported statistics.

It is clear that accidents and unintentional injuries impact upon a number of lives, and so injury prevention and control is an important issue. Traditionally, unintentional injuries have been regarded as unavoidable accidents (WHO, 2000). However, following increased research over the last few decades, unintentional injuries are now regarded as mostly preventable events (WHO, 2000). Consequently, the health implications of unintentional injuries have been given much consideration by decision-

makers worldwide and injury prevention strategies have shown to reduce fatalities (WHO, 2000).

### 4.2.1    Accidents in the Home

In the UK, unintentional injuries occurring in the home account for more than 25% of all emergency hospital admissions in adults aged over 15 years. People aged over 75 years accounted for 50% of these admissions (National Statistics, 2010). The most common type of injury resulting in emergency hospital admission is fracture of the femur, followed by fracture of the shoulder and upper arm, other and unspecified head injuries, and open head wound injury (National Statistics, 2010).

### 4.2.2    Accidents in the Workplace

There are two main sources of workplace injury data in the UK. These include injury reports made under the Reporting of Injury, Diseases and Dangerous Occurrences Regulations (RIDDOR) and the results of questions included in the Labour Force Survey. In 2010/2011, there were approximately 115,000 injuries reported under RIDDOR and 171 deaths in the workplace (Health and Safety Executive, n.d.). The incidence of these events is a cause for concern as workplace injuries accounted for an estimated 4.4 million working days lost in 2010/2011 (Health and Safety Executive, n.d.). It is estimated that the cost to society of work-related injuries and ill health (excluding cancer) in 2009/2010 was £14 billion (Health and Safety Executive, n.d.). The consequences of work-related injury can also include lost income for the employee, resulting health difficulties and burden on relatives (Wilkins & Mackenzie, 2007). Therefore, the impact of work-related injury for employees, employers, the health sector and society is substantial. However, over the past 30 years, there has been a decrease in the number of deaths and unintentional injuries in the workplace (Health and Safety Executive, 2009). Research in accident causation (see section 4.4) and injury prevention strategies, particularly in industry, have contributed to establishing safer work practices (such as risk assessment) and safety legislation at the workplace.

## 4.3    The Psychology of Human Error

As previously stated in Chapter Three (see section 3.3), human error is a generic term that encompasses cognitive, perception and action errors. These errors refer to

incidences when a planned sequence of mental or physical activities does not achieve the intended result and produces an undesirable outcome, which cannot be attributed to some change agency (Health and Safety Executive, 1999; Reason, 1990; Whittingham, 2003). Human errors are often trivial and inconsequential, posing as a mere inconvenience to the individual, for example going from one room to the other and forgetting why. However, others result in more serious and tragic outcomes, for example the Chernobyl and Challenger disasters (Reason, 1990; Robertson, 2003). Consequently, human error has been widely studied and a number of human error theories have been proposed. These theories offer scope to develop preventative measures to improve safety (Reason, 1990; van Dyck, Frese, Baer, & Sonnentag, 2005). One of the most influential psychological theories of human error is Rasmussen's (1983) skill-rule-knowledge model of behaviour (see Figure 4.1). In this model, Rasmussen describes three levels of cognitive processing (skill-based, rule-based, and knowledge-based) that are utilised when performing a task. The nature of the task, as well as the individual's degree of experience with the task, determine what level of cognitive processing is employed. The levels can be described as follows:

(a) Skill-based behaviours occur when a task is highly familiar to the individual so that the cognitive processing required to perform the task is habitual and automatic. An individual extremely experienced at a particular task can process at this skill-based level, for example an experienced car driver changing gears in response to the environment while maintaining a conversation with a passenger. These types of behaviour require minimal conscious effort, allowing attentional resources to be applied elsewhere. However, this automisation can produce incidences of absent-mindedness due to the sensitivity to distraction. Errors in skill-based performances usually occur during the execution of a behaviour, whereby an individual performs an automatic behaviour that is typically associated with another cue (e.g. driving past a turning).

(b) Rule-based performances are more advanced than skill-based performances. The individual may be somewhat familiar with the task, but greater conscious effort due to a lack of experience with the task is required. In order successfully complete the task, the individual applies a rule, for example: If [*problem X*] then [*apply solution Y*]. Such rules are formulated through experience and training, and are stored in memory, leading to expertise. However, rule-based errors can occur when an incorrect rule is applied to an unfamiliar situation (e.g.

misreading the problem), or when the essential information to perform the task is not available.

(c) Knowledge-based performance is the highest level of performance and occurs when an individual applies previously learned information to solve novel problems. This requires a high degree of conscious effort where the individual has to 'think on his/her feet'. Although this conscious cognitive control is flexible, it can be effortful, tiring, and subsequently prone to error. In order to successfully complete a knowledge-based performance, the individual is required to assign meaning to the novel task, which requires working memory, and an action plan is devised. Since working memory processes information serially, the individual may wrongly focus on relatively unimportant aspects of the task. Attention is subsequently diverted and there is a failure to monitor the actions being performed, resulting in an error in completing the task.
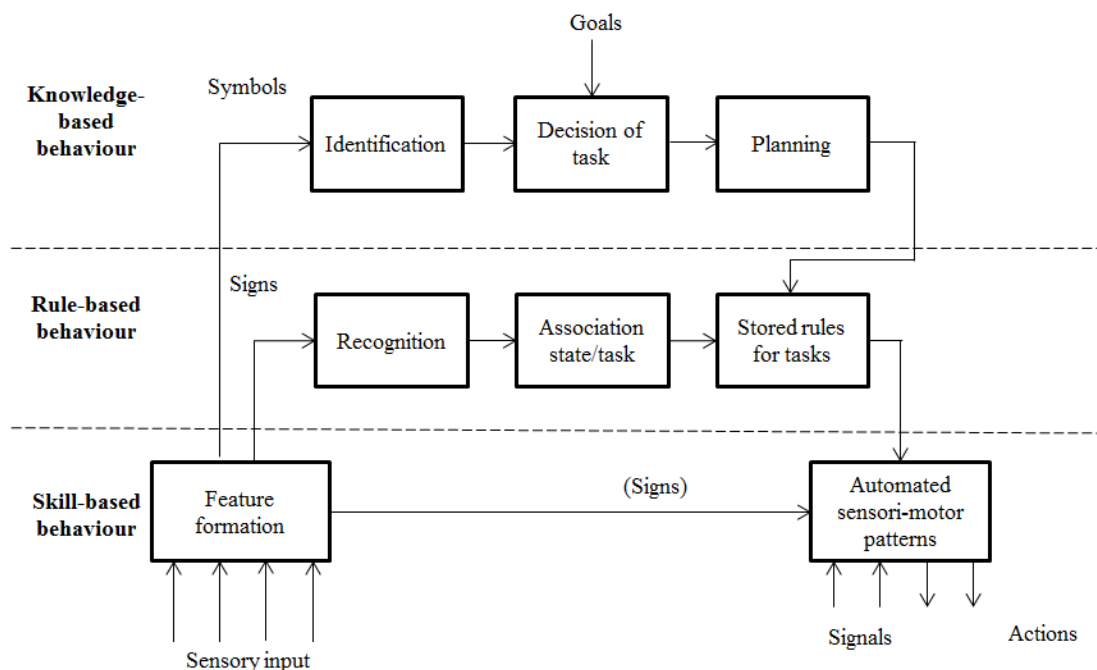


*Figure 4.1.* Rasmussen's (1983) skill-rule-knowledge (SRK) model of human performance.

Reason (1990) further developed the psychological taxonomy of human error through his research on organisational accidents. He proposed the Generic Error Modelling System (GEMS), which is based on Rasmussen's three main categories of human performance (see Figure 4.2). In the GEMS conceptual model, Reason identified three basic error types: skill-based slips (and lapses), rule-based mistakes, and knowledge-

based mistakes. This model focuses on cognitive factors in human error rather than on environment or context-related factors. During familiar routine tasks, where little conscious effort is required to perform skill-based tasks, slips and lapses can occur. These result from failure in the execution of an action sequence. Slips are considered as actions-not-as-planned, for example slips of the tongue. Lapses are more covert in nature, such as lapses of memory, and may only be noticeable by the individual. Mistakes are failures in the formation of a correct plan of action to achieve a goal. Reason also acknowledged intentional deviations from practice and classified these as violations.
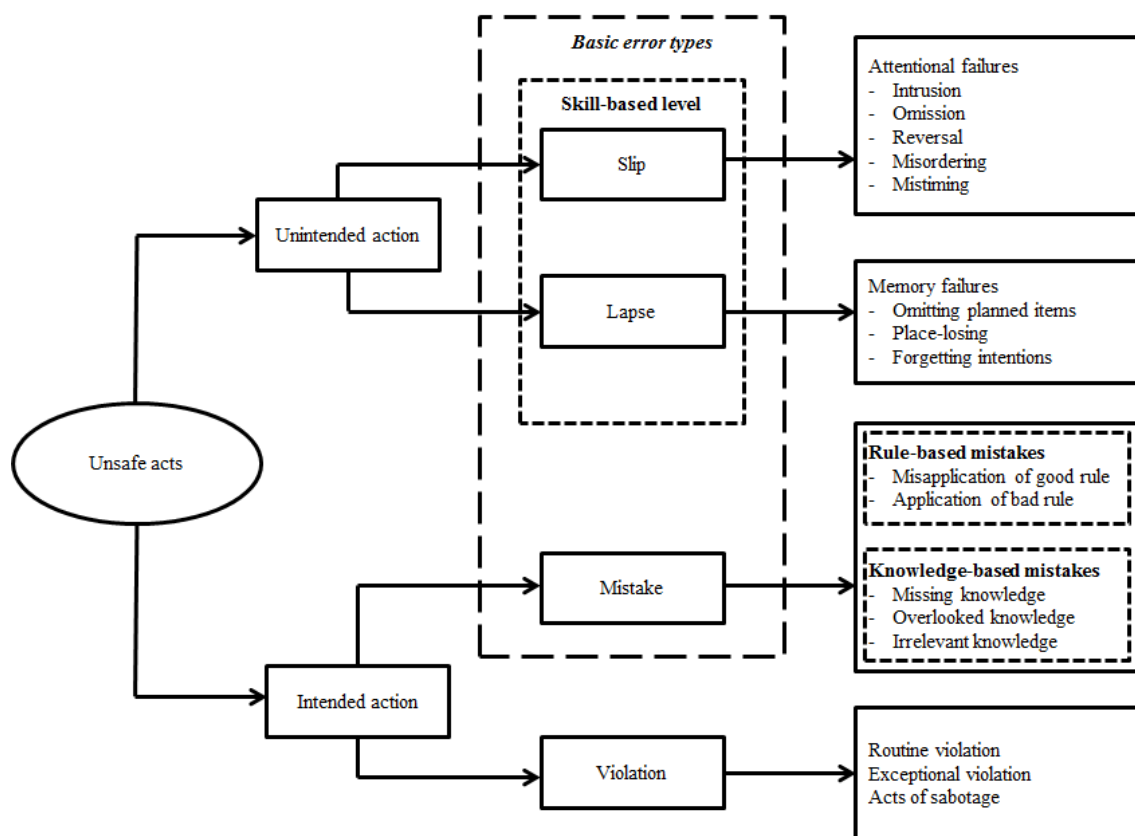


*Figure 4.2.* Reason's (1990) Generic Error Modelling System (GEMS)

## 4.4   Accident Causation Theories

A recent review of the occupational injury and accident research by Khanzode, Maiti, and Ray (2012) illustrates that a considerable body of knowledge exists on accident causation theories. Despite researchers from various fields working to help identify,

isolate and ultimately eliminate the factors that influence accidents, no theory has been universally accepted as yet (Issever, Ozdilli, Onen, Tan, Disci, & Yardimci, 2008). One of the most widely accepted conceptual models of accident causation is Reason's (1990, 1997) Swiss cheese model, which was developed following his work on organisational accidents and extensive evidence from diary studies. This model proposes that organisations have consecutive layers of defensive barriers and safeguards (e.g. policies, fire alarms) that aim to provide protection from hazards. However, there are holes in each layer of the defence (which Reason compared to those found in Swiss cheese) that are created by active failures and latent conditions. Active failures are unsafe acts performed by individuals at the 'sharp end', such as those in direct contact with a patient or system. These types of failures are inevitable and unpredictable, and include slips, lapses, mistakes, and violations. Latent conditions are identifiable and may lie dormant for some time before an accident occurs. They include organisational weaknesses, such as lack of training or resources, or decisions made by management. When these active failures and latent conditions line up they can create windows of opportunity for an accident (Reason, 1997). Although the Swiss cheese model has been praised for its advancement of our understanding of human error and accident causation, particularly in the aviation domain, it has been criticised for being too theoretical and descriptive and lacking real-world application (Shappell & Wiegmann, 2000). Due to the absence of specification regarding the nature of the holes causing the accident and their inter-relationships, the model cannot easily be applied as an investigation tool. Furthermore, Dekker (2002) argues that the layers of the defence are neither static, constant, nor independent, as the model suggests.
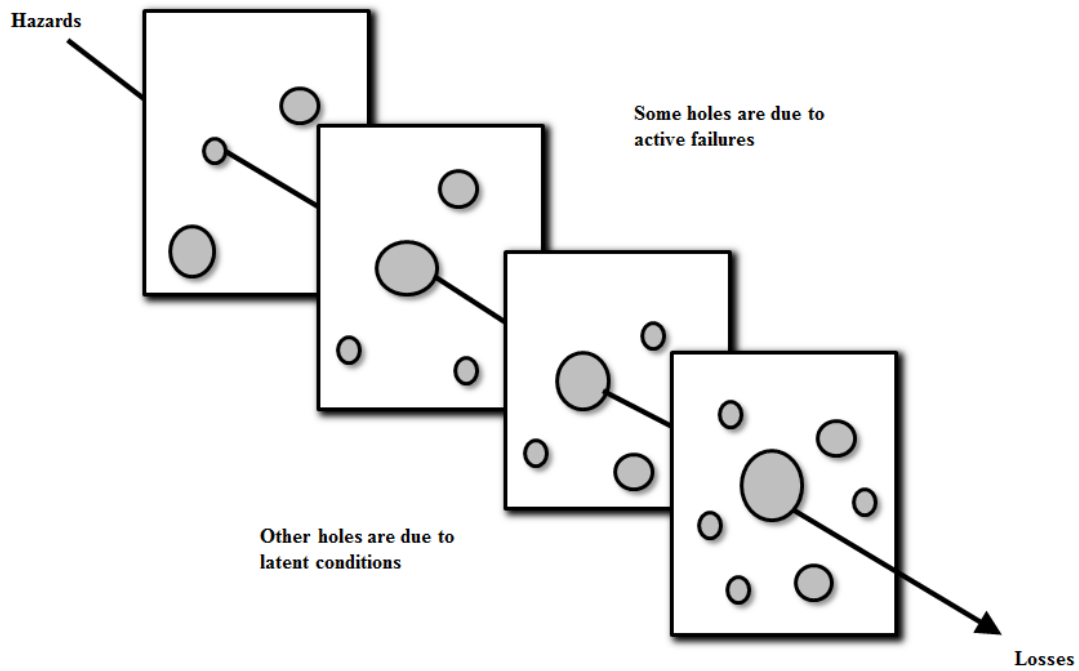
*Fire 4.3.* Reason's (1990) Swiss cheese model of accident causation

A summary of the main theories of accident causation is presented below in Table 4.1. Despite early work focusing on the person-related factors causes of accidents, the literature has developed a strong interest in the influence of situation-related factors, such as supervisor support and work pressures (Clarke, 2012).

Table 4.1

*Summary of Accident Theories (Khanzode, Maiti, & Ray, 2012)*

| Theory | Summary |
| --- | --- |
| Accident proneness theory | The person (unsafe acts) is the cause of the accident, in particular personality traits and unsafe behaviour (Greenwood & Woods, 1919). Individual-related factors for accident causation are examined. |
| Domino theories | The system (unsafe conditions) and the person (unsafe acts) are the causes of the accident. A chain of sequential events (dominoes) leads to an accident (Heinrich, 1932). Used widely in industry. Individual- and job-related factors for accident causation are examined. |
| Injury epidemiology theory | The sequence between system and person is the cause of the accident, in particular uncontrolled energy transfer (Haddon et al., 1964). Job-related factors (leading to energy interactions) for accident causation are examined. |
| System theory | A holistic approach: the system (unsafe conditions) and sequence between system and person (energy interaction) are the causes of accident. Organisation-, job- and individual-related factors for accident causation are examined. |
| Sociotechnical system (STS) theory | Interacting social and technical subsystems, job design based on STS principles. |
| Macroergonomic theory | Holistic approach like system models, organisation-centred approach. |

After consideration of the main accident causation theories, it is the person-related factors that are highly applicable to this thesis. In particular, the accident proneness theory offers a psychological approach to accident investigation and is therefore discussed further in the following section.

### 4.4.1   Accident Proneness Theory

The accident proneness theory was developed to explain why some individuals experience more accidents than others (or that would be expected by chance). The theory originated following a study by Greenwood and Woods (1919) where accidents amongst workers in a British munitions factory were found to be unevenly distributed

amongst the sample. In light of these findings, Greenwood and Woods proposed that some individuals have a greater accident propensity than others. Since the accident proneness theory was published, accident causation theories have tended to focus on the design of the work environment as potentially hazardous factors (Day, Brasher, & Bridger, 2012). As the majority of accident and injury research is conducted in industrial settings, particular interest lies in task-related and organisation-related factors, as opposed to individual-related factors. Subsequently, the popularity of the psychological approach to accident causation dwindled due to the idea that person-as-cause theme associated with this theory lays the blame of accident liability with certain individuals (Khanzode, Maiti, & Ray, 2012), rather than on safety regulations in the workplace (Green, 1991).

Following a recent meta-analysis of 79 studies examining accident proneness, Visser, Pijl, Stolk, Neeleman, and Rosmalen, (2007) concluded that although there is lack of consensus regarding definitions of accident and operationalisations of accident proneness, evidence was discovered providing support for the existence of accident proneness. Studies often examine accidents in specific contexts such as traffic, work and sports, or specific populations, such as children, students, or patients (Visser et al., 2007). Originally, accident proneness was described as a non-modifiable characteristic. However, more recently, research has identified transient factors to explain the theory, such as stress (Khanzode, Maiti, & Ray, 2012).

A number of studies have shown that the Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, FitzGerald, & Parkes, 1982) is able to predict safety behaviour in the workplace (e.g. Wallace & Vodanovich, 2003) and increased driving accidents (e.g. Larson, Alderton, Neideffer, & Underhill, 1997; Larson & Merritt, 1991). Furthermore, several other psychological factors have been shown to be associated with accidents, such as anxiety (e.g. Murata et al., 2000) and fatigue (e.g. Åkerstedt, Fredlund, Gillberg, & Jansson, 2002; Simpson et al., 2005). Salminen and Heiskanen (1997) suggested that individuals who are prone to accidents in the workplace are also at risk of accidents in the home and during leisure activities. The value of the accident proneness theory is that once factors associated with the accident-prone individual are identified, preventive strategies can be tailored to reduce future accidents (Visser, Pijl, Stolk, Neeleman, & Rosmalen, 2007).

## 4.5    Psychological Factors Associated with Accidents

A variety of psychological factors have been associated with accident propensity. Since this thesis is concerned with developing an understanding of the impact of chemotherapy-related side effects on breast cancer patients' daily life, the evidence on the association between accident frequency and anxiety, depression, fatigue and cognitive difficulties is reviewed below. The literature discussed in Chapter Three suggests that these psychological factors are present following chemotherapy treatment.

### 4.5.1    Anxiety, Depression and Fatigue

A number of studies have identified a relationship between anxiety and an increased risk of accidents (e.g. Murata, Kawakami, & Amari, 2000). For example, in response to the increased prevalence of anxiety and depression among the UK population (HSC, 2004), and subsequent use of medications for these conditions, several studies have examined the effects of anxiety and depression on safety outcomes in the workplace. Haslam, Atkinson, Brown, and Haslam (2005) found that that the physical and psychological symptoms of anxiety and depression and the associated prescribed medication impaired work performance. Participants attributed a range of near-misses and accidents, including industrial injuries and falls, to their medical condition or medication. In particular, employees with responsibilities for others where their actions could endanger lives, such as doctors, teachers, managers, electricians and mechanics, were reported to repeatedly check their work. This group were also identified as being at a greater risk of experiencing hazardous events (Haslam et al., 2005). More recent work by Kim, Park, Min, and Yoon (2009) also found that workers who reported depressive symptoms were more likely to self-report occupational injury.

The potential mechanisms of how anxiety and depression impact on accident proneness are currently unclear. Studies that are cross-sectional in design are limited as it is not possible to establish the direction of causality (e.g. Nordstrom, Zwerling, Stromquist, Burmeister, & Merchant, 2001). Researchers have proposed direct effects (e.g. the symptoms related to anxiety and depression) as well as indirect effects mediated by adverse health behaviours (Bhattacherjee et al., 2003; Simpson, Wadsworth, Moss & Smith, 2005; Wadsworth, Simpson, Moss, & Smith, 2005). There is strong evidence for the association between depression and cognitive impairment, in particular in the

domains of executive function, memory, concentration, and psychomotor speed (Castaneda et al., 2008). Consequently, research efforts have focussed on accident risk in individuals experiencing depression, particularly in contexts with high cognitive demands. For example, Bulmash, Moller, Kayumov, Shen, Wang, and Shapiro (2006) examined the association between Major Depressive Disorder (MDD) and driving ability using a simulated driving paradigm. In this study, MDD outpatients ($n = 18$) and controls ($n = 29$) completed four 30-minute simulated driving trials throughout the day. Scores on the Beck Depression Inventory (BDI) and the Epworth Sleepiness Scale (ESS) were recorded. Results showed that after controlling for age and sleepiness, participants with MDD exhibited impaired driving performance, such as slower steering reaction times and increased crash rate compared to the control group.

A number of studies have identified a link between fatigue and increased rates of accidents and injuries. Indeed, the role of fatigue in road traffic accidents is thought to contribute to up to 20% of accidents occurring on major roads and motorways (Horne & Reyner, 1995). Fatigue and disturbed sleep have also been implicated in workplace accidents (Åkerstedt, Fredlund, Gillberg, & Jansson, 2002; Melamed & Oksenberg, 2002; Simpson, Wadsworth, Moss, & Smith, 2005; Wadsworth, Simpson, Moss, & Smith, 2003).

### 4.5.2   Cognitive Difficulties

Larson, Alderton, Neideffer, and Underhill (1997) found a strong association between cognitive difficulties (as measured on the CFQ) and accidents, which suggests that accidents may result from perception, action and memory lapses. Further evidence from Wallace and Vodanovich (2003) demonstrated that high scores on the CFQ (suggesting impaired cognitive function) predicted safety behaviour as well as accidents in the workplace.

A series of studies examining the frequency of cognitive failures and unintentional injuries has been conducted by researchers from Cardiff University. Wadsworth, Simpson, Moss, and Smith (2003) conducted a postal questionnaire study ($n = 4,673$) measuring the prevalence and associations of cognitive failures, minor injuries and accidents in the workplace. Participants were asked to rate how often they experienced problems with memory, attention, or action had been experienced in the workplace over

the past 12 months, using a 5-point scale (*not at all, rarely, occasionally, quite frequently, very frequently*). Similarly, a rating scale was used to measure minor injuries, such as cuts and bruises that did not require medical attention. Accidents were defined as incidents that required medical attention. Wadsworth et al. found that accidents were reported by 4% of participants, 8% reported experiencing minor injuries quite frequently or very frequently, and 13% experienced cognitive failures quite frequently or very frequently. Findings suggested that all three outcomes were associated with each other. Cognitive difficulties were also related to anxiety, work stress and sleeping problems in the previous 14 days. In a similar study, the same research group (Simpson, Wadsworth, Moss, & Smith, 2005) found evidence from 7,980 questionnaire responses that supported earlier findings. Accidents were associated with minor injuries, and minor injuries were associated with cognitive difficulties. They suggested that the context may contribute to the result of an accident following minor injury or cognitive failure. They found that accidents when lifting or carrying were the most common, with slips, trips and falls also being frequent. Despite low response rates, which may have contributed to response bias, these studies documented new factors that are associated with accidents.

## 4.6    Evidence of Accident Risk in Clinical Populations

Researchers have examined the impact that illness, disease and treatment-related side effects can have on daily functioning in a number of clinical populations. Several studies have identified elevated accident risk in clinical populations, and are reviewed in this section.

### 4.6.1    Evidence from Dementia Patients

Dementia, a generic term used to describe a chronically progressive brain disease, is characterised by cognitive and perceptual impairments. Research has examined everyday safety implications within this patient group. For example, it has been found that some individuals with dementia find it difficult to navigate the home environment safely and that caregivers are often required to make changes in the home environment or during activities to reduce the potential risk for injury (Lach & Chang, 2007). Lach and Chang conducted a focus group study with caregivers who cared for people with dementia and results revealed a high proportion of caregivers highlighting safety issues.

This included people with dementia experiencing driving difficulties, such as getting lost and being involved in road traffic crashes (69.2%), falls (41.0%), and difficulties related to cooking (30.8%). Another study specifically examining the safety of drivers with dementia found that one-fifth of dementia patients attending a Memory Clinic ($n =$ 329) continued to drive following diagnosis (O'Neill et al., 1992). Two-thirds of those who continued to drive had impaired driving ability and drove unsafely, such as driving the wrong way around a roundabout and up the wrong lane of a dual carriage-way. Furthermore, 29% of dementia patients were involved in road traffic crashes, which carers rated as being caused by impaired driving ability. There is particular concern regarding the safety of dementia patients as some may be limited by a lack of insight of their condition and limited awareness of the implications of their cognitive difficulties. Similarly, due to the lack of research relating to the safety implications of safety behaviour amongst breast cancer patients experiencing cognitive side effects, these patients may also lack awareness of the limitations of their cognitive ability and thus put themselves into situations that may prove hazardous. However, it is important to note that the type of cognitive difficulties experienced by breast cancer patients tend to be more subtle and temporary compared to those experienced amongst people with dementia.

### 4.6.2   Evidence from Cancer Patients

A review of the literature on safety outcomes associated with any cancer treatment was conducted and a summary of the identified papers is presented in Table 4.2. Many studies were conducted in the hospital setting (e.g. Alcee, 2000; Capone, Albert, Bena, & Morrison, 2010; Capone, Albert, Bena, & Tang, 2013; Fischer et al., 2005; Hendrich, Nyhuis, Kippenbrock, & Soja, 1995; Hitcho et al., 2004; Lakatos et al., 2009; O'Connell, Baker, Gaskin, & Hawkins, 2007; Stone, Lawlor, Nolan, & Kenny, 2011) with a heterogeneous patient sample (e.g. included oncology, neurology, orthopaedics, psychiatry and cardiology department). Evidence suggests that having a cancer diagnosis is associated with safety concerns, particularly fall risk (e.g. Chen et al., 2009; Hendrich, Nyhuis, Kippenbrock, & Soja, 1995), although one study did not support this finding (Spoelstra, Given, von Eye, & Given, 2010).

A handful of studies have considered the safety implications of cognitive impairment on driving ability in head and neck cancer patients (Yuen, Gillespie, Day, Morgan, &

Burik, 2007; Yuen, Logan, Boyd, Day, & Brooks, 2009). Chemotherapy for head and neck cancer can cause central neurotoxicity and peripheral neurotoxicity (Verstappen, Heimans, Hoekman, & Postma, 2003; Vihinen, Katka, Johansson, Vihinen, & Salminen, 2003) while radiotherapy to the central nervous system can result in neurocognitive difficulties (Meyers, Geara, Wong, & Morrison, 2000). As a result, impairment in cognitive, psychomotor and visuoperceptual-motor abilities have been documented. Importantly, these abilities are necessary for successful driving ability. Yuen et al. (2007) were the first to explore the driving behaviours of head and neck cancer patients during and after cancer treatment. They employed a cross-sectional survey design and found that self-report cognitive impairment affecting driving ability was among the reasons for why 67.5% of head and neck cancer patients chose to drive less frequently or ceased driving during treatment while 26.5% continued to drive less frequently or ceased driving post-treatment. Yuen and colleagues argued that this significant reduction in driving can impact upon quality of life, in particular relating to access to social and leisure activities. They also found that six head and neck cancer patients reported traffic violations or crashes following cancer treatment and when compared to pre-diagnosis data, more crashes were reported post-treatment. Further research is required in order to understand causality relating to road traffic accidents amongst this cancer patient population. Nonetheless, these findings raise important issues for the implications of cognitive side effects experienced by breast cancer patients[2], although it is important to note that there are differences between the experiences of head and neck cancer patients and breast cancer patients. These include specific side effects relating to the origin of the cancer and treatment-related side effects, such as neck mobility restriction among head and neck cancer patients (Hunter-Zaworski, 1990), which breast cancer patients would not normally experience.

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[2] In the UK, the Driver and Vehicle Licensing Agency (DVLA) maintains registers of drivers and vehicles and aims to facilitate road safety. Currently, 'cancer' is listed under the conditions that require notification to the DVLA if disease- or treatment-related side effects impact upon driving ability, and specifically, 'cognitive problems' is listed. Affected drivers are required to complete a medical questionnaire so that the DVLA can assess the potential safety implications of these conditions.

Table 4.2

*Summary of Literature on Safety and Accident Issues associated with Cancer Treatment*

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| Alcee (2000) | Retrospective review | Acute-care community hospitalised patients who had experienced a fall (*n* = 209). The following departments were included: surgical; emergency; oncology/medical; paediatrics/medical; orthopaedic/medical; ICU/CCU; telemetry; adolescent psychiatry; adult psychiatry. | SAFE; number of falls and repeat falls; severity of falls; description of measures that were applied to reduce falls by the hospital; frequency of falls related to bathroom use; time of fall; medication use. | Out of 9 nursing units, falls most often occurred on the oncology/medical unit (26%). 57% of patients fell during the night shift. 68% of patients experienced no injury following a fall. Medication use (sedatives, hypnotics, pain relief) did not correlate with falls. | Strengths: large sample size; in-depth review of falls included.<br><br>Weaknesses: retrospective design; no oncology-specific fall details provided; lack of demographic information for sample. | It is not stated if this study included BC patients undergoing CT. There was no longitudinal data and psychological risk factors for falls were not considered. |
| Bylow et al. (2008) | Longitudinal (Baseline; 3 months) | Male prostate cancer patients receiving ADT aged >70 years (*n* = 50). | Functional and physical ability (ADLs; IADLs; VES-13, SPPB); history of falls within the previous 3 months; cognitive screen (Short Portable Mental Status Questionnaire); Charlson Comorbidity Index; medication history; social support; Mini-Nutritional Assessment; fatigue (Medical Outcomes Study Short Form 36-item Health Survey). | 22% of participants reported falls within the previous 3 months. ADL deficits, use of an assistive device, and abnormal functional screen findings were associated with an increased risk of falls. 24% of patients had an underlying cognitive impairment. All patients who fell reported fatigue. | Strengths: homogeneous cancer sample but many received treatments other than ADT; detailed demographic data reported; standardised measures.<br><br>Weaknesses: relatively small convenience sample; limited generalisability due to single recruitment site; 20% attrition rate; short follow-up. | This study did not include BC patients undergoing CT. The study captured some longitudinal data and psychological factors (cognitive ability and fatigue) were included. |

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| Bylow et al. (2011) | Cross-sectional, case-control | Males aged >60 years with BCR of prostate cancer on ADT ($n = 63$); prostate cancer survivors without recurrence ($n = 71$). | Frailty prevalence; obese frailty; objective physical ability (SPPB); grip strength (Jamar hydraulic hand dynamometer); walking speed (timed 15-foot walk); self-reported frequency of falls in the last 6 months; self-reported comorbidities (OARS); fatigue (CES-D); testosterone levels; fasting glucose levels. | Males with BCR of prostate cancer on ADT experienced more falls than controls (14.3% vs. 2.8%; $p = 0.02$). Comorbidity significantly increased the likelihood of falls (OR 2.02, $p = .01$). | Strengths: inclusion of a homogeneous treatment group and a well-matched control group; recruited from several clinics; considered impact of confounders.  Weaknesses: cross-sectional design; possible recruitment bias. | This study did not include BC patients undergoing CT. No longitudinal data was collected and psychological risk factors for falls were not considered |
| Capone et al. (2010) | Prospective and retrospective medical record review | Hospitalised cancer patients who had experienced a fall ($n = 158$). | Patient characteristics (e.g. age, comorbid conditions; use of walking aide; medical treatments or effects of treatments such as pain, pain treatment; weight, gait, fall risk); fall location; fall injury (National Database of Nursing Quality Indicators injury scale); fall severity. | The majority of falls occurred in the patients' room (80.4%), followed by the bathroom (17.1%). Most falls resulted in no injury (70.9) or a minor injury (25.9%). More falls occurred during the night shift (37%) than on evening shifts (32%) or day shift (30%). Of those who fell, 15% had depression and 8% had dementia. | Strengths: mixed-methods; large sample size; quality assurance monitoring of data collection.  Weaknesses: heterogeneous cancer and treatment sample; no comparison group; limited generalisability due to single recruitment site. | This study reported on a heterogeneous cancer sample; some completed CT. This was a record review study and so the patients' perspective was not considered. No longitudinal data was collected. Some psychological factors were measured (e.g. depression and dementia), but only reported descriptively. |

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| Capone et al. (2013) | Retrospective medical record review | Hospitalised patients who had experienced a fall and sustained a serious injury and had cancer (*n* = 16); did not have cancer (*n* = 41). | Cancer type; cancer treatment; fall event details; injury type (National Database of Nursing Quality Indicators injury scale); injury severity level (observation, review of radiographs, CAT scans, healthcare provider assessments, and other post-fall medical record details); comorbid conditions; medication; gait (Morse Falls Scale). | No significant differences in serious injury level patient groups. Cancer patients who had received corticosteroids were more likely to have a serious injury. Depression and dementia (measured comorbid conditions) did not differ based on cancer hospitalisation. | Strengths: quality assurance monitoring of data collection. Weaknesses: small, single-centre sample, limiting generalisability; retrospective data collection may have led to bias; limited data on cancer diagnosis and cancer treatment; data on medication was not recorded; possible recording bias (falls not witnessed may not have been recorded). | This study reported on a heterogeneous hospitalized cancer sample (did not analyse BC patients separately). This was a record review study and so the patients' perspective was not considered. No longitudinal data was collected. Some psychological factors were measured (e.g. depression and dementia). |
| Chen et al. (2005) | Longitudinal (Baseline; annually up to 5.1 years) | Female breast cancer survivors (*n* = 5,298); female non-cancer (*n* = 80,848). | Fracture occurrence (annual self-reports). Hip fractures (medical records); patient characteristics (e.g. age. Age at menopause, ethnicity, smoking, fracture history, fall history, hysterectomy, walking, medication uses); physical function (Medical Outcomes Study Scale); depression (CES-D); dietary intake; alcohol consumption; BMI. | Fracture rates were higher in the BC survivor group (expect for hip fractures). BC survivors were more likely to experience fractures if they had an indication of depression. Post-menopausal BC survivors are at an increased risk for sustaining clinical fractures. | Strengths: large sample size; control group; assessed covariates. Weaknesses: lack of cancer-specific data (e.g. age at diagnosis; tumour stage; treatment regimens; bone metastasis); control group not well-matched on demographic variables. | This study included a homogenous sample of BC survivors and a non-cancer control group, although treatment-related information was not recorded. Longitudinal data was collected and psychological factors were considered. |

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| Chen et al. (2009) | Longitudinal (Baseline; annually in the observational group and biannually in the clinical trials group up to 9 years) | At baseline: healthy post-menopausal females at baseline ($n = 146,959$) At follow-up: no cancer diagnosis ($n = 132,840$); invasive BC ($n = 4,804$); non-invasive BC ($n = 1,073$); other cancer type ($n = 8,242$). | Self-administered questionnaires: medical history; health status; reproductive history; medication; physical activity; dietary intake; fracture history; other lifestyle factors; height; weight. Physician medical review: cancer incident; BC treatment; fractures incident. | Fall risk and fracture risk are significantly increased following a BC diagnosis or other cancer diagnosis in postmenopausal women. | Strengths: longitudinal design; large sample size recruited from a wide geographical area; detailed treatment-related information recorded; controlled for potential confounders. Weaknesses: pathological fractures could not be distinguished from other fractures. | This study included invasive BC patients, non-invasive BC patients, other cancer patients, all undergoing various treatments, and healthy women. This was a prospective study that used self-report measures to obtain fall-related data; however, psychological factors were not considered. |
| Fischer et al. (2005) | Retrospective, observational | Hospitalised patients who had experienced a fall ($n = 1,082$). The following departments were included: women/infants; surgery; cardiology; neurology/orthopaedics; oncology; medicine; psychiatry. | Mental status prior to fall; date and time of fall; reporting department; fall location; mechanism of the fall/activity at the time of the fall; bed position; severity of injury; description of the fall. | Oncology service had highest number of falls and second highest injury rate (40%) and third highest number of falls resulting in injury (33%). Older age ( >75 years), sedated or unconscious mental status, and residence on the geriatric psychiatry floor were significant predictors of serious fall-related injury. | Strengths: large sample size; detailed fall-related information obtained. Weaknesses: retrospective design; heterogeneous patient sample; limited generalisability due to single recruitment site; lack of standardised assessment (e.g. mental status of participants prior to the fall assessed subjectively by staff); multicollinearity. | This study reported on a heterogeneous hospitalised patient group, and did not comment specifically on BC patients or CT. No longitudinal data was collected. Some psychological factors were considered. |

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| Hendrich et al. (1995) | Retrospective chart review | Charts of patients who had experienced a fall ($n = 102$); charts of patients who had not experienced a fall ($n = 236$). | Medication use; presence of known risk factors (recent surgery; diagnosis of cancer, cardiovascular disease, depression, or orthopaedic disease; confusion; decreased mobility; dizziness/vertigo; generalised weakness; history of falls; impaired speech/hearing or vision; incontinence; level of consciousness; sleeplessness; walking aids/devices). | Significant risk factors for falls included recent history of falls, altered elimination; depression, dizziness or vertigo, primary cancer diagnosis, confusion, and altered mobility. | Strengths: large sample size; assessed an extensive list of documented risk factors.<br><br>Weaknesses: retrospective design; heterogeneous patient sample. | This study included a heterogeneous hospitalised patient population. No longitudinal data was collected. Some psychological risk factors for falls were examined (e.g. depression, sleeplessness, and confusion). |
| Hitcho et al. (2004) | Prospective, descriptive | Hospitalised patients who fell ($n = 183$). The following departments were included: medicine; neurology; oncology; cardiology; surgery; orthopaedics; women and infants. | Interviews with patients and/or nurses, review of adverse event reports and medical records: patient characteristics (e.g. demographics, mental condition at time of fall); fall circumstances (e.g. date, time, location, discovery type, activity trying to perform at time of fall, reason for activity, mechanism of fall); other factors (e.g. footwear and clothing, visibility); result of fall (e.g. injury severity). | The oncology service had the highest rate of injury: 74% of first falls resulted in injury, with 11% resulting in moderate or severe injury. Lost balance was the most common mechanism of falls (12%). | Strengths: large sample size; included characteristics of those who fell (e.g. age, sex); triangulation of data sources.<br><br>Weaknesses: limited generalisability due to single recruitment site; cancer patients had the highest average length of stay, which may have confounded results; lack of data describing the types of injuries; lack of a control group. | This study included a heterogeneous hospitalised patient population. No longitudinal data was collected. Some psychological factors were considered (e.g. mental condition at time of fall). |

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| Hussain et al. (2010) | Longitudinal (Baseline; 3 months, 6 months; 12 months) | PC patients receiving ADT ($n = 88$); PC patients not receiving ADT ($n = 86$); HC ($n = 86$). | Participant characteristics (e.g. Charlson score, current smoker; bone mineral density; previous treatment); ability to perform ADL (Barthel Index; Lawton and Brody Scale); physical function (Timed Up and Go; 6MWT; grip strength); balance difficulties. | Independent predictors of falls included prior history of falls, being unmarried and arthritis. ADT use was borderline ($p = .08$). | Strengths: well-matched control groups on age and education; prospective longitudinal design; assessed extensive list of documented risk factors for falls. <br><br> Weaknesses: participant attrition; lack of data on participants' physical activity; limited generalisability due to single recruitment site. | This study reported on a homogeneous PC sample undergoing ADT, with two control groups. Longitudinal data was reported, but no psychological risk factors for falls were considered. |
| Lakatos et al. (2009) | Retrospective chart review | Hospitalised patients who experienced a fall ($n = 252$). The following departments were included: oncology; medicine; surgery; neurology; neurosurgery; orthopaedics; cardiology; psychiatry; other. | Medical records: demographic data; delirium diagnosis (DSM-IV); data and location of fall; fall severity. | Cancer patients experienced the third highest number of hospital falls (approx.. 16%). Falls were associated with delirium, advanced age, and specific surgical procedures. 96% of patients who fell showed signs of delirium. | Strengths: large sample size. <br><br> Weaknesses: heterogeneous patient group; limited description of falls; limited generalisability due to single recruitment site. | This study reported on a heterogeneous hospitalised patient sample undergoing various treatments. No longitudinal or patient-perspective data obtained. Some psychological factors considered (delirium). |

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| O'Connell et al. (2007) | Retrospective and prospective | Hospitalised patients from oncology and palliative care units ($n$ = 377). | FRAT: demographics (e.g. age, patient type); history of falls; continence issues; physical functioning (ECOG); bedside confusion (MMSE); orientation in person, year, month and place (MMSE); muscle strength; fatigue. | Patients who did not experience a fall were more likely to have stronger leg muscles than patients who did experience a fall. No differences between fallers and non-fallers on fatigue score. | Strengths: mixed-methods design; many variables were measured.<br><br>Weaknesses: heterogeneous patient group; limited data on diagnosis; recall bias (recall falls in the previous 12 months). | This study examined falls in a heterogeneous hospitalised patient group. No longitudinal data. Psychological factors considered. |
| Overcash et al. (2008) | Prospective | Aged <70 years: cancer patients receiving CT ($n$ = 86; 38.4% BC); cancer patients not receiving CT ($n$ = 211; 55.5% BC); healthy controls ($n$ = 55). | Interviews: demographics; diagnosis; medical history; comorbid conditions; Comprehensive Geriatric Assessment: functional ability (ADLS); depression (Geriatric Depression Scale); cognitive ability (MMSE); falls (American Geriatrics Society). | ADL scores significantly predicted falls in the CT group and non-CT BC groups. None of the variables significantly predicted falls in the HC group. | Strengths: large sample sizes; inclusion of two control groups.<br><br>Weaknesses: unequal sample sizes; limited generalisability due to single recruitment site. | This study included a heterogeneous cancer group, all received CT, plus two control groups. No longitudinal data was collected. Psychological risk factors for falls were examined. |
| Overcash et al. (2010) | Prospective, exploratory | Cancer patients aged >70 years who had experienced a fall within 3 months ($n$ = 20). | Structured interview: demographic details; cancer site; cancer treatment; information about falls (location of falls, fear of falls). | 75% of falls occurred in the home. Physical problems, general weakness and difficulty walking were thought to cause falls. Themes "being more careful" and "using an assistive device" were employed by participants to reduce fall risk. | Strengths: good sample size; detailed contextual information obtained about fall encounters.<br><br>Weaknesses: heterogeneous cancer population; limited generalisability due to single recruitment site. | This study reported on a heterogeneous cancer group, with some receiving CT. No longitudinal data was included. Qualitative design: self-report data about falls examined. |

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| Puts et al. (2013) | Longitudinal, pilot, secondary data analysis (Pre-treatment baseline; 3 months; 6 months) | Cancer patients aged >65 years 6 months after diagnosis ($n = 112$; 39.3% BC). | Interviews: demographic details; experience of falls in previous 3 months; frailty markers: mobility impairment (4-m timed gait speed test, cognitive impairment (MMSE), mood disturbance (HADS), fatigue (EORTC-QLQ-C30), low grip strength (Fried's norms); physical inactivity (Canadian Health and Aging Study Questionnaire), poor nutritional status; comorbidity (Functional Comorbidity Index); functional status (IADL; OARS). Patient chart: diagnosis, stage, treatment. | 17 participants (18.6%) experienced 1 or more falls within 6 months post-diagnosis. No significant differences between fallers and non-fallers on health and functioning. No significant association between sociodemographic and health characteristics and falls. | Strengths: large sample size; prospective longitudinal design; short timeframe between interviews (reduce recall bias); physical and psychological fall risk factors examined.

Weaknesses: heterogeneous cancer and treatment sample; attrition; context of falls not considered. | This study examined prospectively the risk of falls in a newly-diagnosed heterogeneous cancer group (including BC and CT-treated). Longitudinal data was collated and psychological risk factors for falls were considered. |
| Spoelstra et al. (2010) | Retrospective, cross-sectional; secondary data analysis | Community-dwelling adults aged >65 years ($n = 7,448$). | Number of falls; age; sex; ethnicity; cancer diagnosis; ADLs; IADLs; cognitive ability; vision; incontinence; pain; depression. | Cancer diagnosis was not a predictor of falls. Ethnicity, sex, ADLs, incontinence, depression and pain were significant predictors of falls. | Strengths: large sample size.

Weaknesses: heterogeneous cancer and treatment sample; cross-sectional design; lack of control of comorbidities. | Community-dwelling cancer patients, but unknown diagnosis and treatment. No longitudinal data collected. Some psychological factors considered (cognitive ability and depression). |

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| Stone et al. (2011) | Prospective (Weekly for up to 6 months) | Advanced cancer patients admitted to palliative care services (*n* = 119). | Patient interview and routine record review: demographic details. Performance status (Palliative Performance Scale). Weekly telephone or face-to-face contact: fall-related information. | 62 patients (52.1%) fell during follow-up. Falls occurred in the community (55%) and in hospital or hospice inpatient settings (45%). | Strengths: large sample size; longitudinal design; recruited consecutive admissions.<br><br>Weaknesses: heterogeneous cancer sample; limited generalisability due to single recruitment site; possible selection bias (>50% of eligible patients declined participation). | This study reported on patients receiving palliative care. Longitudinal self-report data was obtained, although psychological fall risk factors were not considered. |
| Tofthagen et al. (2012) | Prospective, descriptive | Cancer patients experiencing chemotherapy-induced peripheral neuropathy (*n* = 109; 22% BC). | Questionnaire: demographic information; cancer- and treatment-related data. Neuropathic symptoms, functional status and incidence of falls (CIPNAT). | Loss of balance and number of CT cycles were independently associated with falling. Patients who received taxanes were more likely to encounter a fall than those who received platinum-based CT. | Strengths: large sample size; prospective design; several recruitment sites (generalisability).<br><br>Weaknesses: no longitudinal data; heterogeneous cancer group; lack of control group. | This study examined risk factors for falls in a heterogeneous cancer sample experiencing chemotherapy-induced peripheral neuropathy. No longitudinal data was collected and psychological risk factors for falls were not considered. |

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| Winters-Stone et al. (2009) | Cross-sectional, prospective (Baseline; 12 months) | BC survivors with CT-induced amenorrhea (*n* = 35; 1 year post-CT); HC (*n* = 26). | Demographic details (e,g. menopausal status); cancer-related information (e.g. BC stage, type of treatment); fall and fracture incidence; leg strength; bone mineral density; body composition; bone turnover; habitual calcium intake (Block Food Frequency Questionnaire); habitual physical activity (Kaiser Physical Activity Survey). | Significantly more BC survivors (75%) experienced >1 fall compared to HC (46%). BC survivors who fell had lower leg strength and calcium intakes than BC non-fallers. | Strengths: homogenous cancer group; inclusion of a control group; controlled for potential confounders.<br><br>Weaknesses: small sample size; heterogeneous treatment group; limited generalisability due to single recruitment site. | This study examined BC survivors who had received CT 12 months prior and compared falls in a HC group. No psychological risk factors for falls were considered. |
| Winters-Stone et al. (2011) | Case-control and prospective observation (Previous 12 months; monthly up to 6 months) | BC survivors <2 years CT completion and/or on adjuvant endocrine therapy (*n* = 59). | Demographic and clinical data (e.g. BC stage, treatment type); balance difficulties (computerised dynamic posturography; sensory organisation test); gait speed (4m walk); neuromuscular function (leg press, chair raises, functional stair climb ability); muscle mass (DXA); vision (visual acuity; spatial contrast sensitivity); self-reported falls in previous 12 months and monthly for 6 months. | 58% of BC survivors experienced falls in the previous 12 months. Balance disturbances and delays in detecting low contrast visual stimuli were associated with falls. | Strengths: homogeneous cancer group; retrospective and prospective data collection.<br><br>Weaknesses: lack of control group. | This study reported on the experience of falls in postmenopausal BC survivors; some had received CT. Longitudinal data was recorded, although no psychological risk factors for falls were measured. |

| Author (year) | Design (Timing of assessment) | Sample | Measures | Summary of findings | Critical appraisal | Relevance to research question |
|---|---|---|---|---|---|---|
| Yuen et al. (2007) | Nonrandomized controlled trial; pilot | Head and neck cancer patients ($n = 10$); HC ($n = 50$). | Laboratory driving simulator: average speed, mean brake reaction time, steering variability, total number of collisions during the 12-min driving simulator course; Simulator Driving Performance Scale. | Brake reaction time was significantly longer and steering variability was significantly larger in the head and neck cancer group than HC group. | Strengths: inclusion of a control group; driving simulators can be an ecologically valid method for assessing driving behaviour.<br><br>Weaknesses: heterogeneous treatment group; control group not well-matched; small sample size; limited generalisability due to single recruitment site. | This study reported on safety-related driving behaviour in head and neck cancer patients, with heterogeneous treatment. No longitudinal data or psychological risk factors for safety behaviour were considered. |
| Yuen et al. (2009) | Pilot | Head and neck cancer patients ($n = 8$) | Laboratory driving simulator: brake reaction time. Questionnaire on driving behaviour; amount of driving pre- and post-treatment; anxiety and depression (HADS). | The amount of driving post-treatment was negatively correlated with the mean brake reaction time and with the anxiety subscale and depression scale on the HADS. | Strengths: driving simulators can be an ecologically valid method for assessing driving behaviour.<br><br>Weaknesses: small sample size; lack of control group. | This study reported on driving behaviour in head and neck cancer patients, with heterogeneous treatment. No longitudinal data collected. Psychological factors considered (anxiety and depression). |

**Key. ADLs:** Activities of Daily Living; **ADT:** androgen deprivation therapy; **BC:** breast cancer; **BCR:** biochemical recurrence; **CAM:** Confusion Assessment Method; **CAT:** computerised axial tomographic; **CCU:** Cardiac Care Unit; **CIPNAT:** Chemotherapy-Induced Peripheral Neuropathy Assessment Tool; **CT:** chemotherapy; **CES-D:** Center for Epidemiological Studies depression scale; **DSM-IV:** Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; **ECOG:** Eastern Cooperative Oncology Group; **EORTC-QLQ-C30:** European Organization for Research and Treatment of Cancer Quality of Life core questionnaire 30 items; **FRAT:** falls risk-assessment tool; **HC:** healthy controls; **IADLs:** Instrumental Activities of Daily Living; **ICU:** Intensive Care Unit; **MMSE:** mini mental state examination; **OARS:** Older Americans Resources and Service; **PC:** prostate cancer; **SAFE:** Staff Against Falls Everywhere; **SPPB:** Short Physical Performance Battery; **VES-13:** Vulnerable Elder's Survey-13.

### 4.6.3   Section Summary

This review chapter has demonstrated clear evidence for the association between anxiety, depression, fatigue, subjective cognitive difficulties and safety outcomes, such as increased risk of accidents and injuries. As shown in Table 4.2, there is currently a lack of literature investigating the impact of chemotherapy-related psychological side effects on safety outcomes particularly in the breast cancer population. Since survival rates in this population are increasing (Skeel, 2003), many breast cancer patients now look to continue or resume pre-diagnosis levels of daily functioning (Steiner, Cavender, Main, & Bradley, 2004). Therefore, it is important that further research examines the potential safety risks in this cancer population. Figure 4.4  below has been developed from the literature review presented in this chapter and provides a general model of accident risks identified in the cancer population. This model will be revised in Chapter Ten following a review of the findings from the current study.
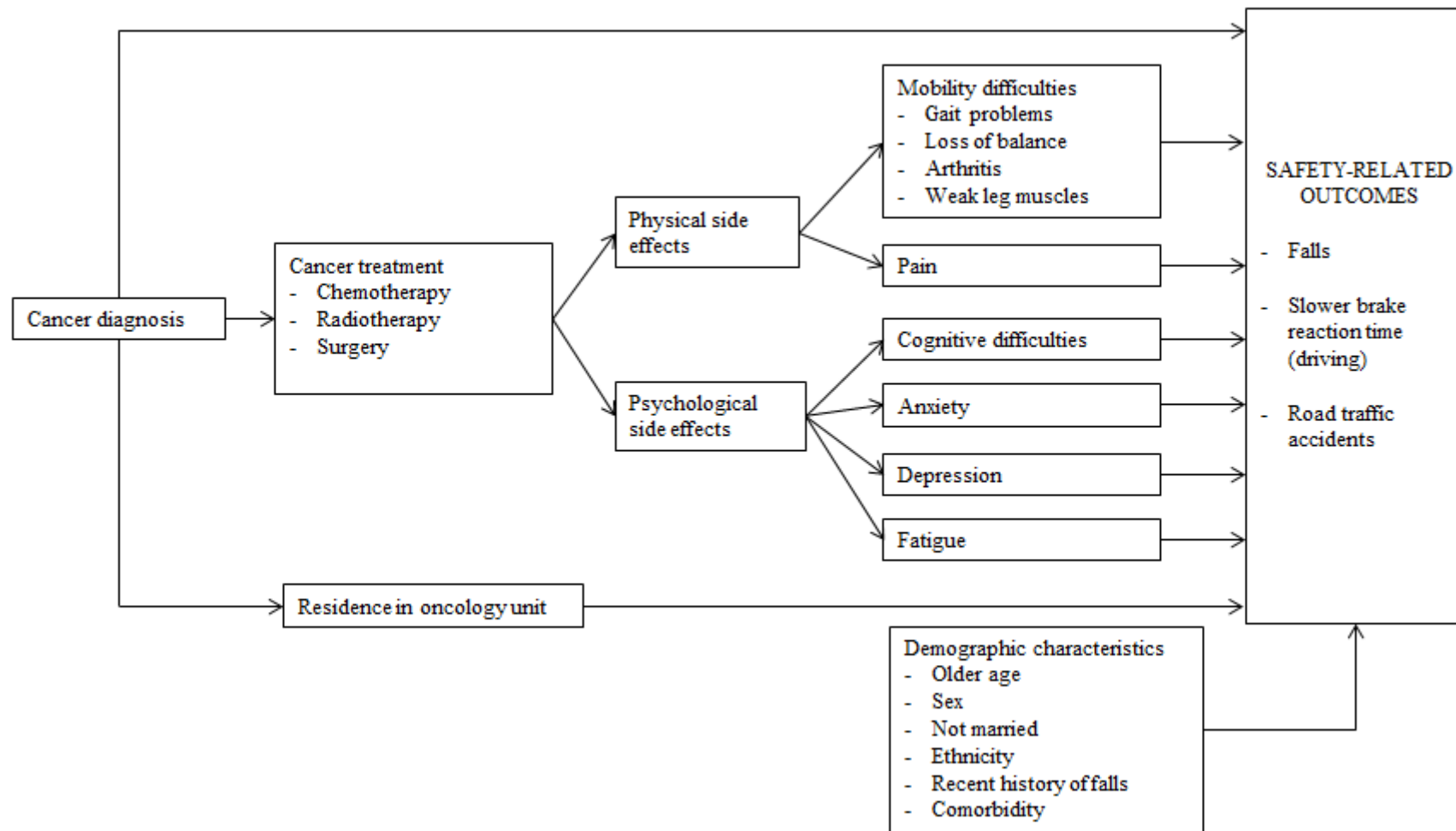
*Figure 4.4.* Accident theory model illustrating risk factors as reported in the relevant literature cited in Chapter Four (Lawrence Model 1)

## 4.7    Research Aims

This section outlines the aims, objectives, and hypotheses addressed in this work. As documented in Chapter Two, breast cancer survival rates are rising in the UK. Following improved prognosis and increased survivorship, more women are now looking to resume or return to pre-diagnosis levels of daily functioning during or following treatment. However, there are a number of adverse psychological side effects associated with chemotherapy, which is one of the main treatments for breast cancer. Despite a wealth of research on the cognitive impact of chemotherapy (as discussed in Chapter Three), many studies have been criticised for their methodological limitations. More recently, the value of measuring self-report cognitive changes in this population has been recognised and there is a current need for further longitudinal work to examine cognitive changes in patients during chemotherapy treatment. This thesis reports the subjective experiences of a cohort of breast cancer patients undergoing chemotherapy treatment and offers a comparison of their psychosocial well-being, cognitive function and frequency of accidents over a 12-month period against two control groups. Self-completion questionnaires and diaries were used to collect data. The first objective of the current study was to:

**Objective One: Examine the impact of chemotherapy for breast cancer on psychosocial well-being and subjective cognitive function.**

**Hypothesis I:** There will be differences in levels of anxiety, depression and fatigue between the chemotherapy group, radiotherapy group and healthy control group, and over time.

**Hypothesis II:** There will be differences in subjective cognitive function scores between the chemotherapy group, radiotherapy group and healthy control group, and over time.

**Hypothesis III (a):** Anxiety, depression and fatigue scores will be significantly associated with each other and with subjective cognitive function scores in the chemotherapy group at each time-point.

**Hypothesis III (b):** Anxiety, depression and fatigue scores will predict subjective cognitive function scores in the chemotherapy group at each time-point.

Based on a review of the literature presented earlier in this chapter (see sections 4.5 and 4.6), evidence suggests that anxiety, depression, fatigue and subjective cognitive difficulties are associated with an increased risk of accident reporting. This relationship between factors has not currently been addressed in the breast cancer population. Breast cancer patients undergoing chemotherapy frequently reported anxiety, depression, fatigue and subjective cognitive difficulties. Therefore, it is important that research considers the safety outcome of chemotherapy-related side effects in the breast cancer population. This could have important implications for breast cancer patients and health professionals when making treatment decisions. Since breast cancer prevalence and survival is increasing and disease and treatment side effects have been shown to persist several years following successful treatment, the potential safety risks may be a concern for a considerable number of women and impact upon home and work environments. This research could help to support patients and practitioners to develop interventions and strategies to assist patients, relatives and employers if, and when, necessary. The impact of safety concerns may also have important implications for managing daily activities in the home and workplace. Knowledge of this would form the development of compensatory and preventative strategies in future intervention studies should safety risks be a concern within this population. The second objective provides a novel insight into the experiences of breast cancer patients managing their daily tasks. Since some breast cancer patients report experiencing chemotherapy-related side effects up to ten years post-treatment (Ahles et al., 2005), it is important to clarify the potential safety implications of these side effects. The second objective of the current study was to:

**Objective Two: Examine the impact of chemotherapy for breast cancer on safety outcomes in the home and workplace.**

**Hypothesis IV:** Breast cancer patients undergoing chemotherapy will report more incidences of accidents at all follow-up time-points compared to treatment and healthy controls.

**Hypothesis V (a):** Demographic, psychosocial, and cognitive function variables will be significantly associated with accident frequency in the chemotherapy group at each time-point.

**Hypothesis V (b):** Demographic, psychosocial, and cognitive function variables will predict accident frequency in the chemotherapy group at each time-point.

Following improvement in the prognosis of this cancer population, the focus for psycho-oncology research relates to understanding and enhancing patients' daily functioning, such as quality of life (Ahles et al., 2005; Reid-Arndt, Hsieh & Perry, 2010), which is an important outcome for breast cancer patients (Montazeri, 2008). Based on the literature review in Chapter Three, treatment-related side effects have been shown to impact upon quality of life (Montazeri, 2008) and work ability. Returning to, or staying at, work during and following treatment is now a realistic outcome for many cancer patients following improved prognosis (Rowland, Aziz, Tesauro, & Feuer, 2001). The Equality Act 2010 states that employers are expected to make reasonable adjustments for employees with cancer to support them in their return to work and to maintain successful work ability (Morrell & Pryce, 2005). Since approximately 55% of new breast cancer cases are of working age, research into the impact of chemotherapy in the workplace is an important focus, particularly as there may be more cancer diagnoses in the working population in the near future following the predicted extension of working life in the UK (Department for Work and Pensions, 2006). However, the potential impact of chemotherapy-related safety outcomes on quality of life and work ability has not yet been investigated in the breast cancer population.

Although psycho-oncology research has considered return to work and work ability issues pertaining to breast cancer patients (e.g. Amir, Neary, & Luker, 2008; de Boer et al., 2008; Steiner, Cavender, Main, & Bradley, 2004; Taskila, Martikainen, Hietanen, & Lindbohm, 2007), there has been a considerable lack of focus on the impact of treatment side effects on daily life within the home. Taking into account that a large proportion of breast cancer patients take sickness absence during and for some time following chemotherapy (Munir, Kalawsky, Lawrence, Yarker, Haslam, & Ahmed, 2011), it is surprising that the home environment has been overlooked. Therefore, there

is a current need for research to incorporate breast cancer patients' daily experiences within the home. The third objective of the current study was to:

**Objective Three: Examine the impact of chemotherapy for breast cancer on quality of life and work ability.**

**Hypothesis VI:** There will be differences in quality of life scores between the chemotherapy group, radiotherapy group and healthy control group, and over time.

**Hypothesis VII (a):** Anxiety, depression, fatigue, cognitive function and frequency of accidents will be significantly associated with quality of life in the chemotherapy group at each time-point.

**Hypothesis VII (b):** Anxiety, depression, fatigue, cognitive function and frequency of accidents will predict quality of life scores in the chemotherapy group at each time-point.

**Hypothesis VIII:** There will be significant differences in work ability scores between the chemotherapy group, radiotherapy group and healthy control group, and over time.

**Hypothesis IX (a):** Demographic, psychosocial, cognitive function and accident frequency variables will be significantly correlated with work ability scores in the chemotherapy group at each time-point.

**Hypothesis IX (b):** Demographic, psychosocial, cognitive function and accident frequency variables will predict work ability scores in the chemotherapy group at each time-point.

There is now a considerable body of literature addressing the impact of chemotherapy for breast cancer with findings from neuropsychological tests. However, research describing the lived experiences of breast cancer patients is sparse (Boykoff, Moieni, & Subramanian, 2009; Pullens, De Vries, & Roukema, 2010; Rey, Bouhnik, Mancini, Bendiane, Seror, & Viens, 2012; Wagner, Sweet, Butt, Lai, & Cella, 2009). In particular, the use of qualitative methods has often been overlooked. This approach can

provide rich data and was employed in the current study to capture an in-depth insight into the experiences of breast cancer patients undergoing chemotherapy, as well as to provide subtle temporal fluctuations not captured by the questionnaires. The fourth objective and its research aim were to:

**Objective Four: Explore the impact of chemotherapy for breast cancer on patients' daily life during and shortly following treatment**

*Describe the experience of cognitive failures, psychosocial difficulties and accidents in breast cancer patients undergoing chemotherapy patients in the home and in the workplace.*

# Chapter Five

## Methods: Questionnaire Survey

## 5.1   Chapter Introduction

Following a review of the documented literature in Chapters Two, Three and Four, it is clear that there is a need for further longitudinal research to examine the lived experiences of breast cancer patients undergoing chemotherapy. In particular, it is important to address the current research gap within psycho-oncology research regarding the risk of accidents in this population. The current chapter describes the overall research design, recruitment strategy, procedure (specific to the questionnaire phase) and ethical considerations related to the study. Due to some procedural variations relating to the qualitative phase, specific information about this phase is presented separately in Chapter Nine.

## 5.2   Ethical Approval

Ethical approval for this research was obtained from the Loughborough University Ethical Advisory Committee and the NHS Research Ethics Committee at Nottingham (see Appendices 1 & 2 for approval letters). Research and Development departments at University Hospitals of Leicester and Nottingham University Hospitals provided permission for the study to be conducted at Leicester Royal Infirmary and Nottingham City Hospital, respectively. The process of obtaining ethical approval took approximately six months.

## 5.3   Research Design

This research employed a prospective, longitudinal, mixed-methods, between-within participants design with four time-points.  The methodological limitations of previous research were addressed as follows:

(a) the prospective nature of the study provided the opportunity to measure changes as they occurred, thereby reducing retrospection bias;

(b) the longitudinal design facilitated the mapping of data in a temporal sequence;

(c) the pre-treatment baseline enabled any impact of chemotherapy on patients' experiences to be recorded, and

(d) the inclusion of a treatment control group enabled any psychosocial impact of a cancer diagnosis to be controlled for, while a healthy control group acted as a comparison group from which any differences could be considered as deviations from the general population.

A combination of quantitative and qualitative approaches to data collection and analysis was applied to this research. The quantitative component involved the use of questionnaires that enabled the collection of quantifiable data that were analysed using statistical tests in order to detect the severity of and temporal changes in psychosocial factors, cognitive function, work ability and accident frequency over a twelve-month period. During this phase, all participants were assessed using questionnaires on four occasions: at baseline (pre-chemotherapy) and follow-up time-points at 4 months, 8 months and 12 months. These data collection time-points synchronised approximately with important timings within the chemotherapy treatment course and were feasible within the research timeframe. Chemotherapeutic drugs are often administered for between one and five days followed by a break of three to four weeks. This constitutes one chemotherapy cycle and a complete treatment course may last up to eight treatment cycles. Therefore, a complete course of chemotherapy can take up to eight months and so follow-up time-points mapped onto chemotherapy treatment as follows:

(a) follow-up time 1 captured breast cancer patients' experiences at approximately the middle of the chemotherapy treatment course,

(b) follow-up time 2 captured breast cancer patients' experiences at approximately the end of the chemotherapy treatment course, and

(c) follow-up time 3 captured breast cancer patients' experiences at approximately four months post-chemotherapy treatment cessation.

In addition, a four-month interval between assessments was considered not too great so that uncontrollable factors could have greatly influenced the data, which is an important concept acknowledged by Budischewski, Fuschbeck, and Mose (2008).

The qualitative component of the current study involved several questions from the questionnaire and the use of diaries (from a sub-sample of participants) that provided rich in-depth data about the individual lived experiences of participants that were

analysed using thematic analysis (as described by Braun & Clarke, 2006). This approach focussed on the context of cognitive difficulties, psychosocial well-being and accident frequency and captured subtle temporal fluctuations experienced by participants. The qualitative component expanded on subtle contextual differences not captured by the quantitative data collection (see Chapter Nine for further details).

This mixed-methods approach provided a valuable, synergistic strategy as it compensated for the limitations of utilising either quantitative or qualitative methods in isolation, as discussed in Chapter One. In addition, this approach can strengthen research findings by increasing the validity of a study's argument when similar findings across different approaches are found and to increase the probability that the findings are credible by increasing the reliability of the data and the method of collating it (Gifford, 1996).

## 5.4    Participants and Recruitment Strategy

### 5.4.1    Participants

Three participant groups were recruited: breast cancer patients undergoing adjuvant or neoadjuvant chemotherapy treatment ($n = 67$), a treatment control group of breast cancer patients undergoing radiotherapy ($n = 61$) and a healthy control group ($n = 122$). All participants were recruited from July 2009 to December 2010.

The inclusion criteria for breast cancer patients were to:

(a) be female, due to the relatively small incidence of breast cancer in males (as previously outlined in Chapter Two section 2.2);

(b) be older than 18 years, as the incidence of breast cancer in younger individuals is relatively rare, and no upper age limit was set to enable the experiences of older breast cancer patients to be captured (a subsample often overlooked within this type of research);

(c) have breast cancer as the primary diagnosis, as other cancers and the various treatments for them may add confounding factors thus making it difficult to definitively attribute side effects to chemotherapy;

(d) have been diagnosed with stage 0, I, II or III breast cancer, to exclude metastatic cancer that would require a more complex treatment regime, and

(e) be expecting to undergo chemotherapy and/or radiotherapy treatment.

Healthy female controls were matched to breast cancer patients undergoing chemotherapy on age ($\pm$ 2.5 years) to control for any effect that age might have on the ability to manage daily tasks, such as age-related cognitive decline (Charlton et al., 2006). Healthy controls were absent from a history of cancer. All participants were required to be fluent in English.

### 5.4.2   Recruitment Strategy

The following section provides a detailed account of the strategies employed to recruit participants from a range of sources and is divided accordingly: the recruitment of breast cancer patients from NHS clinics, the recruitment of breast cancer patients from cancer support groups, and the recruitment of healthy controls. Table 5.1 provides a summary of these recruitment methods.

*Breast cancer patients: NHS cancer clinics*

Several consultant oncologists from local NHS hospitals were contacted with the aim of establishing collaboration and access to breast cancer patients. Following meetings involving the consideration of recruitment feasibility, the support and collaboration of five consultant oncologists from cancer clinics across two counties were obtained (Leicestershire and Nottinghamshire). This type of multi-centre research is valuable as it offers the opportunity to obtain relatively large sample sizes over a shorter period of time and broadens the generalisability of the findings by extending the geographic area of recruited participants. The researcher was granted permission to recruit breast cancer patients by approaching them in the waiting area of the cancer clinic before or after their appointment with the consultant oncologist. A consecutive, convenience sampling strategy was employed to recruit breast cancer patients so that the researcher could approach as many breast cancer patients as possible during the recruitment period. The majority of breast cancer patients were recruited via NHS cancer clinics (Leicester Royal Infirmary, $n = 75$; Nottingham City Hospital, $n = 52$).

*Breast cancer patients: cancer support groups*

Since on-site recruitment at the NHS cancer clinics was a time-demanding activity for the researcher, an additional strategy for recruiting breast cancer patients was

considered with the aim of increasing the sample size. Cancer support groups provided the opportunity for a viable and convenient method to achieve this aim. An online search engine was used to identify breast cancer support groups in the UK. The researcher sent details regarding the nature and purpose of the study to numerous contact persons. Those who expressed an interest in the study were sent recruitment posters to be displayed at support group centres (see Appendix 3) or permission was requested to advertise the study on online support group forums. Only two breast cancer patients were recruited from cancer support groups. This may have been due to relatively few breast cancer patients utilising cancer support groups at the pre-treatment stage.

### *Healthy controls*

Healthy controls were recruited opportunistically. A press release through Loughborough University was issued that included a summary of the study and invited those interested in participating to contact the researcher. This raised awareness about the study, resulting in an article in a local newspaper and the University alumni newsletter as well as an advertisement on a local radio station. Furthermore, posters advertising the study were placed in libraries, leisure centres, community centres and churches in the local area (see Appendix 4). A snowballing technique was also used whereby recruited healthy controls were invited to raise awareness about the study to female relatives, friends and colleagues. Since breast cancer can be a personal and sensitive topic for some women, snowballing was considered a useful technique to help identify others with no history of cancer in a non-invasive manner. The healthy control group within this research represented a convenience sample.

Table 5.1.

*Recruitment Strategies for the Chemotherapy Group, Radiotherapy Group and Healthy Control Group*

| Participant group | Source | Recruitment strategy |
|---|---|---|
| Breast cancer patients | NHS cancer clinics | Researcher emailed consultant oncologists to obtain access to breast cancer patients. On-site recruitment: researcher approached potential participants in the clinic waiting area and verbally explained the study and provided to those interested with an information sheet. |
| | Cancer support group centres | Researcher contacted cancer support group centre representatives and provided details about the study. Posters were displayed at cancer support group centres. |
| | Online cancer support forums | Researcher emailed the cancer support group representative with details about the study. Advertisements were written on online forums. |
| | Press release through Loughborough University | Newspaper advertisement invited interested readers to contact the researcher. Snowballing technique. |
| Healthy controls | Local amenities | Researcher obtained permission from representatives at local amenities to display posters on notice boards. |
| | Press release through Loughborough University | Newspaper and radio advertisements invited interested persons to contact the researcher. Snowballing technique. |

## 5.5    Sample Size

A power calculation was performed to ensure that the sample size for the quantitative analyses was large enough to be able to detect any differences between the participant groups. An a-prior power calculation was performed for each statistical analyses, as detailed below.

**One-way between-groups ANOVA**

Using Cohen's (1992) tables, a sample size of 26 per participant group was required to detect a large effect size ($f = 0.40$) where $\alpha = 0.05$ and power $= 0.80$. A sample size of 76 per participant group was required to detect a medium effect size ($f = 0.64$) where $\alpha = 0.05$ and power $= 0.80$.

**3 x 3 mixed ANOVA**

Using G*Power Version 3.1.3 (Faul, Erdfelder, Lang, & Buchner, 2007), a sample size of 78 per participant group was required to detect a large effect size ($f = 0.40$) where $\alpha = 0.05$ and power $= 0.80$ (with three participant groups and three follow-up time-points). A sample size of 65 per participant group was required to detect a medium effect size ($f = 0.25$) where $\alpha = 0.05$ and power $= 0.80$ (with three participant groups and three follow-up time-points).

**Correlations**

Using Cohen's (1992) tables, a sample size of 28 was required to detect a large effect size ($f^2 = 0.35$) where $\alpha = 0.05$ and power $= 0.80$. A sample size of 85 was required to detect a medium effect size ($f^2 = 0.15$) where $\alpha = 0.05$ and power $= 0.80$.

**Multiple regression**

Using Cohen's (1992) tables, a sample size of 42 was required to detect a large effect size ($f^2 = 0.35$) where $\alpha = 0.05$ and power $= 0.80$ with five independent variables (this is the maximum number of variables included in the regression analyses). A sample size of 91 was required to detect a medium effect size ($f^2 = 0.15$) where $\alpha = 0.05$ and power $= 0.80$ with five independent variables.

## 5.6    Measures

This research included measures of cognitive function, psychosocial well-being, quality of life, work ability and accident frequency. The following criteria were considered when selecting measures for the questionnaire booklet:

(a) applicability of the measure to both a cancer patient group and a healthy control group,

(b) favourable reliability and validity reported in previous studies (reported in section 5.6.4 where available), and

(c) accessibility of measures.

The content of the Recruitment Questionnaire and questionnaire survey, which was developed following feedback from the collaborating consultant oncologists, are described below. Importantly, the questionnaire survey was designed not to be unduly time-consuming in an attempt to minimise fatigue, maintain participant motivation and increase response rate. Measures were available in paper format and online, hosted by Survey Monkey.

### 5.6.1    Recruitment Questionnaire

The Recruitment Questionnaire requested the following demographic information from participants: age, marital status, education, ethnicity, menopausal status and co-morbidity. Three versions of the Recruitment Questionnaire were developed with wording tailored to the site of recruitment and participant group: breast cancer patients recruited from NHS cancer clinics, breast cancer patients recruited from cancer support groups (with additional questions relating to treatment) and healthy controls (with diagnosis- and treatment-related questions omitted) (shown in Appendices 8 to 10). This information was used for describing the sample characteristics and for including in quantitative analyses (see Chapter Six).

### 5.6.2    Treatment Questionnaire

The Treatment Questionnaire was completed by the collaborating consultant oncologists at the NHS cancer clinics and requested details about the breast cancer patient's diagnosis and treatment course (shown in Appendix 11).

### 5.6.3   Questionnaire Booklet

A description of the validated measures included in the questionnaire survey is presented below and summarised in Table 5.3. The questionnaire took approximately 30 minutes to complete. See Appendix 12 for the questionnaire booklet designed for breast cancer patients, only minor amendments were made to the version completed by healthy controls (e.g. removal of reference to 'illness').

*Hospital Anxiety and Depression Scale* (HADS; Zigmond & Snaith, 1983). This is a measure of **anxiety** (seven items) and **depression** (seven items). Participants are asked to reflect upon the past week and to rate 14 items on a 4-point Likert scale. An example of an item from the anxiety subscale is: *'Worrying thoughts go through my mind'*, which is rated on the scale 0 = *'only occasionally'* to 3 = *'a great deal of the time'*, and the following item is from the depression subscale: *'I feel cheerful'*, which is rated on the scale 0 = *'most of the time'* to 3 = *'not at all'*. Scores are summed giving maximum scores of 21 for each subscale. When interpreting the scores, on each subscale, scores from 11 to 21 indicate probable clinical disorder, scores from 8 to 10 represent possible clinical disorder and scores from 0 to 7 are considered normal. This measure usually takes no more than five minutes to complete and has been widely used in research with breast cancer patients (e.g. Hermelink et al., 2007; Weis, Poppelreuter, & Bartsch, 2009). An exploratory factor analysis of this measure carried out in 568 cancer patients demonstrated excellent internal consistency (anxiety subscale, $\alpha = 0.93$; depression subscale, $\alpha = 0.90$) (Moorey et al., 1991). For the current research, the anxiety subscale had an internal consistency of $\alpha = 0.88$ at baseline; $\alpha = 0.87$ at follow-up time 1; $\alpha = 0.90$ at follow-up time 2, and $\alpha = 0.89$ at follow-up time 3 (in the chemotherapy group). The depression subscale had an internal consistency of $\alpha = 0.83$ at baseline; $\alpha = 0.88$ at follow-up time 1; $\alpha = 0.90$ at follow-up time 2, and $\alpha = 0.90$ at follow-up time 3 (in the chemotherapy group).

*Functional Assessment of Cancer Therapy-Fatigue* (FACIT-F; Yellen, Cella, Webster, Blendowski, & Kaplan, 1997). This is a commonly used measure of cancer-related **fatigue** (e.g. Downie, Mar Fan, Houede-Tchen, Yi, & Tannock, 2006; Jenkins et al., 2006; Mar Fan et al., 2005; Shilling, Jenkins, Morris, Deutsch, & Bloomfield, 2005; Tchen et al., 2003). Participants are asked to rate 13 items on a 5-point Likert scale

ranging from 0 = *'not at all'* to 4 = *'very much'* in reference to fatigue experienced in the past week. This measure usually takes no more than 5 minutes to complete. This measure has demonstrated excellent internal consistency in a study of 1,011 cancer patients ($\alpha = 0.93$) (Lai, Cella, Chang, Bode, & Heinemann, 2003). For the current research, this measure had an internal consistency of $\alpha = 0.73$ at baseline; $\alpha = 0.83$ at follow-up time 1; $\alpha = 0.86$ at follow-up time 2, and $\alpha = 0.86$ at follow-up time 3 (in the chemotherapy group).

*Functional Assessment of Cancer Therapy-General Population* (FACT-GP; Cella, Lai, Chang, Peterman, & Slavin, 2002). This is a measure of **quality of life** designed for the general population. Four dimensions of quality of life are assessed: physical well-being; social well-being; emotional well-being, and functional well-being. Participants are asked to rate 21 items on a 5-point Likert scale ranging from 0 = *'not at all'* 4 = to *'very much'* in reference to quality of life in the past week. This measure usually takes no more than five minutes to complete. A review of the literature examining quality of life in breast cancer patients described this measure as one of the most common and well-developed measures of quality of life (Downie, Mar Fan, Houede-Tchen, Yi, & Tannock, 2006; Mar Fan et al., 2005; Montazeri, 2008; Tchen et al., 2003).

*Cognitive Failures Questionnaire* (CFQ; Broadbent, Cooper, FitzGerald, & Parkes, 1982). This is a self-report measure of **error proneness in perception, memory and motor function** during everyday tasks. The CFQ measures the behavioural consequences of cognitive impairment (Stuss, Winocur, & Robertson, 1999). Participants are asked to rate 25 items on a 5-point Likert scale ranging from 0 = *'never'* to 4 = *'very often'*. Scores can range from 0 to 100 with higher scores representing a higher frequency of cognitive failures. In the general population, typical scores range from 25 to 35 (Wagle, Berrios, & Ho, 1999). The timescale was changed from *'in the past 6 months'* to *'in the past week'* to maintain consistency with the other measures within the questionnaire and to fit in with the four questionnaires administered over a 12-month period. This measure usually takes no more than five minutes to complete. The CFQ is typically used as a unitary measure of cognitive function and has been extensively used in research with breast cancer patients (Castellon, Ganz, Bower, Petersen, Abraham, & Greendale, 2004; Jenkins, Shilling, Fallowfield, Howell, & Hutton, 2004; Jenkins et al., 2006; Munir, Kalawsky, Lawrence,

Yarker, Haslam, & Ahmed, 2011; Quesnel, Savard, & Ivers, 2009; Schilder et al., 2009; Schilder et al., 2012; Shilling, Jenkins, Morris, Deutsch, & Bloomfield, 2005). Evidence suggests that the CFQ has good discriminant validity and has demonstrated differences in the reporting of frequency of cognitive failures in participant groups with depression (Wagle, Berrios, & Ho, 1999), stress (Broadbent, Cooper, FitzGerald, & Parkes, 1982) and multiple sclerosis (Phillips et al., 2009) compared to healthy controls. Therefore, it was anticipated that the CFQ would be sufficiently sensitive to detect differences in cognitive function in the breast cancer patient group and healthy controls. Research suggests that the CFQ has considerable ecological validity and a high internal consistency of 0.91 in a sample of 335 healthy participants (Wallace, Kass, & Stanny, 2002) and 0.90 in a sample of 235 cancer survivors (Spelten et al., 2003). For the current research, this measure had an internal consistency of $\alpha = 0.91$ at baseline; $\alpha = 0.94$ at follow-up time 1; $\alpha = 0.94$ at follow-up time 2, and $\alpha = 0.96$ at follow-up time 3 (in the chemotherapy group).

*Accident frequency.* A question was developed by the researcher to obtain further information about participants' everyday experiences of **accident frequency** in the home and in the workplace. Participants were asked to choose from a 5-point rating scale from 5 = *'all the time'* to 0 = *'never'* about *'How often have accidents occurred, while you were at home, during the past week?'* Participants were then asked to list the types of accidents that had occurred during the past week. This question was also asked in relation to work for those who were employed at the time. The use of a single-item question to measure incidences of human error has been used within health and occupational research (e.g. Simpson, Wadsworth, Moss, & Smith, 2005; Wadsworth, Simpson, Moss, & Smith, 2003). As demonstrated in Chapter Four, the accident and injury research often use the terms accident and injury synonymously, although they are not synonyms (Khanzode, Maiti, & Ray, 2012). However, only the term 'accident' was used in the questionnaire in the current study as this was considered a useful generic and simple term to describe unsafe events that may or may not involve injury. Furthermore, this term is frequently used in psychological research that is closely related to the current study (e.g. Simpson, 2005).

*Work Ability Index* (WAI; Tuomi, Ilmarinen, Jahkola, Katajarinne, & Tulki, 1998). This is a measure of **work ability**. Three items were taken from the WAI to measure

work ability – an approach employed by other researchers examining cancer patients (e.g. Bains, Munir, Yarker, Thomas, Armitage, & Steward, 2012; de Boer, Verbeek, Spelten, Uitterhoeve, Ansink, & Reijke, 2008). This is beneficial in terms of simplicity and interpretation (Bowling, 2005), as well as reduced time demands for participants as it takes less than five minutes to complete. Participants are asked to rate their current work ability with their lifetime best a scale from 0 = *'completely unable to work'* to 10 = *'work ability at its best'*. They are then asked to rate their work ability with respect to the physical demands of their job and the mental demands, both on a scale from 1 = *'very poor'* to 5 = *'very good'*. Ahlstrom, Grimby-Ekman, Hagberg, and Dellve (2010) found a strong association ($r = 0.87$) between the WAI and the first item on the measure. The internal consistency for the full scale has been demonstrated to be good ($\alpha = 0.79$) in a sample of 40,000 healthy participants (Radkiewicz & Widerszal-Bazyl, 2005). For the current research, this measure had an internal consistency of $\alpha = 0.84$ at baseline; $\alpha = 0.76$ at follow-up time 1; $\alpha = 0.69$ at follow-up time 2, and $\alpha = 0.82$ at follow-up time 3 (in the chemotherapy group).

*Additional questions.* The questionnaires concluded with a blank page and invited participants to share additional information about their experiences of managing daily activities. Chapter Nine presents the findings of this data that were analysed qualitatively.

## 5.7    Procedure

This section describes the data collection procedures involved in the current study. Procedures relating to breast cancer patients recruited from NHS cancer clinics are presented first, followed by breast cancer patients recruited from cancer support groups, and finally the collection of data from healthy controls. Informed written consent was obtained from all participants. To maximise response rate, participants were contacted by telephone, email or post if the questionnaire had not been returned within two weeks. Data collection occurred from July 2009 to December 2011.

### 5.7.1    Breast Cancer Patients Recruited from NHS Cancer Clinics

The researcher contacted the clinic co-ordinators on a weekly basis to establish whether any new breast cancer patients eligible for the research would be attending the clinic

during the week. The clinic co-ordinators were able to identify eligible breast cancer patients from their medical records. The researcher approached these potential participants individually in a quiet area of the clinic waiting room to explain the purpose and nature of the research. The opportunity to ask any questions about the study was provided. An information pack containing the Participant Information Sheet, Consent Form, Recruitment Questionnaire, Questionnaire Booklet, and a pre-paid envelope was given to those who expressed an interest in the research and their telephone or email contact details were obtained. These details were entered into a Microsoft Excel® spreadsheet on a password-protected computer, along with the dates to send out follow-up questionnaires. These breast cancer patients were contacted approximately seven days later, as this had been considered sufficient time by the NHS ethics committee for careful evaluation of the details provided in the information pack and for the patient to come to an informed decision about taking part in the research. The researcher answered any questions the breast cancer patient had and confirmed their interest in the research. A number of breast cancer patients (33.51%) declined to take part in the research at this stage. Common reasons for refusal included having too much to deal with in their personal lives such as coping with treatment, feeling too emotional and general lack of interest in the research. These breast cancer patients were thanked for their time and their contact details were subsequently destroyed. Those who wished to take part in the research were asked to complete and return the Consent Form, Recruitment Questionnaire and Questionnaire Booklet to the researcher in the pre-paid envelope prior to the start of chemotherapy or radiotherapy (usually within seven days). Participants were also given the option to complete the questionnaire online (hosted by Survey Monkey).

The researcher signed and dated returned Consent Forms and copies were sent to the breast cancer patients and to the clinic co-ordinators to be filed in the patients' medical records. The questionnaires were assigned an anonymising identifier and this information was entered into the Microsoft Excel® spreadsheet. The researcher obtained the contact details for recruited participants' General Practitioners from the clinical co-ordinators and a letter was sent informing them that their patients were involved in the study and a Participant Information Sheet was included.

Subsequent questionnaire booklets were posted to patients 4 months, 8 months and 12 months later. At each follow-up time-point, a covering letter providing an update of participant recruitment developments (in an attempt to maintain participant interest), questionnaire booklet, and stamped addressed envelope were posted to participants. The covering letter asked participants to complete and return the questionnaire to the researcher within seven days and they were reminded that they were free to withdraw from the research at any time with no reason necessary. The researcher acknowledged returned completed questionnaires by a letter thanking participants for their time. The researcher asked the consultant oncologists to complete the Treatment Questionnaire for their respective breast cancer patients after follow-up time 3 so that complete treatment information during the study period could be obtained. A letter summarising the findings was disseminated to all participants following complete data analyses.

### 5.7.2   Breast Cancer Patients Recruited from Cancer Support Groups

Cancer support group members who responded to the study advertisements and expressed an interest in taking part in the research were given the option to be sent the Participant Information Sheet, Consent Form and questionnaire booklet by post or online. The online version asked participants to provide their email address, and a hyperlink directing the participant to the online questionnaire was sent to this email address. The online database was checked on a regular basis for newly completed questionnaires. For those who wished to complete a paper version of the questionnaire, a contact postal address was obtained and similar methods as described above were performed. Participants were thanked by email or post for their time and for sharing their experiences after completion of each questionnaire.

### 5.7.3   Healthy Control Group

Healthy control participants who responded to the study advertisements and expressed an interest in taking part in the research were given the option to complete either a paper or an online version. Similar procedures previously described were undertaken.

## 5.8     Ethical Considerations

This research was conducted in accordance with the guidelines stipulated by the ethical committees at Loughborough University and the NHS. This section describes the

ethical considerations involved in the study relating to the research design, recruitment strategy, data collection and analysis.

Due to the applied setting of this study, the researcher discussed feasible methods of approaching breast cancer patients with the consultant oncologists (who agreed to collaborate and offered access to their patients at the NHS) and with the staff at the hospitals involved in the day-to-day running of the clinics. It was important that the study design and recruitment methods caused minimal distress to the breast cancer patients (e.g. not being time-consuming, inconvenient or overly burdensome) as well as minimal disruption to the appointment schedule at the cancer clinics. Short versions of validated measures were included in the questionnaire survey, where available, in an attempt to reduce fatigue and the time-demands placed on the participants. The majority of the breast cancer patients recruited for this study had recently received their diagnosis of the disease and were awaiting confirmation of their treatment course, while others had recently undergone surgery, and so this was an anxious time for many patients. Therefore, breast cancer patients were approached in a sensitive manner, provided with a clear summary of the study verbally, and offered the opportunity to ask any questions about the study. All participants were also given detailed written information about the study and had approximately seven days to consider their decision to participate. All participants provided informed consent to take part in the study and were made aware that they were free to withdraw at any time with no reason necessary, without their decision affecting their treatment or standard of care that they received. Due to the longitudinal nature of the current research, participants were reminded at each time-point that they could withdraw from the study at any time, with no reason necessary, so that they did not feel pressured into participating. In addition, breast cancer patients were informed that the researcher was not a healthcare professional and that they should contact their GP, breast cancer nurse, consultant or local cancer support group should they experience distress at any time. As stipulated by the NHS Nottingham Research Ethics Committee, the researcher informed the GPs of breast cancer patients recruited from NHS cancer clinics that their patients were involved in the study.

The procedure for handling, processing, storage and destruction of data were compliant with the Data Protection Act 1998 and the Loughborough University data protection

policy. A unique identification number was allocated to each participant to protect their identity and was written on the questionnaires and diaries. This meant that all measures were anonymised and data was confidential – only the researcher could identify participants. This identification number was used to link data between questionnaires and diaries. Documents containing personal details, such as Consent Forms and an electronic spreadsheet containing personal data, were stored separately from questionnaires and diaries. All paper documents were stored securely in a locked filing cabinet at Loughborough University. All electronic data were stored securely on a password-protected computer at Loughborough University, and an electronic password-protected spreadsheet included the participants' contact details. The results report anonymous data to ensure that participants cannot be identified.

## 5.9    Data Analysis

The demographic data, treatment data and quantitative data from the questionnaire booklets were entered into the quantitative software package Predictive Analytics SoftWare (PASW) Version 18.0 and were screened for potential inputting errors as part of data cleaning procedures. Totals for each variable were calculated according to standard scoring rules for the questionnaire. Missing data for questionnaire items remained as blank values if the questionnaire scoring rules specified this; otherwise, missing values were substituted with the mean value for that variable, as recommended by Loewenthal (2001). This approach was considered appropriate for the current study since participants may have missed questionnaire items due impaired psychosocial and/or cognitive function (e.g. poor concentration) (Smith & Wefel, 2008). Since the aim of this study was to examine the psychosocial and cognitive experiences of participants, it was important not to exclude incomplete data unnecessarily since this may have distorted findings and their subsequent interpretation.

Exploratory data analysis was conducted to check the suitability of data in relation to the assumptions associated with the specific tests used for the hypotheses. While it is often advised that parametric tests tend to be robust to moderate violations of assumptions in relatively large samples (over 30) (e.g. Field, 2009; Tabachnick & Fidell, 2007), a number of steps were taken to check the normality of data for all dependent variables (DVs). Firstly, the significance of the Shapiro-Wilk test was

considered. A number of DVs were not normally distributed, however this is common in larger samples since small deviations from normality can produce significant results and does not necessarily mean that the data could bias statistical analyses (Field, 2009; Pallant, 2007). Secondly, distributions were visually inspected using histograms with normality curves and Q-Q plots. These also showed that several variables were skewed. Therefore, the data were transformed using square root or reflect and square transformations to normalise the data. During hypothesis-testing, both the original variables and transformed variables were used in the analyses, and the results were compared. Since no differences in the results were found (i.e. no difference in level of significance or interpretation of findings), the original data are reported here. This allows for comparisons to be made easily with other studies and avoids potential confusion in interpreting transformed data values. Boxplots revealed several outliers, but none were considered sufficiently extreme to warrant exclusion from analysis. Details of specific statistical analyses conducted to test the hypotheses in Objectives One, Two and Three are described in Chapters Six, Seven and Eight, respectively.

## 5.10   Chapter Summary

This chapter has described the design, recruitment strategies and ethical issues involved in this research, as well as the measures and procedures specific to the questionnaire phase. The results of the questionnaire phase are presented in the following chapters.

# Chapter Six

# The Impact of Chemotherapy for Breast Cancer on Psychosocial Well-Being and Subjective Cognitive Function

## 6.1    Chapter Introduction

This chapter presents the results of the questionnaire data in relation to Objective One. This considered the impact of chemotherapy for breast cancer on self-reported psychosocial well-being and cognitive function during and after treatment. Increasing evidence suggests that breast cancer patients undergoing chemotherapy report higher levels of anxiety, depression, fatigue and cognitive difficulties compared to controls (see Chapter Three for a review of the literature). However, many of these studies are criticised due to their cross-sectional design, lack of appropriate control groups, and their focus on objective measures, which often lack ecological validity and have insufficient sensitivity to detect subtle cognitive changes in the breast cancer population (Vardy et al., 2008). The purpose of the current study was partly to address these limitations. The following hypotheses are examined in this chapter:

**Hypothesis I:** There will be differences in levels of anxiety, depression and fatigue between the chemotherapy group, radiotherapy group and healthy control group, and over time.

**Hypothesis II:** There will be differences in subjective cognitive function scores between the chemotherapy group, radiotherapy group and healthy control group, and over time.

**Hypothesis III (a):** Anxiety, depression and fatigue scores will be significantly associated with each other and with subjective cognitive function scores in the chemotherapy group at each time-point.

**Hypothesis III (b):** Anxiety, depression and fatigue scores will predict subjective cognitive function scores in the chemotherapy group at each time-point.

## 6.2    Sample Accrual

The recruitment phase for all participants took place from July 2009 to December 2010. During this time, breast cancer patients about to undergo chemotherapy ($n = 108$) or radiotherapy ($n = 86$) were approached by the researcher at cancer clinics in Leicester Royal Infirmary and Nottingham City Hospital and provided with an information pack. In total, 67 breast cancer patients about to undergo chemotherapy and 61 breast cancer patients about to undergo radiotherapy met the inclusion criteria for the study, consented to take part and completed the recruitment questionnaire and baseline questionnaire (recruitment rate of 61.1% and 70.9%, respectively). Concurrently, three breast cancer patients were recruited via advertisements at support group centres and on online forums across the UK (including one chemotherapy patient; treatment data missing from the other two breast cancer patients who later withdrew from the study). Healthy controls were recruited via advertisements in the local community and using a snowballing technique (see Chapter Five, section 5.4.2 for further details). Due to the indirect nature of recruitment strategies employed for support group users and healthy controls (i.e. without direct presence of the researcher), it was not possible to ascertain sample accrual estimates. In total, 122 healthy controls met the inclusion criteria, consented to take part in the study and completed the recruitment questionnaire and baseline questionnaire.

## 6.3    Sample Attrition

Sample attrition is inevitable in longitudinal research due to time demands and commitment required from participants over multiple assessments, and is particularly present in applied research involving patient groups (see Chapter Ten for a discussion). Therefore, in order to minimise sample attrition and its impact on the current study, short versions of questionnaires were included and the researcher maintained rapport with participants throughout the data collection period (see Chapter Five for further details). Participants who failed to return the questionnaire within a week of its reception were contacted by telephone or email and asked if they required more time to complete the questionnaire or if they wished to withdraw from the study. The attrition associated with each participant group at follow-up time-points is described in Table

6.1. The fluctuation in sample size is the result of some participants not completing all questionnaires (typically due to feeling unwell).

The final sample size included 60 chemotherapy patients, 56 radiotherapy patients, and 58 healthy controls. For the chemotherapy group and radiotherapy group, the final sample was determined by excluding participant data where insufficient data was available to conduct repeated measures analyses. For the healthy control group, the final sample was determined firstly by excluding participants with any missing follow-up questionnaire data, and secondly if participants were not well-matched to the chemotherapy group in relation to age ($\pm$ 2.5 years).

Table 6.1

*Attrition at Baseline and Follow-Up Time-Points in the Chemotherapy Group, Radiotherapy Group and Healthy Control Group*

| Assessment | Chemotherapy group | | Radiotherapy group | | Healthy control group | |
|---|---|---|---|---|---|---|
| | Completed questionnaires (*n*) | Attrition rate (%) | Completed questionnaires (*n*) | Attrition rate (%) | Completed questionnaires (*n*) | Attrition rate (%) |
| Baseline | 67 | - | 61 | - | 122 | - |
| Follow-up time 1 | 55 | 17.91 | 52 | 14.75 | 109 | 10.66 |
| Follow-up time 2 | 59 | 10.45 | 51 | 16.39 | 104 | 14.75 |
| Follow-up time 3 | 57 | 14.93 | 48 | 21.31 | 83 | 31.97 |

*Note.* Attrition rates calculated from baseline value.

## 6.4    Statistical Analyses

This section briefly describes the statistical analyses employed in this chapter relevant to Objective One.

**Sociodemographic characteristics**

Differences in sociodemographic characteristics between participant groups were analysed using univariate analysis of variance (ANOVA) for continuous variables and Chi-square tests for independence for categorical variables.

**Preliminary baseline data analysis**

Preliminary analyses compared baseline scores of anxiety, depression, fatigue, and subjective cognitive function across the three participant groups. A series of one-way between-groups ANOVAs were conducted with participant group (chemotherapy, radiotherapy, healthy control) as the between-subjects factor and anxiety, depression, fatigue, and subjective cognitive function as separate DVs. Pearson's product moment correlation and Spearman's rank order correlation analyses were performed to examine the association between age and education with the DVs. Education (none, high school, university) significantly correlated with some DVs. Upon further inspection of the data, this variable was found to violate the assumption of regression slopes, which meant that it could not be included as a covariate, and instead was entered as an additional between-subjects factor so that its effect could be filtered out. Therefore, a series of two-way between-groups ANOVAs were also conducted where appropriate.

**Hypothesis I**

To examine any differences in levels of anxiety, depression and fatigue between the chemotherapy group, radiotherapy group and healthy control group over time, a series of 3 x 3 mixed ANOVAs were conducted with participant group as the between-subjects factor and time (follow-up time 1, follow-up time 2, follow-up time 3) as the within-subjects factor. A series of 3 x 3 mixed ANCOVAs were also performed with the DV baseline measure as a covariate to control for differences in pre-treatment levels. Further analyses were conducted with a series of 3 x 3 x 3 mixed ANCOVAs with education as a second between-subjects factor, where relevant.

**Hypothesis II**

To examine any differences in cognitive function between the chemotherapy group, radiotherapy group and healthy control group over time, a 3 x 3 mixed ANOVA was conducted with participant group as the between-subjects factor and time as the within-subjects factor. Pearson's product moment correlations were conducted between potential covariates (baseline measures of anxiety, depression and fatigue) and cognitive function. A 3 x 3 mixed ANCOVA was then conducted to control for the effect of covariates.

**Hypothesis III (a) and (b)**

For Hypothesis III (a), Pearson's product moment correlations and Spearman's rank order correlations were conducted to examine the associations between age, education, anxiety, depression, fatigue and cognitive function at each time-point.

For Hypothesis III (b), standard multiple regressions were conducted to examine the ability of anxiety, depression and fatigue to predict cognitive function. Where demographic variables were significantly correlated with cognitive function, hierarchical multiple regressions were conducted with covariates entered at Step 1.

Preliminary analyses were conducted to check that the assumptions underlying each of the statistical tests mentioned above were met. This included assumptions of normality, linearity, multicollinearity and homoscedasticity. An alpha level of .05 was used for all analyses, unless otherwise stated. Effect size statistics (e.g. phi [$\varphi$], eta squared [$\eta^2$] and partial eta squared [$\eta_p^2$]) are reported, where relevant, and determined using Cohen's (1992) criteria: 0.10 to 0.29 is considered small, 0.30 to 0.49 is considered medium, and 0.50 to 1.00 is considered large.

## 6.5    Demographics

Table 6.2 summarises the demographic characteristics for the three participant groups. Significant group differences were found for age, $F(2, 171) = 11.07$, $p < 0.001$, with radiotherapy patients being significantly older ($M = 59.2$, $SD = 8.9$, range 38-78) than chemotherapy patients ($M = 51.4$, $SD = 10.6$, range 28-73) and healthy controls ($M = 51.6$, $SD = 10.7$, range 29-78). There were also significant group differences in the

highest education attained, $\chi^2(4, N = 173) = 27.33$, $p < .001$, $\varphi = .40$, menopausal status, $\chi^2(2, N = 174) = 14.81$, $p = .001$, $\varphi = .29$, employment status before diagnosis, $\chi^2(4, N = 172) = 17.52$, $p = .002$, $\varphi = .32$, and type of occupation for those in employment, $\chi^2(2, N = 110) = 12.88$, $p = .002$, $\varphi = .35$. No significant differences existed in terms of marital status, $\chi^2(2, N = 174) = .58$, $p = .750$, $\varphi = .06$, and ethnicity, $\chi^2(2, N = 174) = .35$, $p = .839$, $\varphi = .05$.

Table 6.3 summarises the cancer-related characteristics for the chemotherapy group and radiotherapy group. The groups significantly differed in terms of the type of breast cancer that the patients had, $\chi^2(5, N = 116) = 24.27$, exact $p < .001$, $\varphi = .46$, the stage of breast cancer, $\chi^2(3, N = 116) = 36.06$, $p < .001$, $\varphi = .56$, the grade of breast cancer, $\chi^2(3, N = 116) = 40.93$, exact $p < .001$, $\varphi = .59$, the type of surgery, $\chi^2(3, N = 116) = 32.90$, exact $p < .001$, $\varphi = .53$, the administration of radiotherapy, $\chi^2(2, N = 116) = 5.48$, exact $p = .040$, $\varphi = .22$, and the type of biological therapy received, $\chi^2(1, N = 116) = 9.11$, exact $p = .003$, $\varphi = .28$. There were no group differences in terms of the type of hormone therapy received by both patient groups, $\chi^2(3, N = 116) = 2.47$, exact $p = .474$, $\varphi = .15$.

Table 6.2

*Demographic Characteristics for the Chemotherapy Group, Radiotherapy Group and Healthy Control Group*

| Variable | Chemotherapy ($n = 60$)[a] | | Radiotherapy ($n = 56$)[b] | | Healthy ($n = 58$) | | p |
|---|---|---|---|---|---|---|---|
| Age (years), *M* (*SD*) | 51.4 | (10.6) | 59.2 | (8.9) | 51.6 | (10.7) | **<.001** |
| | | | | | | | |
| Marital status, *n* (%) | | | | | | | .750 |
| Single/widowed | 15 | (25.0) | 16 | (28.6) | 13 | (22.4) | |
| Married/cohabiting | 45 | (75.0) | 40 | (71.4) | 45 | (77.6) | |
| | | | | | | | |
| Ethnicity, *n* (%) | | | | | | | .839 |
| White European | 58 | (96.7) | 55 | (98.2) | 56 | (96.6) | |
| Other | 2 | (3.3) | 1 | (1.8) | 2 | (3.4) | |
| | | | | | | | |
| Education, *n* (%) | | | | | | | **<.001** |
| None | 11 | (18.3) | 11 | (20.0) | 2 | (3.4) | |
| High School | 30 | (50.0) | 25 | (45.5) | 13 | (22.4) | |
| University | 19 | (31.7) | 19 | (34.5) | 43 | (74.1) | |
| | | | | | | | |
| Menopausal status, *n* (%) | | | | | | | **.001** |
| Pre-menopausal | 26 | (43.3) | 9 | (16.1) | 28 | (48.3) | |
| Post-menopausal | 34 | (56.7) | 47 | (83.9) | 30 | (51.7) | |
| | | | | | | | |
| Employment status (pre-diagnosis), *n* (%) | | | | | | | **.002** |
| Full-time (≥18.5 hrs) | 33 | (56.9) | 19 | (33.9) | 39 | (67.2) | |
| Part-time (≤18.4 hrs) | 8 | (13.8) | 5 | (8.9) | 6 | (10.3) | |
| Not working | 17 | (29.3) | 32 | (57.1) | 13 | (22.4) | |
| | | | | | | | |
| Occupation, *n* (%) | | | | | | | **.002** |
| Manual | 18 | (43.9) | 7 | (29.2) | 4 | (8.9) | |
| Non-manual | 23 | (56.1) | 17 | (70.8) | 41 | (91.1) | |

*Note.* M = mean; SD = standard deviation. [a]Missing data for one participant for the variable menopausal status and for two participants for the variable employment status. [b]Missing data for one participant for the variable education.

Table 6.3

*Treatment Details for the Chemotherapy Group and Radiotherapy Group*

| Variable | Chemotherapy ($n = 60$) | | Radiotherapy ($n = 56$) | | $p$ |
|---|---|---|---|---|---|
| | $n$ | (%) | $n$ | (%) | |
| Type of breast cancer | | | | | **<.001**[a] |
|   Invasive ductal | 49 | (81.7) | 25 | (44.6) | |
|   Invasive lobular | 4 | (6.7) | 7 | (12.5) | |
|   Tubular | 0 | (0.0) | 10 | (17.9) | |
|   Other | 5 | (8.3) | 8 | (14.3) | |
|   Unknown | 2 | (3.3) | 6 | (10.7) | |
| | | | | | |
| Stage of breast cancer | | | | | **<.001** |
|   I | 15 | (25.0) | 39 | (69.6) | |
|   II | 24 | (40.0) | 8 | (14.3) | |
|   III | 18 | (30.0) | 1 | (1.8) | |
|   Unknown | 3 | (5.0) | 8 | (14.3) | |
| | | | | | |
| Grade of breast cancer | | | | | **<.001**[a] |
|   I | 0 | (0.0) | 23 | (41.1) | |
|   II | 25 | (41.7) | 17 | (30.4) | |
|   III | 33 | (55.0) | 9 | (16.1) | |
|   Unknown | 2 | (3.3) | 7 | (12.5) | |
| | | | | | |
| Type of surgery | | | | | **<.001**[a] |
|   None | 1 | (1.7) | 1 | (1.8) | |
|   Lumpectomy | 29 | (48.3) | 52 | (92.9) | |
|   Mastectomy | 29 | (48.3) | 1 | (1.8) | |
|   Unknown | 1 | (1.7) | 2 | (3.6) | |
| | | | | | |
| Type of chemotherapy | | | | | |
|   FEC | 24 | (40.0) | n/a | n/a | |
|   FEC-T | 33 | (55.0) | n/a | n/a | |
|   Other | 2 | (3.3) | n/a | n/a | |
|   Unknown | 1 | (1.7) | n/a | n/a | |
| | | | | | |
| Radiotherapy | | | | | **.040**[a] |
|   Not received | 9 | (15.0) | 2 | (3.6) | |
|   Received | 50 | (83.3) | 54 | (96.4) | |
|   Unknown | 1 | (1.7) | 0 | (0.0) | |
| | | | | | |
| Type of hormone therapy | | | | | .474[a] |
|   Tamoxifen | 19 | (31.7) | 17 | (30.4) | |
|   Arimidex | 15 | (25.0) | 10 | (17.9) | |
|   Letrozole | 3 | (5.0) | 1 | (1.8) | |
|   None | 23 | (38.3) | 28 | (50.0) | |
| | | | | | |
| Type of biological therapy | | | | | .003[a] |
|   Herceptin | 9 | (15.0) | 0 | (0.0) | |
|   None | 51 | (85.0) | 56 | (100.0) | |

*Note.* FEC (fluorouracil, epirubicin and cyclophosphamide); FEC-T (FEC followed by taxotere). [a]Exact significance test due to the violation of the minimum expected cell frequency assumption.

## 6.6    Preliminary Baseline Data Analysis

As an initial step, preliminary analyses were conducted on the pre-treatment baseline data to identify any differences between participant groups on the following DVs: anxiety, depression, fatigue and cognitive function. Primarily, this served to identify any differences in scores on these measures that could potentially be attributed to the impact of breast cancer diagnosis and therefore controlled for in subsequent repeated measures analyses. It is important that differences at baseline were not incorrectly attributed to the onset of chemotherapy treatment. Furthermore, since the current psycho-oncology literature reports inconsistent findings, with some researchers suggesting that cognitive difficulties exist in breast cancer patients prior to the commencement of chemotherapy (e.g. Ahles et al., 2008; Bender et al., 2006; Hermelink et al., 2007; Hurria et al., 2006; Mar Fan et al., 2005; Paraska & Bender, 2003; Quesnel, Savard, & Ivers, 2009), while others reporting typical levels of cognitive function (e.g. Jenkins et al., 2006; Schagen, Muller, Boogerd, Mellenbergh, & van Dam, 2006; Stewart, Collins, Mackenzie, Tomiak, Verma, & Bielajew, 2008), this preliminary baseline data analysis provided additional contribution to this debate. In keeping with previous literature, and due to significant differences in age and education between participant groups in the current study, the impact of these demographic variables on the DVs were considered using correlations (see Table 6.4).

Table 6.4

*Correlations Between Demographic Variables, Psychosocial Variables and Cognitive Function in the Chemotherapy Group (n = 60), Radiotherapy Group (n = 56) and Healthy Control Group (n = 58) at Baseline*

|  | Chemotherapy | | Radiotherapy | | Healthy | |
|---|---|---|---|---|---|---|
| Variable | Age | Education | Age | Education[a] | Age | Education |
| Anxiety | 0.04 | **-0.40**\*\* | -0.23 | 0.03 | -0.17 | 0.07 |
| Depression | 0.08 | **-0.27**\* | -0.23 | 0.04 | 0.03 | 0.08 |
| Fatigue | -0.14 | **0.28**\* | 0.11 | -0.24 | 0.05 | -0.14 |
| Cognitive function | 0.02 | -0.23 | -0.25 | -0.05 | -0.24 | 0.03 |

*Note.* Pearson's product moment correlation performed on age; Spearman's rank order correlation performed on education.
[a]Data missing for one participant due to missing education data.
\**p* < .05. \*\* *p* < .01.

As Table 6.4 shows, education significantly correlated with anxiety, depression and fatigue in the chemotherapy group. In the following sections, for each DV (anxiety, depression, fatigue and cognitive function), a one-way between-groups ANOVA was conducted, followed by a two-way between-groups ANOVA with education as an additional factor, where relevant. Table 6.5 presents the results of these ANOVAs.

**Anxiety**

The one-way ANOVA showed that the three participant groups differed significantly on levels of anxiety at baseline with a medium effect size, $F(2, 171) = 5.13$, $p = .007$, $\eta^2 = .06$. Post-hoc comparisons using the Bonferroni correction revealed that breast cancer patients about to receive chemotherapy ($M = 7.50$, $SD = 4.38$) reported significantly higher levels of anxiety compared to breast cancer patients about to receive radiotherapy ($M = 5.23$, $SD = 4.00$). There was no significant difference in anxiety levels between these two patient groups and healthy controls ($M = 5.91$, $SD = 3.32$).

The two-way ANOVA showed similar results. There was a statistically significant main effect for participant group, $F(2, 164) = 4.61$, $p = .011$, $\eta_p^2 = .05$. Post-hoc comparisons using the Bonferroni correction indicated that breast cancer patients about to receive chemotherapy ($M = 7.75$, $SE = 0.54$) reported significantly higher levels of anxiety compared to those about to receive radiotherapy ($M = 5.56$, $SE = 0.55$). No significant differences were found in anxiety levels between the patient groups and healthy controls ($M = 5.61$, $SE = 0.99$). There was no main effect of education on anxiety levels, $F(2, 164) = 0.61$, $p = .544$, $\eta_p^2 = .01$. The overall interaction between participant group and education was significant, $F(4, 164) = 2.69$, $p = .033$, $\eta_p^2 = .06$.

**Depression**

The *Levene's F* test revealed that the homogeneity of variance assumption was not met for the depression variable, therefore the *Welch F-test* was used. The one-way ANOVA showed that the three participant groups did not significantly differ on levels of depression at baseline, *Welch's F*$(2, 112.84) = 2.62$, $p = .077$, $\eta^2 = .03$.

The two-way ANOVA showed similar results. There was no significant interaction between participant group and education, $F(4, 164) = 1.943$, $p = .106$, $\eta_p^2 = .05$, no

main effect of participant group, $F(2, 164) = 2.62$, $p = .076$, $\eta_p^2 = .03$, and no main effect of education on depression, $F(2, 164) = 1.844$, $p = .161$, $\eta_p^2 = .02$.

**Fatigue**

The *Levene's F* test revealed that the homogeneity of variance assumption was not met for the fatigue variable, therefore the *Welch F-test* was used. The one-way ANOVA showed that the three participant groups did not significantly differ on levels of fatigue at baseline, *Welch's F*$(2, 171) = 1.383$, $p = .254$, $\eta^2 = .02$.

The *Levene's F* test revealed that the homogeneity of variance assumption for the two-way ANOVA was not met, therefore the more stringent significance level ($p < .01$) was set, as recommended by Pallant (2007). Similar results were found to the one-way ANOVA, with no main effect of participant group, $F(2, 164) = 1.033$, $p = .354$, $\eta_p^2 = .012$, no main effect of education on fatigue, $F(2, 164) = .744$, $p = .477$, $\eta_p^2 = .01$, and the interaction was not considered significant at the new significance level, $F(4, 164) = 2.840$, $p = .026$, $\eta_p^2 = .07$.

**Cognitive Function**

The one-way ANOVA showed that the three participant groups did not significantly differ on levels of cognitive function at baseline, $F(2, 171) = 1.573$, $p = .210$, $\eta^2 = .02$. Since education was not correlated with cognitive function in any of the participant groups (see Table 6.4), a two-way between-groups ANOVA was not conducted.

### 6.6.1   Section Summary

In summary, breast cancer patients about to receive chemotherapy, breast cancer patients about to receive radiotherapy and healthy controls reported similar levels of depression, fatigue and subjective cognitive function at pre-treatment baseline. However, breast cancer patients about to receive chemotherapy experienced significantly higher levels of anxiety compared to breast cancer patients about to receive radiotherapy. This significant difference remained after adjusting for education level. However, there was no significant difference in anxiety scores between the chemotherapy group and healthy control group.

Table 6.5

*One-Way and Two-Way ANOVA Results for the Chemotherapy Group (n = 60), Radiotherapy Group (n = 56) and Healthy Control Group (n = 58) at Baseline*

| | One-way ANOVA | | | | | | | Two-way ANOVA | | | | | | |
| | Chemotherapy | | Radiotherapy | | Healthy | | | Chemotherapy | | Radiotherapy[a] | | Healthy | | |
| Variable | *M* | (*SD*) | *M* | (*SD*) | *M* | (*SD*) | *p* | *M* | (*SE*) | *M* | (*SE*) | *M* | (*SE*) | *p* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anxiety | 7.50 | (4.38) | 5.23 | (4.00) | 5.91 | (3.32) | **.007** | 7.75 | (0.54) | 5.56 | (0.55) | 5.61 | (0.99) | **.011** |
| Depression | 3.58 | (3.37) | 2.32 | (2.56) | 2.91 | (2.44) | .077[b] | 3.70 | (0.39) | 2.44 | (0.40) | 3.40 | (0.72) | .076 |
| Fatigue | 41.13 | (9.06) | 41.79 | (9.46) | 43.63 | (6.53) | .186[b] | 40.65 | (1.16) | 41.74 | (1.19) | 44.12 | (2.14) | .358 |
| Cognitive function | 34.12 | (13.44) | 30.09 | (13.65) | 33.86 | (13.66) | .210 | - | - | - | - | - | - | - |

*Note.* The p-value for the main effect of participant group is shown for the two-way ANOVA.

[a]Data missing for one participant due to missing education data.

[b]*Welch F-ratio* (assumption of homogeneity of variance violated).

## 6.7    Findings from Hypothesis I

*There will be differences in levels of anxiety, depression and fatigue between the chemotherapy group, radiotherapy group and healthy control group, and over time.*

To consider the impact of chemotherapy on psychosocial well-being over time, a series of 3 x 3 mixed ANOVAs were conducted with participant group (chemotherapy, radiotherapy, healthy control group) as the between-subjects factor and time (follow-up time 1, follow-up time 2, follow-up time 3) as the within-subjects factor for each DV (anxiety, depression, fatigue). Further analyses were conducted, with the baseline measure for the DV as a covariate, in a series of 3 x 3 mixed ANCOVAs. In addition, a series of 3 x 3 x 3 mixed ANCOVAs were performed with education (none, high school, university) as an additional between-subjects factor to filter out the effect of this variable.

**Anxiety**

A 3 x 3 mixed ANOVA was conducted to assess the impact of chemotherapy on breast cancer participants' subjective levels of anxiety over time (see Table 6.6; higher scores indicate higher levels of anxiety). There was no main effect for time, $F(2, 308) = 0.46$, $p = .633$, $\eta_p^2 < .01$, suggesting no significant temporal changes in anxiety scores during treatment. There was no significant interaction between time and participant group, $F(4, 308) = 1.14$, $p = .340$, $\eta_p^2 = .02$. The main effect for participant group was not significant, $F(2, 154) = 2.84$, $p = .061$, $\eta_p^2 = .04$, suggesting similar levels of anxiety scores between participant groups.

The analysis was re-run as a 3 x 3 mixed ANCOVA with baseline anxiety score as a covariate. Although controlling for baseline anxiety measure did not change the significance of these results, there were deviations in the adjusted mean anxiety scores (see Table 6.6). For example, the ANOVA showed that the chemotherapy group scored higher levels of anxiety compared to the radiotherapy and healthy control group, whereas the ANCOVA revealed that healthy controls scored the highest levels of anxiety across all follow-up time-points. There was no main effect for time, $F(2, 306) =$

2.79, $p = .063$, $\eta_p^2 = .02$. There was no significant interaction between treatment group and time, $F(4, 306) = 1.26$, $p = .287$, $\eta_p^2 = .02$. The main effect comparing the three participant groups was not significant, $F(2, 153) = 0.87$, $p = .422$, $\eta_p^2 = .01$, suggesting no differences in anxiety amongst the three participant groups.

Further adjustment for education was examined using a 3 x 3 x 3 mixed ANCOVA with education as an additional between-subjects factor. Similar to previous analyses, there was no main effect for time, $F(2, 292) = 1.67$, $p = .190$, $\eta_p^2 = .01$, no main effect for participant group, $F(2, 306) = 2.79$, $p = .063$, $\eta_p^2 = .02$, and no interaction between these variables, $F(2, 146) = 0.60$, $p = .548$, $\eta_p^2 = .01$. Overall, this suggests that the three participant groups exhibited comparative levels of anxiety over time (see Figure 6.1).



*Figure 6.1.* Adjusted mean anxiety scores (+ *SE*) for the chemotherapy, radiotherapy and healthy control groups at each follow-up time-point.

As shown in Figure 6.1 above, anxiety scores were similar between participant groups and over time. The healthy control group in particular showed stable levels of anxiety over time. In contrast, radiotherapy patients showed a slight reduction in anxiety score from follow-up time 1 to follow-up time 2, followed by a slight increase in anxiety from follow-up time 2 to follow-up time 3. Interestingly, the chemotherapy group showed the reverse pattern. However, these changes between group and over time did not reach statistical significance. Therefore, this finding does not support Hypothesis I.

Table 6.6

*Mixed ANOVA and ANCOVA Results for Anxiety for the Chemotherapy Group (n = 53), Radiotherapy Group (n = 46) and Healthy Control Group (n = 58)*

| Type of analysis | Participant group | Follow-up time 1 | | Follow-up time 2 | | Follow-up time 3 | | Factor | $F$ | $p$ | $\eta_p^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $M$ | $SD$/$SE$ | $M$ | $SD$/$SE$ | $M$ | $SD$/$SE$ | | | | |
| Two-way mixed ANOVA | Chemotherapy | 6.38 | 4.22 | 6.93 | 4.80 | 6.30 | 4.45 | Time | 0.46 | .633 | <.01 |
| | Radiotherapy | 4.65 | 3.91 | 4.50 | 3.81 | 5.13 | 3.99 | Group | 2.84 | .061 | .04 |
| | Healthy | 5.85 | 3.69 | 6.07 | 4.06 | 5.98 | 3.95 | Time x Group | 1.14 | .340 | .02 |
| Two-way mixed ANCOVA | Chemotherapy | 5.35 | 0.33 | 6.05 | 0.46 | 5.41 | 0.43 | Time | 2.79 | .063 | .02 |
| | Radiotherapy | 5.60 | 0.35 | 5.31 | 0.49 | 5.96 | 0.46 | Group | 0.87 | .422 | .01 |
| | Healthy | 6.04 | 0.31 | 6.23 | 0.44 | 6.15 | 0.41 | Time x Group | 1.26 | .287 | .02 |
| Three-way mixed ANCOVA | Chemotherapy | 5.42 | 0.35 | 6.20 | 0.50 | 5.57 | 0.47 | Time | 1.67 | .190 | .01 |
| | Radiotherapy[a] | 5.80 | 0.37 | 5.39 | 0.53 | 6.09 | 0.49 | Group | 0.60 | .548 | .01 |
| | Healthy | 6.45 | 0.60 | 6.54 | 0.86 | 6.47 | 0.81 | Time x Group | 1.27 | .283 | .02 |

[a]Radiotherapy group, $n = 45$, due to missing education data.

**Depression**

A 3 x 3 mixed ANOVA was conducted to assess the impact of chemotherapy on breast cancer participants' subjective levels of depression over time (see Table 6.7; higher scores indicate higher levels of depression). To correct for the violation of sphericity, values for the Greenhouse-Geisser Epsilon are reported. There was a significant interaction between time and participant group, $F(3.82, 294.03) = 3.42$, $p = .011$, $\eta_p^2 = .04$. There was a main effect for time, $F(1.91, 294.03) = 5.57$, $p = .005$, $\eta_p^2 = .04$. Depression levels in the radiotherapy and healthy control groups remained relatively stable over time; however, they decreased over time in the chemotherapy group. The main effect for participant group was significant, $F(2, 154) = 12.38$, $p < .001$, $\eta_p^2 = .14$, with the chemotherapy group reporting higher levels of depression compared to the radiotherapy and healthy control groups at each time-point.

The analysis was re-run as a 3 x 3 mixed ANCOVA with baseline depression score as a covariate, and again values for the Greenhouse-Geisser Epsilon are reported. There was a significant interaction between time and participant group, $F(3.82, 292.01) = 3.28$, $p = .013$, $\eta_p^2 = .04$. The main effect for time was not significant, $F(1.91, 292.01) = 2.60$, $p = .076$, $\eta_p^2 = .02$. There was a significant main effect of participant group, $F(2, 153) = 11.89$, $p < .001$, $\eta_p^2 = .14$. Post-hoc comparisons showed a significant difference in depression score between the chemotherapy group and both the radiotherapy and healthy control groups ($p < .001$).

Further adjustment for education was examined using a 3 x 3 x 3 mixed ANCOVA with education as an additional between-subjects factor. There was no main effect for time, $F(1.91, 278.92) = 1.39$, $p = .250$, $\eta_p^2 = .01$. There was a main effect for participant group, $F(2, 146) = 8.12$, $p < .001$, $\eta_p^2 = .10$. Post-hoc comparisons revealed that the chemotherapy group scored significantly higher on levels of depression compared to the radiotherapy group ($p = .001$) and the healthy control group ($p = .018$). There was an interaction between time and participant group, $F(4, 278.92) = 2.80$, $p = .026$, $\eta_p^2 = .04$ (see Figure 6.2).

Table 6.7

*Mixed ANOVA and ANCOVA Results for Depression for the Chemotherapy Group (n = 53), Radiotherapy Group (n = 46) and Healthy Control Group (n = 58)*

| Type of analysis | Participant group | Follow-up time 1 | | Follow-up time 2 | | Follow-up time 3 | | Factor | $F$ | $p$ | $\eta_p^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $M$ | $SD/SE$ | $M$ | $SD/SE$ | $M$ | $SD/SE$ | | | | |
| Two-way mixed ANOVA | Chemotherapy | 6.28 | 4.41 | 5.23 | 4.50 | 4.42 | 4.61 | Time | 5.57 | **.005** | .04 |
| | Radiotherapy | 2.48 | 2.89 | 2.37 | 3.09 | 2.50 | 3.06 | Group | 12.38 | **<.001** | .14 |
| | Healthy | 3.96 | 2.74 | 2.97 | 2.95 | 2.62 | 2.91 | Time x Group | 3.42 | **.011** | .04 |
| Two-way mixed ANCOVA | Chemotherapy | 5.73 | 0.35 | 4.70 | 0.39 | 3.87 | 0.38 | Time | 2.60 | .079 | .02 |
| | Radiotherapy | 3.06 | 0.37 | 2.93 | 0.42 | 3.08 | 0.41 | Group | 11.89 | **<.001** | .14 |
| | Healthy | 3.04 | 0.33 | 3.00 | 0.37 | 2.66 | 0.36 | Time x Group | 3.28 | **.013** | .04 |
| Three-way mixed ANCOVA | Chemotherapy | 5.80 | 0.38 | 4.76 | 0.42 | 3.91 | 0.42 | Time | 1.39 | .250 | .01 |
| | Radiotherapy[a] | 3.17 | 0.41 | 2.85 | 0.45 | 3.12 | 0.44 | Group | 8.12 | **<.001** | .10 |
| | Healthy | 2.89 | 0.66 | 3.29 | 0.74 | 2.81 | 0.72 | Time x Group | 2.80 | **.029** | .04 |

*Note.* Greenhouse-Geisser reported due to violation of sphericity.

[a]Radiotherapy group, $n = 45$, due to missing education data.

*Figure 6.2.* Adjusted mean depression scores (+ *SE*) for the chemotherapy, radiotherapy and healthy control groups at each follow-up time-point.

As shown in Figure 6.2 above, chemotherapy patients experienced relatively high levels of depression at follow-up time 1, which decreased at follow-up time 2. Depression scores continued to decrease at follow-up time 3 and reached more similar levels reported by the radiotherapy group and healthy control group. Radiotherapy patients and healthy controls experienced similar levels of depression and with minimal fluctuation over time. This finding supports Hypothesis I.

**Fatigue**

A 3 x 3 mixed ANOVA was conducted to assess the impact of chemotherapy on breast cancer participants' subjective levels of fatigue over time (see Table 6.8; higher scores indicate better fatigue). To correct for the violation of sphericity, values for the Greenhouse-Geisser Epsilon are reported. For this measure the higher the score indicates less fatigue. There was a significant interaction between time and participant

group, $F(3.83, 294.84) = 5.36$, $p < .001$, $\eta_p^2 = .07$. There was a main effect for time, $F(1.92, 294.84) = 17.32$, $p < .001$, $\eta_p^2 = .10$. The level of fatigue in the radiotherapy and healthy control groups remained relatively stable over time; however, fatigue scores increased over time in the chemotherapy group indicating a reduction in fatigue over time. The main effect for participant group was significant, $F(2, 154) = 15.22$, $p < .001$, $\eta_p^2 = .17$, with the chemotherapy group reporting lower scores on this measure (higher levels of fatigue) compared to the radiotherapy and healthy control groups at each time-point.

The analysis was re-run as a 3 x 3 mixed ANCOVA with baseline fatigue score as a covariate, and again values for the Greenhouse-Geisser Epsilon are reported. There was a significant interaction between time and participant group, $F(3.81, 291.28) = 5.31$, $p < .001$, $\eta_p^2 = .07$. The main effect for time was not significant, $F(1.90, 291.28) = 2.00$, $p = .139$, $\eta_p^2 = .01$. However, post-hoc comparisons revealed a significant difference in fatigue scores between follow-up time 1 and follow-up time 2 ($p < .001$) and follow-up time 3 ($p < .001$). There was a significant main effect of participant group, $F(2, 153) = 17.44$, $p < .001$, $\eta_p^2 = .19$. Post-hoc comparisons showed a significant difference in fatigue scores between the chemotherapy group and both the radiotherapy group ($p < .001$) and healthy control group ($p < .001$), suggesting that the chemotherapy group experienced lower scores on this measure (higher levels of fatigue).

Further adjustment for education was examined using a 3 x 3 x 3 mixed ANCOVA with education as an additional between-subjects factor. There was no main effect for time, $F(1.90, 277.41) = 1.59$, $p = .208$, $\eta_p^2 = .01$. There was a main effect for participant group, $F(2, 146) = 10.20$, $p < .001$, $\eta_p^2 = .12$. Post-hoc comparisons revealed that the chemotherapy group scored significantly lower on the FACIT-F, indicating higher fatigue, compared to the radiotherapy group ($p < .001$) and the healthy control group ($p = .020$) (see Figure 6.3). There was an interaction between time and participant group, $F(3.8, 277.41) = 3.88$, $p = .005$, $\eta_p^2 = .05$.

As shown in Figure 6.3 below, chemotherapy patients experienced higher levels of fatigue at follow-up time 1, which reduced at follow-up time 2. Levels of fatigue continued to reduce by follow-up time 3 to reach similar levels reported by the radiotherapy group and healthy control group. Radiotherapy patients and healthy

controls experienced similar levels of fatigue to each other and with relatively little change over time. This finding supports Hypothesis I.
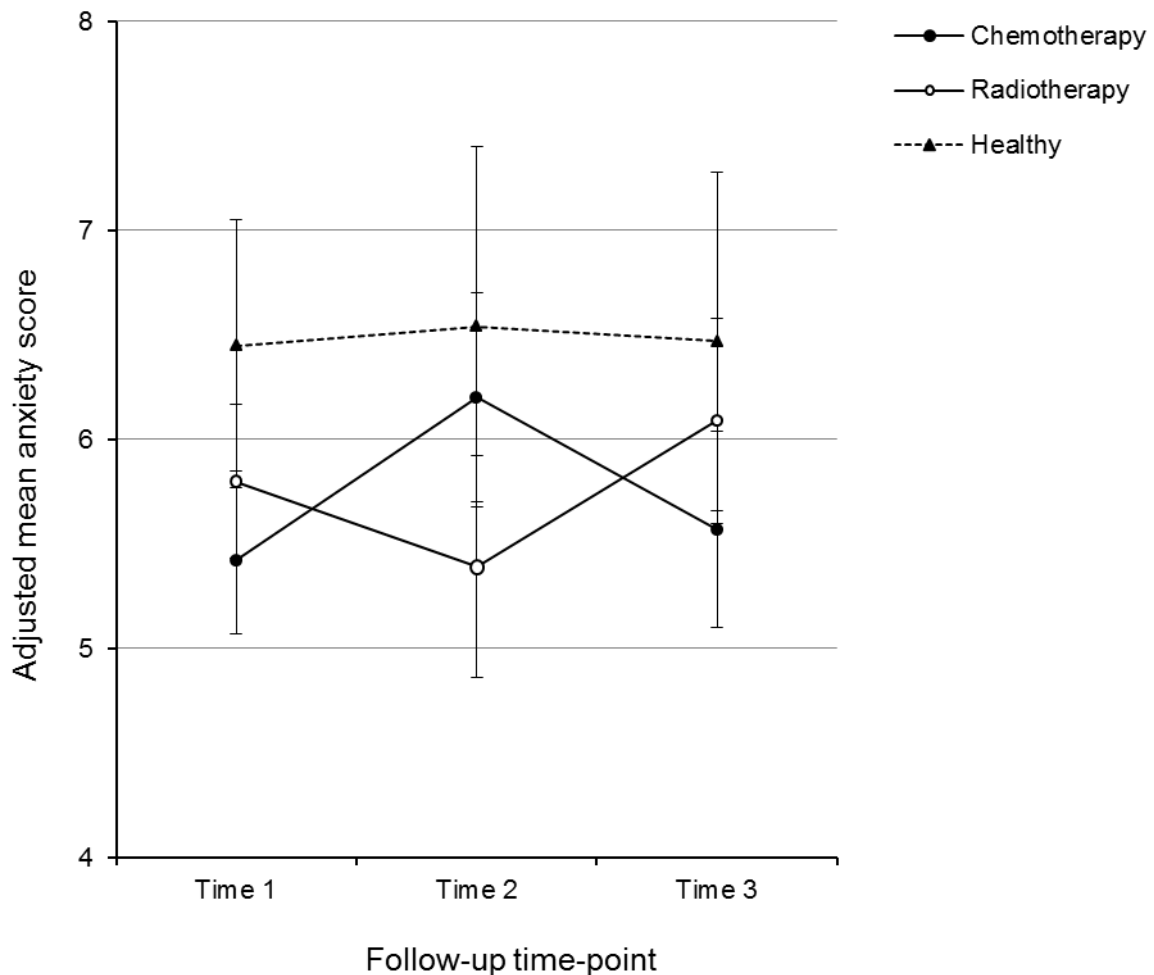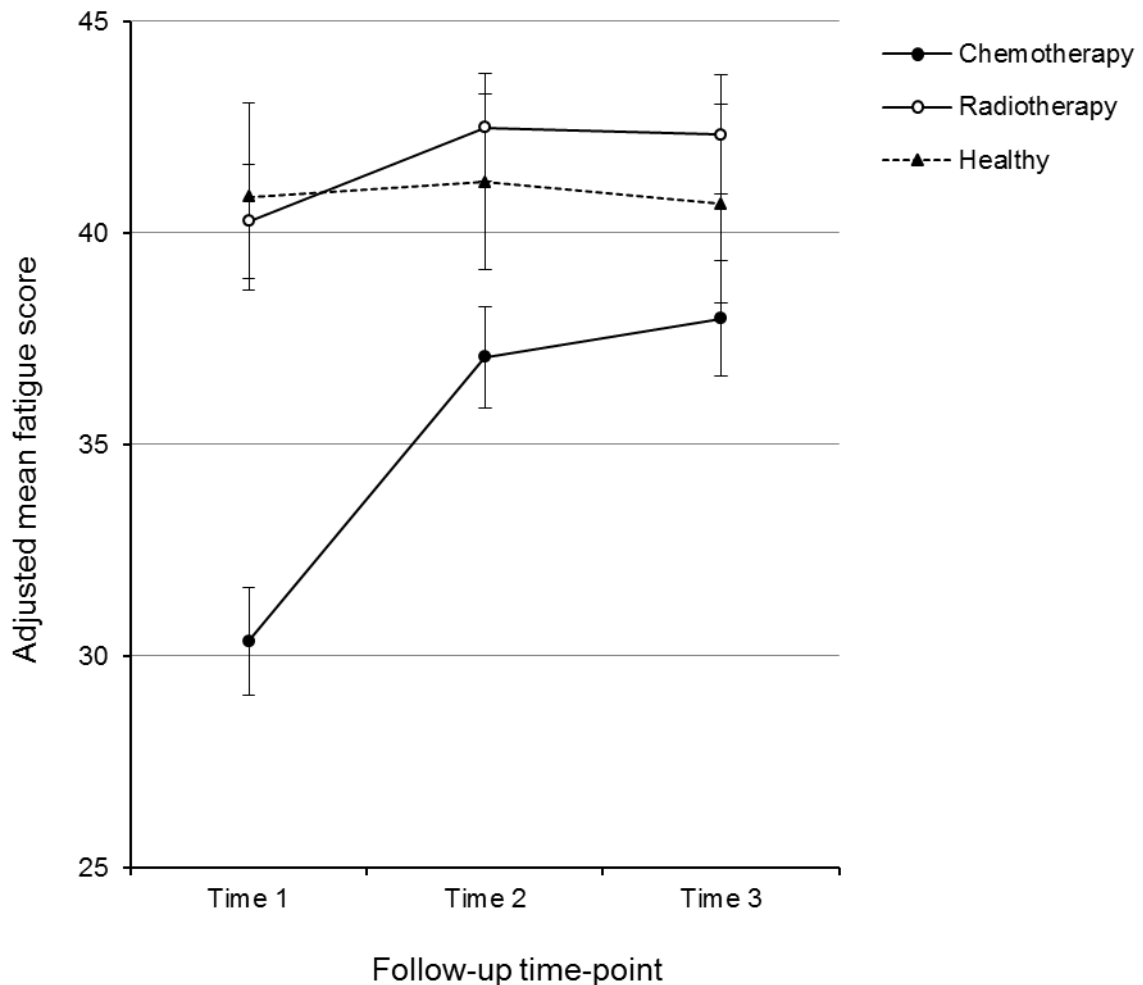


*Figure 6.3.* Adjusted mean fatigue scores (+ *SE*) for the chemotherapy, radiotherapy and healthy control groups at each follow-up time-point.

### 6.7.1   Section Summary

In summary, Hypothesis I was partially supported. All three participant groups experienced similar levels of anxiety, with minimal temporal changes over follow-up time-points. However, breast cancer patients in the chemotherapy group reported considerably higher levels of depression and fatigue compared to the radiotherapy group and the healthy control group at follow-up time 1. By follow-up time 2, levels of depression and fatigue reduced and by follow-up time 3 scores were similar to those reported in the radiotherapy group and healthy control group.

Table 6.8

*Mixed ANOVA and ANCOVA Results for Fatigue for the Chemotherapy Group (n = 53), Radiotherapy Group (n = 46) and Healthy Control Group (n = 58)*

| Type of analysis | Participant group | Follow-up time 1 | | Follow-up time 2 | | Follow-up time 3 | | Factor | *F* | *p* | $\eta_p^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *M* | *SD/SE* | *M* | *SD/SE* | *M* | *SD/SE* | | | | |
| Two-way mixed ANOVA | Chemotherapy | 28.54 | 12.48 | 35.07 | 13.34 | 36.19 | 12.37 | Time | 17.32 | **<.001** | .10 |
| | Radiotherapy | 40.72 | 10.73 | 42.56 | 10.88 | 42.46 | 10.80 | Group | 15.22 | **<.001** | .17 |
| | Healthy | 41.43 | 8.19 | 43.01 | 7.84 | 42.62 | 8.98 | Time x Group | 5.36 | **<.001** | .07 |
| Two-way mixed ANCOVA | Chemotherapy | 29.70 | 1.17 | 36.40 | 1.13 | 37.28 | 1.24 | Time | 2.00 | .137 | .01 |
| | Radiotherapy | 40.41 | 1.25 | 42.20 | 1.20 | 42.16 | 1.33 | Group | 17.44 | **<.001** | .19 |
| | Healthy | 40.61 | 1.12 | 42.08 | 1.07 | 41.85 | 1.19 | Time x Group | 5.31 | **<.001** | .07 |
| Three-way mixed ANCOVA | Chemotherapy | 30.35 | 1.28 | 37.06 | 1.20 | 37.98 | 1.35 | Time | 1.59 | .207 | .01 |
| | Radiotherapy[a] | 40.28 | 1.35 | 42.49 | 1.27 | 42.33 | 1.42 | Group | 10.20 | **<.001** | .12 |
| | Healthy | 40.86 | 2.22 | 41.20 | 2.08 | 40.69 | 2.34 | Time x Group | 4.42 | **<.001** | .06 |

*Note*. Greenhouse-Geisser reported due to violation of sphericity.

[a]Radiotherapy group, *n* = 45, due to missing education data.

## 6.8    Findings from Hypothesis II

*There will be differences in subjective cognitive function scores between the chemotherapy group, radiotherapy group and healthy control group, and over time.*

The second hypothesis examined the impact of chemotherapy on subjective cognitive function. Correlations previously conducted between the study variables revealed no relationship between age and education with cognitive function in all participant groups (see Table 6.4), thus these demographic variables were not included as covariates. A number of studies have demonstrated that anxiety, depression and fatigue are associated with subjective cognitive function (e.g. Bender et al., 2008; Castellon et al., 2004). Therefore, baseline measures of these psychosocial variables were considered as potential covariates and Pearson's product moment correlations were conducted with baseline cognitive function scores for each participant group. Table 6.9 shows that anxiety, depression and fatigue were significantly associated with cognitive function in all participant groups. Therefore, these psychosocial variables were included as covariates in a mixed ANCOVA in order to filter out their effect.

Table 6.9
*Correlations Between Psychosocial Variables and Cognitive Function in the Chemotherapy Group (n = 60), Radiotherapy Group (n = 56) and Healthy Control Group (n = 58) at Baseline*

| Variable | Chemotherapy | Radiotherapy | Healthy |
|---|---|---|---|
|  | Cognitive function | Cognitive function | Cognitive function |
| Anxiety | 0.46* | 0.46* | 0.55* |
| Depression | 0.51* | 0.52* | 0.37* |
| Fatigue | -0.45* | -0.43* | -0.38* |

* $p < .01$ (two-tailed).

First, a 3 x 3 mixed ANOVA was conducted to assess the impact of chemotherapy on breast cancer participants' subjective levels of cognitive function over time (see Table 6.10; higher scores indicate higher frequency of cognitive failures). The interaction between time and participant group was not significant, $F(4, 308) = 0.62$, $p = .650$, $\eta_p^2 =$

.01. There was no main effect for time, $F(2, 308) = 0.77$, $p = .465$, $\eta_p^2 = .01$, suggesting that cognitive function scores remained relatively stable over time. The main effect for participant group was marginally significant, $F(2, 154) = 3.10$, $p < .05$, $\eta_p^2 = .04$, with the chemotherapy group reporting significantly more cognitive difficulties compared to the radiotherapy group.

The analysis was re-run as a 3 x 3 mixed ANCOVA with baseline anxiety, depression, fatigue and cognitive function scores as covariates. There was no main effect for time, $F(2, 300) = 0.12$, $p = .983$, $\eta_p^2 < .01$. There was no significant interaction between treatment group and time, $F(4, 300) = 0.57$, $p = .683$, $\eta_p^2 = .01$. The main effect comparing the three participant groups was not significant, $F(2, 150) = 1.91$, $p = .152$, $\eta_p^2 = .03$, suggesting no significant differences in cognitive function score across the three participant groups (see Figure 6.4).
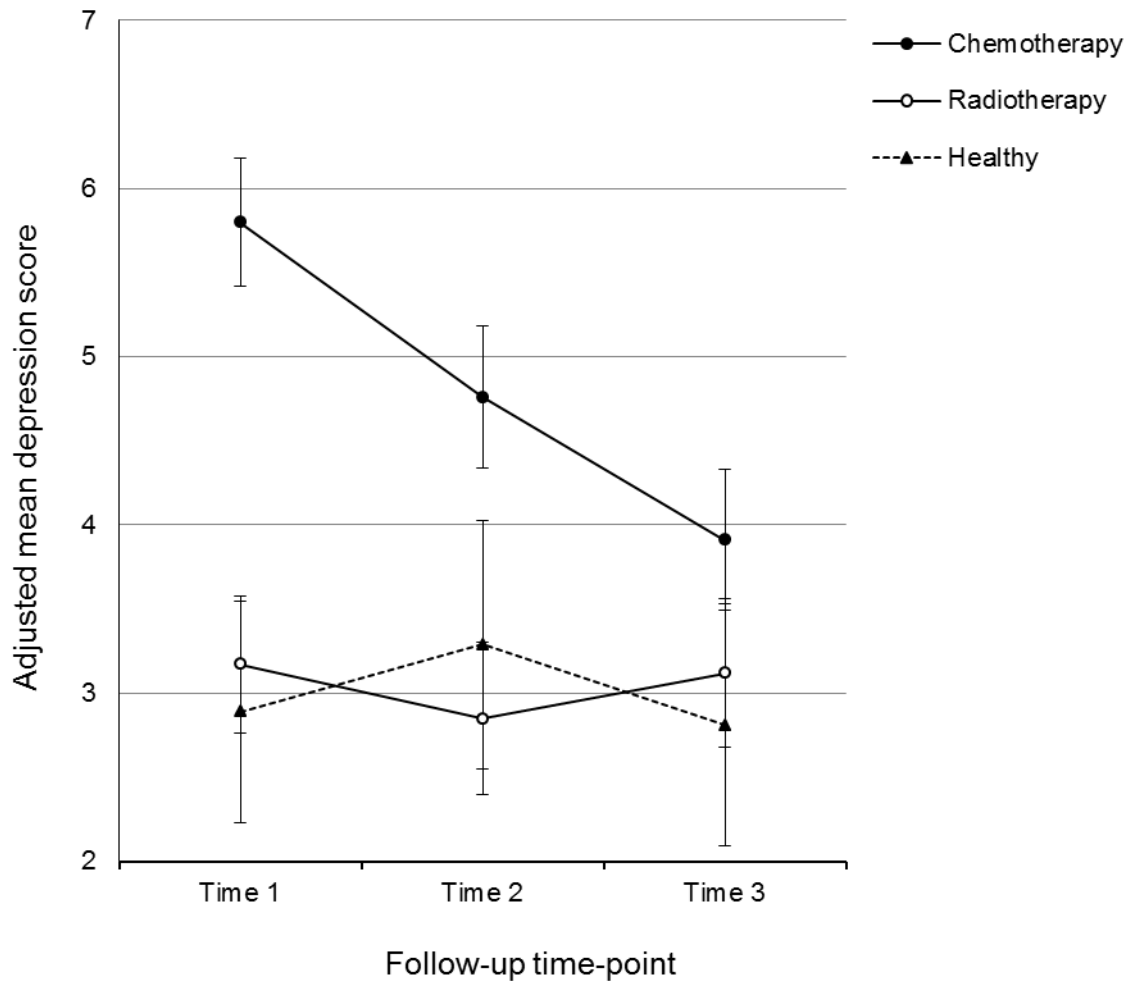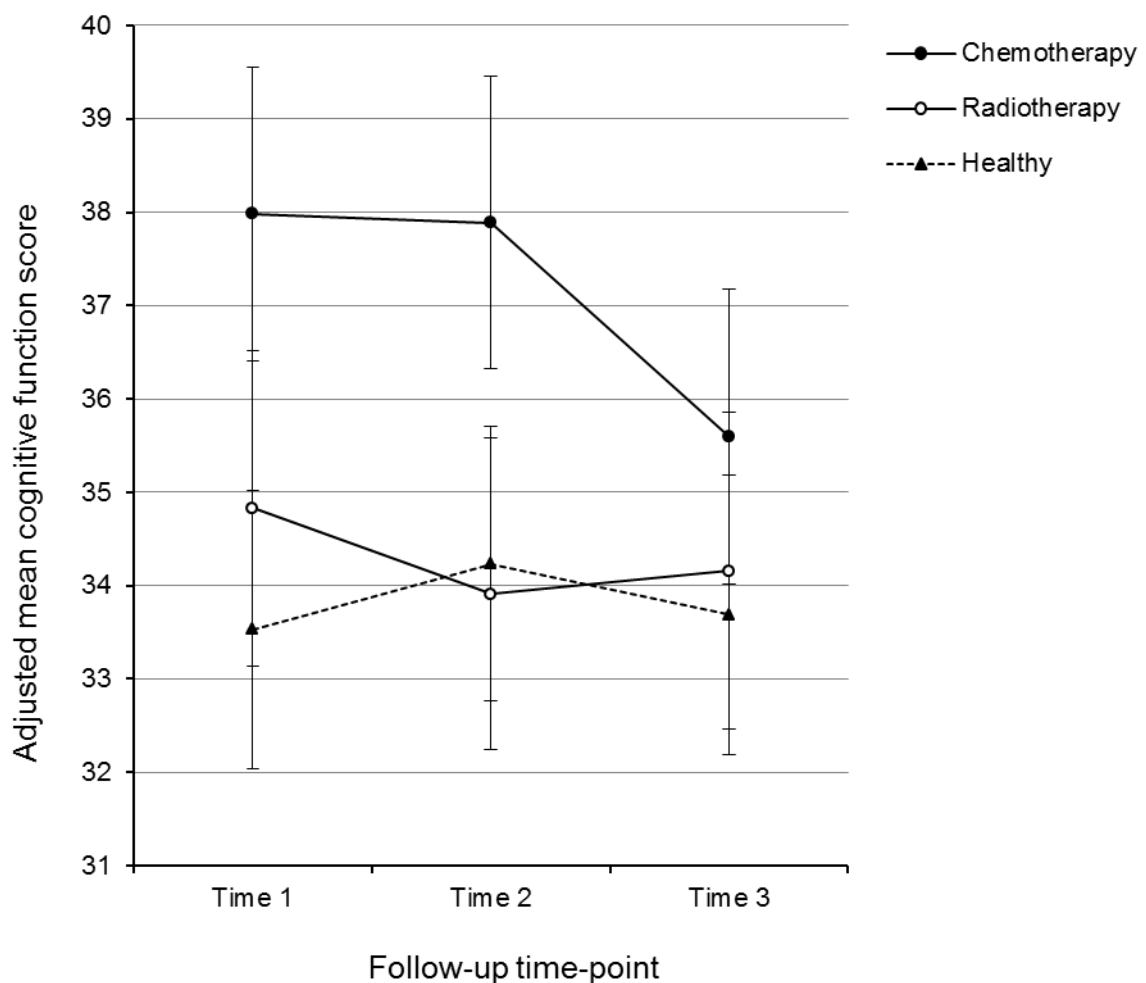


*Figure 6.4.* Adjusted mean cognitive function scores (+ *SE*) for the chemotherapy, radiotherapy and healthy control groups at each follow-up time-point.

Figure 6.4 above shows that chemotherapy patients experienced relatively high levels of cognitive impairment at follow-up time 1, which remained stable by follow-up time 2. However, by follow-up time 3, the frequency of cognitive failures declined. Radiotherapy patients and healthy controls exhibited similar levels of cognitive function to each, with minimal temporal fluctuation.

### 6.8.1 Section summary

In summary, Hypothesis II was not supported. Although there were subtle differences in cognitive function scores between the chemotherapy group and the two control groups, these did not reach statistical significance level.

Table 6.10

*Mixed ANOVA and ANCOVA Results for Cognitive Function for the Chemotherapy Group (n = 53), Radiotherapy Group (n = 46) and Healthy Control Group (n = 58)*

| Type of analysis | Participant group | Follow-up time 1 | | Follow-up time 2 | | Follow-up time 3 | | Factor | $F$ | $p$ | $\eta_p^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $M$ | SD/SE | $M$ | SD/SE | $M$ | SD/SE | | | | |
| Two-way mixed ANOVA | Chemotherapy | 39.43 | 16.68 | 39.62 | 16.57 | 37.26 | 19.48 | Time | 0.77 | .465 | <.01 |
| | Radiotherapy | 31.96 | 16.49 | 30.76 | 16.95 | 31.00 | 14.53 | Group | 3.10 | **.048** | .04 |
| | Healthy | 34.48 | 13.88 | 35.14 | 15.73 | 34.67 | 15.89 | Time x Group | 0.62 | .650 | .01 |
| Two-way mixed ANCOVA | Chemotherapy | 37.98 | 1.57 | 37.89 | 1.56 | 35.60 | 1.58 | Time | 0.02 | .983 | <.01 |
| | Radiotherapy | 34.83 | 1.69 | 33.91 | 1.67 | 34.16 | 1.70 | Group | 1.91 | .152 | .03 |
| | Healthy | 33.53 | 1.49 | 34.23 | 1.47 | 33.69 | 1.50 | Time x Group | 0.57 | .683 | <.01 |

## 6.9    Findings from Hypothesis III (a)

*Anxiety, depression and fatigue scores will be significantly associated with each other and with subjective cognitive function scores in the chemotherapy group at each time-point.*

Research has shown that anxiety, depression and fatigue are associated with subjective cognitive difficulties in breast cancer patients (e.g. Bender et al., 2008; Castellon, Ganz, Bower, Petersen, Abraham, & Greendale, 2004; van Dam et al., 1998). Hypothesis III (a) examines the associations between demographic variables (age and education), psychosocial variables (anxiety, depression and fatigue) and cognitive function at each time-point in the chemotherapy group. The purpose of this hypothesis is twofold: first, to consider potential changes in the relationship between these variables over time, which has received little attention in previous literature; and second, to identify significant correlations amongst variables to be included in regression analyses in Hypothesis III (b). Pearson's product moment correlations ($r$) were conducted, except for correlations including education, where Spearman's rank order correlations ($r_s$) were performed.

**Correlations at Baseline**

Table 6.11 shows that psychosocial variables were significantly correlated with each other and with cognitive function in the chemotherapy group at pre-treatment baseline. Age and education were not significantly correlated with cognitive function.

Table 6.11

*Correlations Between Psychosocial Variables and Cognitive Function in the Chemotherapy Group at Baseline (n = 60)*

| Variable | Age | Education | Anxiety | Depression | Fatigue |
|---|---|---|---|---|---|
| Anxiety | 0.04 | **-0.40\*\*** | | | |
| Depression | 0.08 | **-0.27\*** | **0.78\*\*** | | |
| Fatigue | -0.14 | **0.28\*** | **-0.55\*\*** | **-0.71\*\*** | |
| Cognitive function | 0.02 | -0.23 | **0.46\*\*** | **0.51\*\*** | **-0.45\*\*** |

*Note.* Spearman's rank order correlation performed on education; Pearson's product moment correlation performed on all other variables.

\**p* < .05. \*\* *p* < .01.

## Correlations at Follow-Up Time 1

Table 6.12 shows that psychosocial variables were significantly correlated with each other and with cognitive function in the chemotherapy group at follow-up time 1. Education was also significantly correlated with cognitive function.

Table 6.12

*Correlations Between Psychosocial Variables and Cognitive Function in the Chemotherapy Group at Follow-Up Time 1 (n = 55)*

| Variable | Age | Education | Anxiety | Depression | Fatigue |
|---|---|---|---|---|---|
| Anxiety | -0.08 | **-0.45\*\*** | | | |
| Depression | -0.11 | **-0.30\*** | **0.58\*\*** | | |
| Fatigue | 0.05 | 0.22 | **-0.45\*\*** | **-0.73\*\*** | |
| Cognitive function | -0.24 | **-0.29\*** | **0.50\*\*** | **0.43\*\*** | **-0.41\*\*** |

*Note.* Spearman's rank order correlation performed on education; Pearson's product moment correlation performed on all other variables.

\**p* < .05. \*\* *p* < .01.

## Correlations at Follow-Up Time 2

Table 6.13 shows that psychosocial variables were strongly correlated with each other and with cognitive function in the chemotherapy group at follow-up time 2. Age and education were also significantly correlated with cognitive function.

Table 6.13
*Correlations Between Psychosocial Variables and Cognitive Function in the Chemotherapy Group at Follow-Up Time 2 (n = 59)*

| Variable | Age | Education | Anxiety | Depression | Fatigue |
|---|---|---|---|---|---|
| Anxiety | -0.16 | **-0.39\*\*** | | | |
| Depression | -0.13 | **-0.33\*** | **0.79\*\*** | | |
| Fatigue | 0.16 | **0.34\*\*** | **-0.73\*\*** | **-0.89\*\*** | |
| Cognitive function | **-0.34\*\*** | **-0.29\*** | **0.72\*\*** | **0.70\*\*** | **-0.63\*\*** |

*Note.* Spearman's rank order correlation performed on education; Pearson's product moment correlation performed on all other variables.
*p < .05. ** p < .01.

## Correlations Follow-Up Time 3

Table 6.14 shows that psychosocial variables were strongly correlated with each other and with cognitive function in the chemotherapy group at follow-up time 3. Age and education were not significantly correlated with cognitive function.

Table 6.14
*Correlations Between Psychosocial Variables and Cognitive Function in the Chemotherapy Group at Follow-Up Time 3 (n = 57)*

| Variable | Age | Education | Anxiety | Depression | Fatigue |
|---|---|---|---|---|---|
| Anxiety | -0.15 | **-0.35\*\*** | | | |
| Depression | -0.12 | **-0.31\*** | **0.76\*\*** | | |
| Fatigue | 0.13 | **0.29\*** | **-0.65\*\*** | **-0.82\*\*** | |
| Cognitive function | -0.12 | -0.25 | **0.61\*\*** | **0.74\*\*** | **-0.64\*\*** |

*Note.* Spearman's rank order correlation performed on education; Pearson's product moment correlation performed on all other variables.
*p < .05. ** p < .01.

### 6.9.1    Section Summary

In summary, these findings support Hypothesis III (a). Psychosocial variables (anxiety, depression and fatigue) were found to be significantly correlated with each other and with cognitive function, suggesting that perceived poorer cognitive function was related to higher levels of anxiety, depression and fatigue at each time-point.

## 6.10   Findings from Hypothesis III (b)

*Anxiety, depression and fatigue scores will predict subjective cognitive function score in the chemotherapy group at each time-point.*

Standard multiple or hierarchical regression analyses were conducted at each time-point to identify predictors for cognitive function in the chemotherapy group. Standard multiple regressions were performed when age and education were not found to be significantly correlated with cognitive function in Hypothesis III (a). Where they were found to be significantly correlated, hierarchical multiple regressions were performed with age and/or education were entered as covariates in the first step, followed by anxiety, depression and fatigue in the second step.

### Regression at Baseline

Standard multiple regression was used to assess the ability of anxiety, depression and fatigue to predict cognitive function (see Table 6.15). These predictors explained a significant proportion of the variance in cognitive function scores at baseline, adjusted $R^2 = .24$, $F (3, 56) = 7.35$, $p < .001$. However, anxiety, depression and fatigue were not statistically significant unique predictors of cognitive function. This finding does not support Hypothesis III (b).

Table 6.15
*Standard Multiple Regression Analysis for Anxiety, Depression and Fatigue Predicting Cognitive Function in the Chemotherapy Group at Baseline (n = 60)*

| Variable | *B* | *SE B* | B |
|---|---|---|---|
| Constant | 37.38 | 11.83 | |
| Anxiety | 0.48 | 0.56 | .16 |
| Depression | 1.04 | 0.86 | .26 |
| Fatigue | -0.26 | 0.24 | -.17 |

*Note*. $R^2 = .28$, $\Delta R^2 = .24$ ($p < .001$).

### Regression at Follow-Up Time 1

Hierarchical regression was used to assess the ability of anxiety, depression and fatigue to predict cognitive function after controlling for education (see Table 6.16). Education

was entered at Step 1 and explained 9% of the variance in cognitive function scores. Anxiety, depression and fatigue were entered at Step 2 and the total variance explained by the model as a whole was 25%, $F (4, 50) = 5.46$, $p = .001$. Anxiety, depression and fatigue explained an additional 22% of the variance in cognitive function, after controlling for education, $R^2$ change $= .22$, $F$ change $(3, 50) = 5.17$, $p < .005$. In the final model, anxiety ($\beta = .36$, $t = 2.14$, $p < .05$) was a statistically significant predictor of cognitive function. This finding partially supports Hypothesis III (b).

Table 6.16
*Hierarchical Regression Analysis for Anxiety, Depression and Fatigue Predicting Cognitive Function in the Chemotherapy Group at Follow-Up Time 1 (n = 55)*

| Variable | *B* | *SE B* | B |
|---|---|---|---|
| Step 1 | | | |
| Constant | 47.53 | 4.17 | |
| Education | -7.09 | 3.14 | **-.30*** |
| Step 2 | | | |
| Constant | 41.85 | 11.77 | |
| Education | -1.94 | 3.20 | -.08 |
| Anxiety | 1.37 | 0.64 | **.36*** |
| Depression | 0.02 | 0.77 | <.01 |
| Fatigue | -0.32 | 0.23 | -.24 |

*Note.* $R^2 = .09$ for Step 1 ($p < .05$)., $\Delta R^2 = .25$ for Step 2 ($p = .001$).
*$p < .05$.

**Regression at Follow-Up Time 2**

Hierarchical regression was used to assess the ability of anxiety, depression and fatigue to predict quality of life after controlling for age and education (see Table 6.17). Age and education was entered at Step 1 and explained 22% of the variance in cognitive function. Anxiety, depression and fatigue were entered at Step 2 and the total variance explained by the model as a whole was 58%, $F (5, 53) = 17.24$, $p < .001$. Anxiety, depression and fatigue explained an additional 38% of the variance in cognitive function, after controlling for age and education, $R^2$ change $= .38$, $F$ change $(3, 53) = 17.50$, $p < .001$. In the final model, age ($\beta = -.25$, $t = -2.74$, $p < .01$) and anxiety ($\beta = .40$, $t = 2.77$, $p < .01$) were statistically significant. This finding partially supports Hypothesis III (b).

Table 6.17
*Hierarchical Regression Analysis for Anxiety, Depression and Fatigue Predicting Cognitive Function in the Chemotherapy Group at Follow-Up Time 2 (n = 59)*

| Variable | *B* | *SE B* | Β |
|---|---|---|---|
| Step 1 | | | |
| Constant | 87.15 | 11.58 | |
| Age | -0.69 | 0.20 | **-.42\*\*\*** |
| Education | -9.22 | 2.99 | **-.37\*\*** |
| Step 2 | | | |
| Constant | 43.94 | 15.02 | |
| Age | -0.41 | 0.15 | **-.25\*** |
| Education | -1.77 | 2.45 | -.07 |
| Anxiety | 1.49 | 0.54 | **.40\*** |
| Depression | 1.46 | 0.81 | .37 |
| Fatigue | 0.06 | 0.25 | .05 |

*Note.* $R^2$ = .24 for Step 1 ($p$ < .001)., $\Delta R^2$ = .58 for Step 2 ($p$ < .001).
\**p* < .01. \*\**p* < .005. \*\*\**p* = .001.

## Regression at Follow-Up Time 3

Standard multiple regression was used to assess the ability of anxiety, depression and fatigue to predict cognitive function (see Table 6.18). These predictors explained a significant proportion of the variance in cognitive function scores at follow-up time 3, adjusted $R^2$ = .56, $F$ (3, 53) = 22.14, $p$ < .001. Depression ($\beta$ = .57, $t$ = 3.03, $p$ < .005) was a statistically significant predictor of cognitive function. This finding partially supports Hypothesis III (b).

Table 6.18
*Standard Multiple Regression Analysis for Anxiety, Depression and Fatigue Predicting Cognitive Function at Follow-Up Time 3 (n = 57)*

| Variable | *B* | *SE B* | Β |
|---|---|---|---|
| Constant | 30.45 | 12.52 | |
| Anxiety | 0.51 | 0.66 | .11 |
| Depression | 2.54 | 0.84 | **.57\*** |
| Fatigue | -0.19 | 0.26 | -.11 |

*Note.* $R^2$ = .56, $\Delta R^2$ = .53 ($p$ < .001).
\**p* < .005.

### 6.10.1  Section Summary

In summary, these findings partially support Hypothesis III (b). Only anxiety was found to predict cognitive function scores at follow-up time 1 and at follow-up time 2 (in addition to age). Only depression was found to significantly predict cognitive function at follow-up time 3.

## 6.11  Chapter Summary

This chapter presented the results of the first objective, which examined the impact of chemotherapy for breast cancer on levels of anxiety, depression, fatigue and cognitive function during and after treatment. Preliminary analyses showed no differences in these variables between groups at baseline except for anxiety. Breast cancer patients about to receive chemotherapy experienced significantly higher levels of anxiety compared to breast cancer patients about to receive radiotherapy, but they were of a similar level to those reported by the healthy control group. These findings could be taken to suggest that there are generally no pre-existing differences in levels of anxiety, depression, fatigue and cognitive function in breast cancer patients and healthy controls. In addition, these results suggest that there is a minimal impact of breast cancer diagnosis on levels of anxiety, depression, fatigue and cognitive function.

Hypothesis I was partially supported. Although there were no significant differences in levels of anxiety between participant groups and over time, chemotherapy patients did report significantly higher levels of depression and fatigue compared to the two control groups at follow-up time 1. This suggests that the administration of chemotherapy may increase feelings of depression and fatigue, particularly at four months into the treatment. However, this effect is temporary, as depression and fatigue scores resumed to normal levels by follow-up time 3.

Hypothesis II was not supported. There was no significant difference in cognitive function scores between participant groups or over time. This finding suggests that chemotherapy does not impact upon subjective cognitive function in breast cancer patients.

Hypothesis III (a) was supported. Results suggest that anxiety, depression, fatigue and cognitive function were highly correlated with each other. Hypothesis III (b) was partially supported. Anxiety was found to predict cognitive function at follow-up time 1 and follow-up time 2, whereas depression was found to predict cognitive function at follow-up time 3. Fatigue was not found to significantly predict cognitive function. A comprehensive discussion of these results is presented in Chapter Ten.

# Chapter Seven

# The Impact of Chemotherapy for Breast Cancer on Safety Outcomes in the Home and Workplace

## 7.1    Chapter Introduction

This chapter presents the results of the questionnaire data in relation to Objective Two. This considered the impact of chemotherapy for breast cancer on accident frequency in the home and workplace during and after treatment. Findings from Chapter Six suggested that the chemotherapy group experienced higher levels of depression and fatigue compared to the radiotherapy group and healthy control group. As discussed in Chapter Four, there is a wealth of literature from a number of research areas that has demonstrated an association between these variables and an increase in the frequency of accidents. To the researcher's knowledge, the experience of accidents related to psychological predictors has not currently been examined in the breast cancer patient population. Therefore, to address this current research gap, the following hypotheses are examined in this chapter:

**Hypothesis IV:** Breast cancer patients undergoing chemotherapy will report more incidences of accidents at all follow-up time-points compared to treatment and healthy controls.

**Hypothesis V (a):** Demographic, psychosocial, and cognitive function variables will be significantly associated with accident frequency in the chemotherapy group at each time-point.

**Hypothesis V (b):** Demographic, psychosocial, and cognitive function variables will predict accident frequency in the chemotherapy group at each time-point.

## 7.2    Statistical Analyses

This section briefly describes the statistical analyses employed in this chapter relevant to Objective Two.

**Hypothesis IV**

For Hypothesis IV, Chi-square tests were conducted to compare the frequency of accidents between participant groups at each time-point. The distribution of accident frequency at each time-point is also presented in histograms. Accidents occurring in the home are examined first, followed by accidents in the workplace.

**Hypothesis V (a) and (b)**

For Hypothesis V (a), Spearman's rank order correlations were performed at each time-point to examine which variables were associated with accidents in the chemotherapy group. For Hypothesis V (b), logistic regression analyses were conducted at each time-point with variables found to be significantly correlated with accidents entered as predictors.

Preliminary checks revealed that the assumptions underlying Chi-square, Spearman's rank order correlations and logistic regression were met, unless otherwise stated. An alpha level of .05 was used for all analyses, unless otherwise stated.

## 7.3    Findings from Hypothesis IV

*Breast cancer patients undergoing chemotherapy will report more incidences of accidents at all follow-up time-points compared to treatment and healthy controls.*

### 7.3.1    Frequency of Accidents in the Home

This section presents the results of the frequency of accidents experienced by participants in the home over the study period. A 3 x 5 Chi-square test for independence was conducted at each time-point. The minimum expected cell frequency assumption was violated in each analysis, since less that 80% of cells had expected frequencies of 5 or more; therefore, an exact significance test was selected for Pearson's Chi-square (Brace et al., 2009). Figure 7.1 shows the frequency of accidents in the home for each participant group at baseline (A), follow-up time 1 (B), follow-up time 2 (C), and follow-up time 3 (D).

**Baseline**

The chemotherapy group ($n = 60$), radiotherapy group ($n = 56$) and healthy control group ($n = 58$) did not significantly differ in terms of frequency of accidents at baseline, $\chi^2(6, N = 174) = 5.66$, exact $p = .47$. The majority of participants in each group reported experiencing no accidents in the home during the previous week: 42 (70.0%) breast cancer patients about to receive chemotherapy, 44 (78.6%) breast cancer patients about to receive radiotherapy, and 36 (62.1%) healthy controls (see Figure 7.1, A). Thirteen (21.7%) chemotherapy patients, 10 (17.9%) radiotherapy patients, and 16 (27.6%) healthy controls reported that they had rarely experienced accidents, while 5 (8.3%) chemotherapy patients, 2 (3.6%) radiotherapy patients, and 5 (8.6%) healthy controls reported that they had occasionally experienced accidents in the preceding week. Only 1 (1.7%) participant in the healthy control group reported having experienced accidents often, and no participants reported having accidents all the time.

**Follow-Up Time 1**

The chemotherapy group ($n = 55$), radiotherapy group ($n = 52$) and healthy control group ($n = 57$) marginally differed in their experience of frequency of accidents, $\chi^2(8, N = 164) = 14.57$, exact $p < .05$. Similar to baseline accounts, the vast majority of participants in each group reported having experienced no accidents in the previous week (see Figure 7.1, B). However, it is important to also compare subtle temporal changes within participant groups, as well as between these groups. Compared to baseline accounts, fewer breast cancer patients (now generally four months into their chemotherapy treatment) reported having experienced no accidents: only 29 (52.7%) patients, compared to 70.0% chemotherapy patients at baseline. Also, fewer radiotherapy patients, 34 (65.4%) reporting having experienced no accidents, compared to 78.6% of radiotherapy patients at baseline. In the opposite trend, there was a slight increase in the reporting of no accidents by healthy controls compared to baseline reports: now 38 (66.7%) healthy controls reported having experienced no accidents, compared to 62.1% of healthy controls at baseline. A similar proportion of participants reported rarely experiencing accidents: 11 (20.0%) chemotherapy patients, 12 (23.1%) radiotherapy patients, and 14 (24.6%) healthy controls. There was an increase in the number of chemotherapy patients and radiotherapy patients reporting that they occasionally have accidents: 9 (16.4%) chemotherapy patients and 6 (11.5%) radiotherapy patients. The same number of healthy controls reported occasionally

having accidents as baseline: 5 (8.8%). No radiotherapy patients or healthy controls reported experiencing accidents often or all the time. However, 5 (9.1%) chemotherapy patients reported experiencing accidents often and 1 (1.8%) reported such incidences all the time.

**Follow-Up Time 2**

There was no significant difference between the chemotherapy group ($n = 58$), radiotherapy group ($n = 52$) and healthy control group ($n = 58$) in the frequency of accidents reported at follow-up time 2, $\chi^2(6, N = 168) = 10.40$, exact $p = .11$. For the chemotherapy group, the trend for the number of participants reporting no accidents continued to decrease: 24 (41.4%) participants (see Figure 7.1, C). Thirty-six (69.2%) radiotherapy patients and 32 (55.2%) healthy controls reported having experienced no accidents during the previous week. Twenty-one (36.2%) chemotherapy patients reported accidents occurring rarely, compared to 13 (25.0%) radiotherapy patients, and 16 (27.6%) healthy controls. Ten (17.2%) chemotherapy patients occasionally experienced accidents, compared to only two (3.8%) radiotherapy patients and eight (13.8%) healthy controls. Three (5.2%) chemotherapy patients reported accidents often, so did one (1.9%) radiotherapy patient and two (3.4%) healthy controls. No participants reported experiencing accidents all the time.

**Follow-Up Time 3**

At follow-up time 3, there was a significant difference in frequency of accidents between the chemotherapy group ($n = 56$), radiotherapy group ($n = 48$) and healthy control group ($n = 58$), $\chi^2(6, N = 163) = 14.58$, exact $p < .05$. Compared to the previous time-point, similar numbers of radiotherapy patients and healthy controls reported never experiencing accidents: 36 (73.5%) and 31 (53.4%), respectively (see Figure 7.1, D). However, there was an increase in the number of chemotherapy patients reporting no accidents in the previous week: 28 (50.0%). Thirteen (23.2%) chemotherapy patients, 10 (22.4%) radiotherapy patients and 19 (32.8%) healthy controls reported accidents occurring rarely. A relatively large proportion of chemotherapy patients reporting experiencing accidents occasionally: 14 (25.0%), compared to 1 (2.0%) radiotherapy patient and 7 (12.1%) healthy controls. One chemotherapy patient, one radiotherapy patient and one healthy control reported often experiencing accidents: 1.8%, 2.0% and 1.7%, respectively.
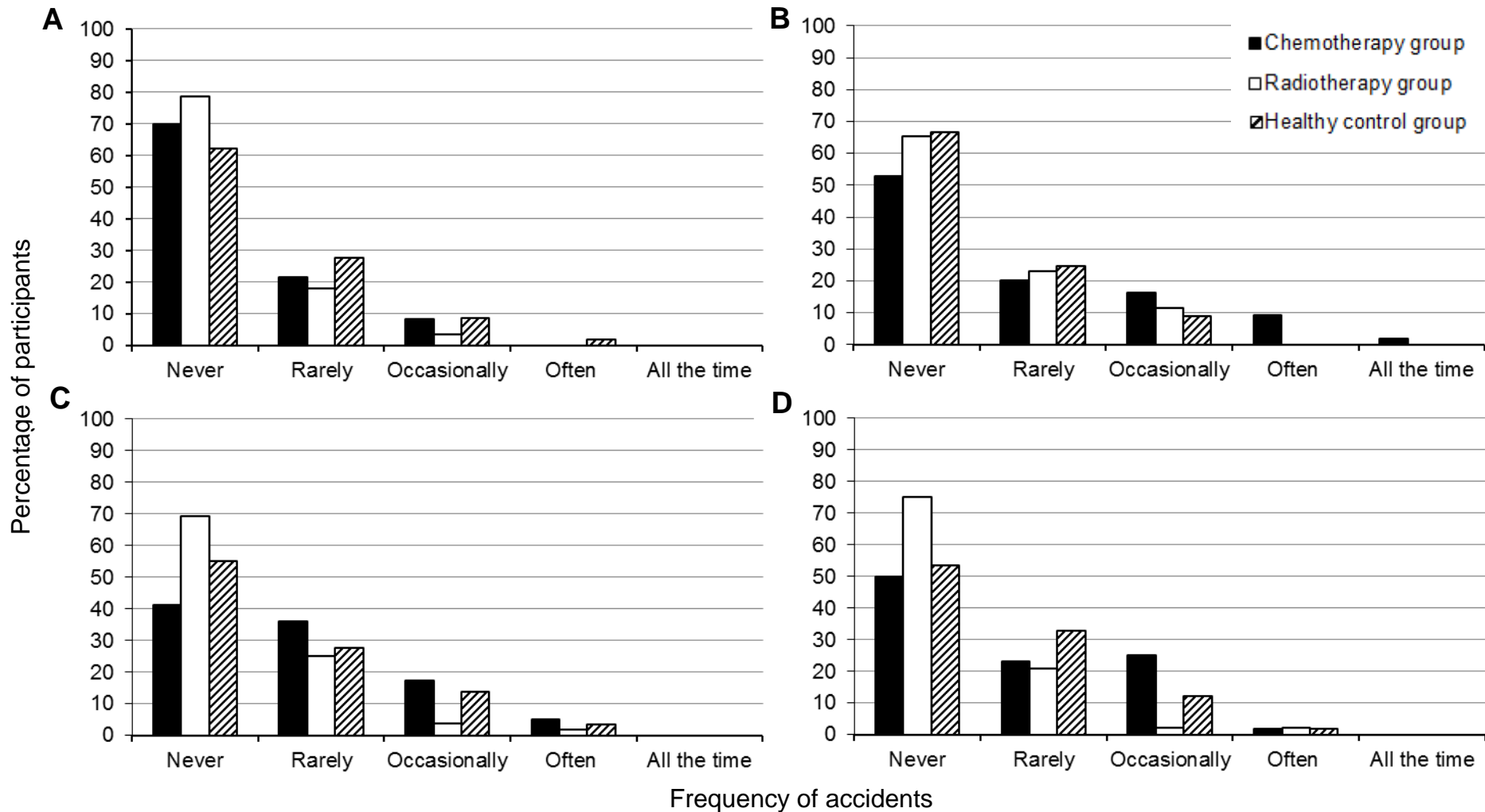
*Figure 7.1.* Frequency of accidents in the home reported (A) in the CT group (*n* = 60), RT group (*n* = 56), and HC group (*n* = 58) at pre-treatment baseline; (B) in the CT group (*n* = 55), RT group (*n* = 52), and HC group (*n* = 57) at follow-up time 1; (C) in the CT group (*n* = 58), RT group (*n* = 52), and HC group (*n* = 58) at follow-up time 2, and (D) in the CT group (*n* = 56), RT group (*n* = 48), and HC group (*n* = 58) at follow-up time 3.

### 7.3.2   Frequency of Accidents in the Workplace

This section presents the results of the frequency of accidents experienced by participants in the workplace over the study period. A 3 x 5 Chi-square test for independence was conducted at each time-point. The minimum expected cell frequency assumption was violated in each analysis, since less that 80% of cells had expected frequencies of 5 or more; therefore, an exact significance test was selected for Pearson's Chi-square. Figure 7.2 shows the frequency of accidents in the workplace for each participant group at baseline (A), follow-up time 1 (B), follow-up time 2 (C), and follow-up time 3 (D).

### Baseline

The chemotherapy group ($n = 14$), radiotherapy group ($n = 15$) and healthy control group ($n = 44$) did not differ in terms of frequency of accidents at baseline, $\chi^2(4, N = 73) = 5.13$, exact $p = .25$. The majority of participants in each group reported experiencing no accidents in the workplace during the previous week: 10 (71.4%) breast cancer patients about to receive chemotherapy, 15 (100.0%) breast cancer patients about to receive radiotherapy, and 38 (86.4%) healthy controls (see Figure 7.2, A). Three (21.4%) chemotherapy patients and four (9.1%) healthy controls reported that they had rarely experienced accidents. One (7.1%) chemotherapy patients, two (4.5%) healthy controls reported that they had occasionally experienced accidents in the preceding week. There were no reports in any participant group of experiencing accidents often or all the time while at work.

### Follow-Up Time 1

At follow-up time 1, the chemotherapy group ($n = 12$), radiotherapy group ($n = 20$) and healthy control group ($n = 44$) did not differ in frequency of accidents, $\chi^2(4, N = 76) = 3.4$, exact $p = .52$. Similar to baseline accounts, the vast majority of participants in each group reported having experienced no accidents in the previous week (see Figure 7.2, B). Nine (75.0%) breast cancer patients in the chemotherapy group reported (now four months into their chemotherapy treatment) reported no accidents, as did 19 (95.0%) radiotherapy patients and 37 (84.11%) healthy controls. Only three (25%) chemotherapy patients, one (5.0%) radiotherapy patient and six (13.6%) healthy controls reported having experienced accidents rarely in the workplace. None of the chemotherapy or radiotherapy patients and only one

(2.3%) healthy control reported accidents occasionally in the workplace. There were no reports of accidents occurring more frequently than this.

## Follow-Up Time 2

There was no difference between the chemotherapy group ($n = 29$), radiotherapy group ($n = 17$) and healthy control group ($n = 44$) in the reported frequency of accidents at follow-up time 2, $\chi^2(4, N = 90) = 0.59$, exact $p = 1.00$. In fact, the distribution of accidents across participant groups was remarkably similar. Twenty-two (75.9%) chemotherapy patients, 13 (76.5%) radiotherapy patients and 35 (79.5%) healthy controls reported never having experienced accidents in the workplace during the previous week. There were six (20.7%) chemotherapy patients, three (17.6%) radiotherapy patients and eight (18.2%) healthy controls that reported rarely experiencing accidents rarely in the previous week. Finally, just one participant in each group (chemotherapy, 3.4%; radiotherapy, 5.9%; healthy control, 2.3%) experienced accidents occasionally. Again, there were no accounts of experiencing accidents often or all the time in the workplace.

## Follow-Up Time 3

At follow-up time 3, there was no significant difference in the frequency of accidents between the chemotherapy group ($n = 34$), radiotherapy group ($n = 14$) and healthy control group ($n = 40$), $\chi^2(4, N = 88) = 5.00$, exact $p = .28$. The majority of chemotherapy patients ($n = 27$; 79.4%), radiotherapy patients ($n = 13$; 92.9%), and healthy controls ($n = 26$; 65.0%) reported experiencing no accidents in the workplace during the previous week. Five (14.7%) chemotherapy patients, one (7.1%) radiotherapy patient and ten (25.0%) healthy controls reported experiencing accidents rarely. Only two (5.9%) chemotherapy patients and four (10.0%) healthy controls reported accidents occasionally in the workplace. Similar to previous time-points, there were no accounts of experiencing accidents often or all the time in the workplace.
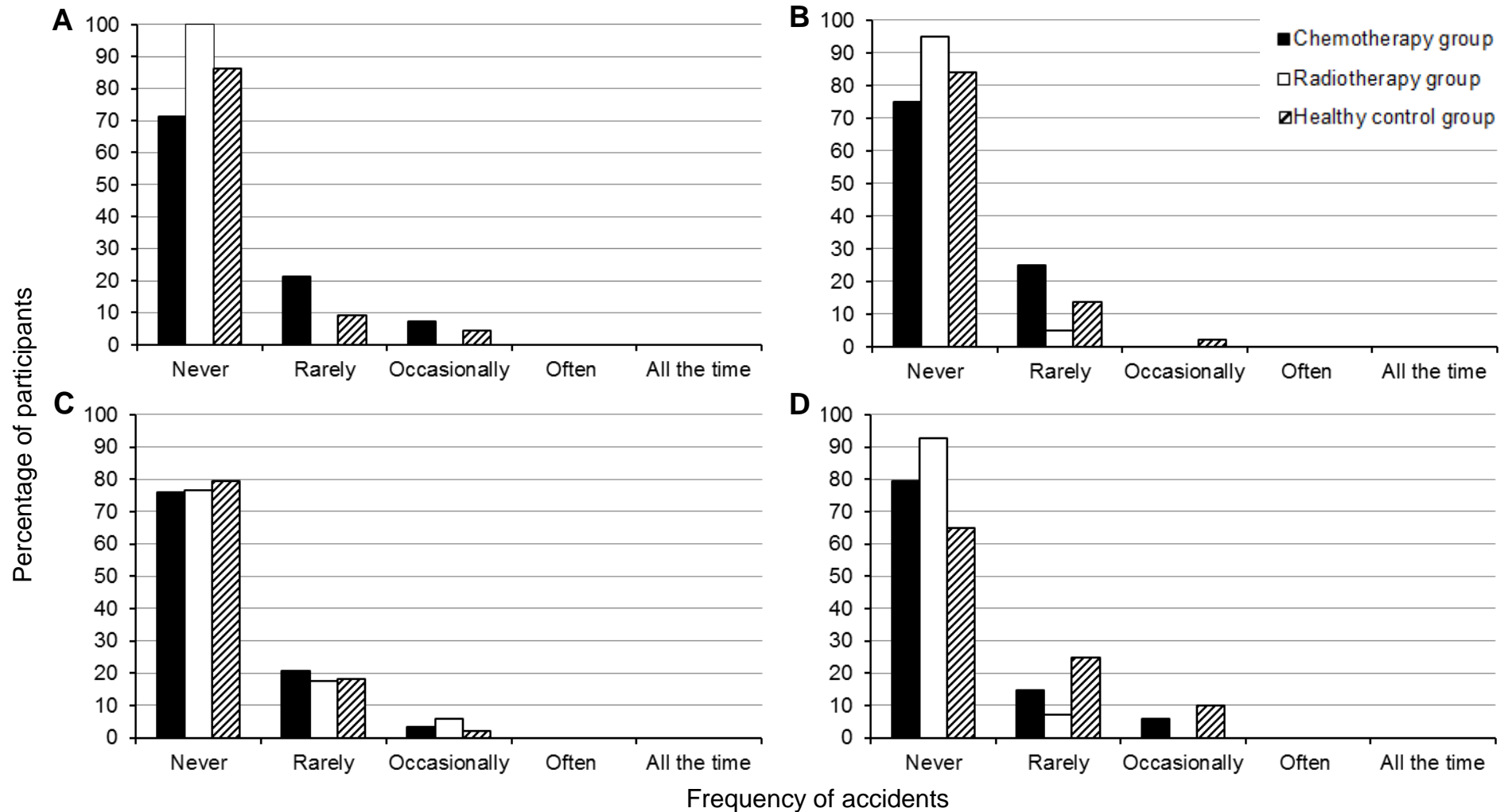
*Figure 7.2.* Frequency of accidents in the workplace reported (A) in the CT group (*n* = 14), RT group (*n* = 15), and HC group (*n* = 44) at pre-treatment baseline; (B) in the CT group (*n* = 12), RT group (*n* = 20), and HC group (*n* = 44) at follow-up time 1; (C) in the CT group (*n* = 29), RT group (*n* = 17), and HC group (*n* = 44) at follow-up time 2, and (D) in the CT group (*n* = 34), RT group (*n* = 14), and HC group (*n* = 40) at follow-up time 3.

### 7.3.3  Section Summary

Hypothesis IV was partially supported. Findings suggested that at baseline, chemotherapy patients, radiotherapy patients and healthy controls reported similar levels of accidents in the home. However, at follow-up time 1, chemotherapy patients encountered accidents more frequently. At follow-up time 2, differences in accident frequency between the groups subsided, but at follow-up time 3, chemotherapy patients once again reported more accidents compared to the two control groups. In contrast, all participant groups reported similar levels of accidents in the workplace at each time-point.

## 7.4  Findings from Hypothesis V (a)

***Demographic, psychosocial, and cognitive function variables will be significantly associated with accident frequency in the chemotherapy group at each time-point.***

To identify the best predictors of accidents in the chemotherapy group, a series of correlational analyses and logistic regressions were conducted at each time-point. Chapter Four provided evidence for a number of variables shown to predict the risk of accidents, including age, anxiety, depression, fatigue and cognitive function. First, correlations were conducted at each time point to identify which of these variables were significantly associated with accident frequency. Only those significantly correlated were included in the regression models. As shown in Figure 7.1, the vast majority of participants experienced accidents rarely or never, and relatively few participants reporting accidents occasionally, often or all the time. Therefore, accident frequency was re-coded to binary format, so that *never* and *rarely* were grouped (recoded = 0) and *occasionally*, *often* and *all the time* were grouped (recoded = 1). Due to the small number of participants in the chemotherapy group at work (many took sickness absence), there were very few reports of accidents for these categories; therefore, regressions for predictors of accidents in the workplace were not conducted.

**Correlations with Accident Frequency at Baseline**

As Table 7.1 below shows, accident frequency scores were significantly correlated with depression ($r_s = 0.27$, $p < .05$) and cognitive function ($r_s = 0.27$, $p < .05$).

Table 7.1
*Correlations Between Demographic Variables, Psychosocial Variables, Cognitive Function and Accident Frequency in the Chemotherapy Group (n = 60) at Baseline*

| Variable | Age | Education | Anxiety | Depression | Fatigue | Cognitive function |
|---|---|---|---|---|---|---|
| Accident frequency | -0.15 | -0.14 | 0.06 | **0.27*** | -0.08 | **0.27*** |

$*p < .05.$

## Correlations with Accident Frequency at Follow-Up Time 1

As Table 7.2 below shows, accident frequency scores were significantly correlated with fatigue ($r_s = -0.30$, $p < .05$) and cognitive function ($r_s = 0.42$, $p < .01$).

Table 7.2
*Correlations Between Demographic Variables, Psychosocial Variables, Cognitive Function and Accident Frequency in the Chemotherapy Group (n = 55) at Follow-Up Time 1*

| Variable | Age | Education | Anxiety | Depression | Fatigue | Cognitive function |
|---|---|---|---|---|---|---|
| Accidents | 0.06 | -0.19 | 0.12 | 0.22 | **-0.30*** | **0.42\*\*** |

$*p < .05. ** p < .01.$

## Correlations with Accident Frequency at Follow-Up Time 2

As Table 7.3 below shows, accident frequency scores were significantly correlated with anxiety ($r_s = 0.26$, $p < .05$), depression ($r_s = 0.38$, $p < .01$), fatigue ($r_s = -0.39$, $p < .01$), and cognitive function ($r_s = 0.30$, $p < .05$).

Table 7.3
*Correlations Between Demographic Variables, Psychosocial Variables, Cognitive Function and Accident Frequency in the Chemotherapy Group (n = 58) at Follow-Up Time 2*

| Variable | Age | Education | Anxiety | Depression | Fatigue | Cognitive function |
|---|---|---|---|---|---|---|
| Accidents | -0.03 | -0.08 | **0.26*** | **0.38\*\*** | **-0.39\*\*** | **0.30*** |

$*p < .05. ** p < .01.$

## Correlations with Accident Frequency at Follow-Up Time 3

As Table 7.4 below shows, accident frequency scores were significantly correlated with anxiety ($r_s = 0.32$, $p < .05$) and cognitive function ($r_s = 0.41$, $p < .01$).

Table 7.4

*Correlations Between Demographic Variables, Psychosocial Variables, Cognitive Function and Accident Frequency in the Chemotherapy Group (n = 56) at Follow-Up Time 3*

| Variable | Age | Education | Anxiety | Depression | Fatigue | Cognitive function |
|----------|-----|-----------|---------|------------|---------|--------------------|
| Accidents | -0.20 | -0.07 | **0.32*** | 0.24 | -0.22 | **0.41**** |

*$p < .05$. ** $p < .01$.

### 7.4.1    Section Summary

In summary, since not all variables were found to be significantly correlated with accident frequency, Hypothesis V (a) was partially supported. At baseline, increased levels of depression and cognitive difficulties were significantly associated with increased accident frequency. At follow-up time 1, increased levels of fatigue and cognitive difficulties were significantly correlated with increased accident frequency. At follow-up time 2, increased levels of anxiety, depression, fatigue and cognitive difficulties were related to increased accident frequency. At follow-up time 3, increased levels of anxiety and cognitive difficulties were correlated with increased accident frequency.

## 7.5    Findings from Hypothesis V (b)

*Demographic, psychosocial, and cognitive function variables will predict accident frequency in the chemotherapy group at each time-point.*

Standard logistic regression analyses were conducted at each time-point to identify significant predictors for accident frequency in the home in the chemotherapy group. Variables found to be significantly correlated with accident frequency in Hypothesis V (a) were entered as predictor variables in the regression model.

**Predictors of Accidents at Baseline**

A logistic regression analysis was conducted with frequency of accidents as the DV and depression and cognitive function as predictor variables (see Table 7.5 below). The full model did not significantly predict accident frequency, $\chi^2(2, N = 60) = 5.20$, $p = .07$.

The model accounted for between 8.3% (Cox and Snell R square) and 19.0% (Nagelkerke R square) of the variance in accident frequency. Overall, the model accurately classified 91.7% of cases. As the table shows, neither depression nor cognitive function made a statistically significant contribution to the model.

Table 7.5
*Logistic Regression Model Predicting Accident Frequency at Baseline (n = 60)*

| Predictor | *B* | SE | Odds Ratio (95% CI) |
|---|---|---|---|
| Depression | 0.08 | 0.15 | 1.09 (0.81, 1.46) |
| Cognitive function | 0.07 | 0.05 | 1.07 (0.98, 1.17) |
| Constant | -5.60 | 1.87 | |

## Predictors of Accidents at Follow-Up Time 1

Table 7.6 below shows the results from the logistic regression for the chemotherapy group follow-up time 1. The full model was statistically significantly at predicting accident frequency, $\chi^2(2, N = 55) = 12.31$, $p = .002$. The model accounted for between 20.1% (Cox and Snell R square) and 29.1% (Nagelkerke R square) of the variance in accident frequency. Overall, the model accurately classified 81.8% of cases. Cognitive function made a statistically significant contribution to the model.

Table 7.6
*Logistic Regression Model Predicting Accident Frequency at Follow-Up Time 1 (n = 55)*

| Predictor | *B* | SE | Odds Ratio (95% CI) |
|---|---|---|---|
| Fatigue | -0.03 | 0.03 | 0.97 (0.91, 1.03) |
| Cognitive function | **0.07** | **0.03** | **1.07 (1.01, 1.13)** |
| Constant | -2.96 | 1.69 | |

## Predictors of Accidents at Follow-Up Time 2

Table 7.7 below shows the results from the logistic regression for the chemotherapy group follow-up time 2. The full model was statistically significantly at predicting accident frequency, $\chi^2(4, N = 58) = 10.88$, $p = .028$. The model accounted for between 17.1% (Cox and Snell R square) and 26.1% (Nagelkerke R square) of the variance in

accident frequency. Overall, the model accurately classified 81.0% of cases. None of the selected predictors made a statistically significant contribution to the model.

Table 7.7
*Logistic Regression Model Predicting Accident Frequency at Follow-Up Time 2 (n = 58)*

| Predictor | B | SE | Odds Ratio (95% CI) |
|---|---|---|---|
| Anxiety | -0.12 | 0.14 | 0.89 (0.68, 1.17) |
| Depression | 0.17 | 0.18 | 1.18 (0.83, 1.68) |
| Fatigue | -0.03 | 0.05 | 0.97 (0.88, 1.08) |
| Cognitive function | 0.03 | 0.03 | 1.04 (0.97, 1.10) |
| Constant | -2.03 | 2.73 | |

**Predictors of Accidents at Follow-Up Time 3**

Table 7.8 below shows the results from the logistic regression for the radiotherapy group follow-up time 3. The full model was statistically significantly at predicting accident frequency, $\chi^2(2, N = 56) = 9.59$, $p = .008$. The model accounted for between 15.7% (Cox and Snell R square) and 22.9% (Nagelkerke R square) of the variance in accident frequency. Overall, the model accurately classified 73.2% of cases. None of the selected predictors made a statistically significant contribution to the model.

Table 7.8
*Logistic Regression Model Predicting Accident Frequency at Follow-Up Time 3 (n = 56)*

| Predictor | B | SE | Odds Ratio (95% CI) |
|---|---|---|---|
| Anxiety | 0.06 | 0.10 | 1.06 (0.88, 1.28) |
| Cognitive function | 0.04 | 0.02 | 1.04 (1.00, 1.09) |
| Constant | -3.15 | 0.88 | |

**7.5.1   Section Summary**

In summary, only cognitive function was found to be a significant predictor of accident frequency at follow-up time 1. There were no other significant predictors of accident frequency at other time-points. Therefore, this finding partially supports Hypothesis V (b).

## 7.6    Chapter Summary

This chapter presented the results of the second objective, which examined the impact of chemotherapy for breast cancer on accident frequency in the home and workplace during and shortly after treatment. The Chi-square tests relating to Hypothesis IV revealed significant differences in the distribution of accident frequency between participant groups at follow-up time 1 and follow-up time 3. The histograms suggested that the chemotherapy group experienced accidents more frequently compared to the radiotherapy group and healthy control group at these time-points. Findings from Hypothesis V (a) suggested that cognitive function was significantly and consistently correlated with accident frequency at each time-point. At baseline depression was also found to be significantly associated with accident frequency; at follow-up time 1 fatigue was also significantly associated with accident frequency; at follow-up time 2 anxiety, depression and fatigue were also significantly correlated with accident frequency, and at follow-up time 3 anxiety was also significantly associated with accident frequency. However, findings from Hypothesis V (b) suggested that despite these significant associations, only cognitive function was found to be a significant predictor of accident frequency and only at follow-up time 1. A discussion of these results is presented in Chapter Ten.

# Chapter Eight

# The Impact of Chemotherapy for Breast Cancer on Quality of Life and Work Ability

## 8.1    Chapter Introduction

This chapter presents the results of the questionnaire data in relation to Objective Three. This considered the impact of chemotherapy for breast cancer on quality of life and work ability during and shortly after treatment. Findings from the previous results chapters suggested that the chemotherapy group reported higher levels of depression and fatigue compared to the radiotherapy group and healthy control group (Chapter Six) and experienced a slightly higher frequency of accidents in the home compared to the radiotherapy group and healthy control group at follow-up time 1 and follow-up time 3 (Chapter Seven). The psycho-oncology literature has found that although treatment side effects are generally subtle and improve following treatment cessation, they can still have a profound impact on quality of life and affect daily functioning in the home and workplace (Vardy, 2009). Therefore, the following hypotheses are examined in this chapter:

**Hypothesis VI:** There will be significant differences in quality of life scores between the chemotherapy group, radiotherapy group and healthy control group, and over time.

**Hypothesis VII (a):** Anxiety, depression, fatigue, cognitive function and frequency of accidents will be significantly associated with quality of life in the chemotherapy group at each time-point.

**Hypothesis VII (b):** Anxiety, depression, fatigue, cognitive function and frequency of accidents will predict quality of life scores in the chemotherapy group at each time-point.

**Hypothesis VIII:** There will be significant differences in work ability scores between the chemotherapy group, radiotherapy group and healthy control group, and over time.

**Hypothesis IX (a):** Demographic, psychosocial, cognitive function and accident frequency variables will be significantly correlated with work ability scores in the chemotherapy group at each time-point.

**Hypothesis IX (b):** Demographic, psychosocial, cognitive function and accident frequency variables will predict work ability scores in the chemotherapy group at each time-point.

## 8.2    Statistical Analyses

This section briefly describes the statistical analyses employed in this chapter relevant to Objective Three.

**Hypothesis VI**

For Hypothesis VI, a 3 x 3 mixed ANCOVA with participant group (chemotherapy, radiotherapy, healthy control group) as the between-subjects factor and time (follow-up time 1, follow-up time 2, follow-up time 3) as the within-subjects factor, with baseline quality of life measure as a covariate, was conducted. In addition, a 3 x 3 x 3 mixed ANCOVA with education (none, high school, university) as an additional between-subjects factor was conducted.

**Hypothesis VII (a) and (b)**

For Hypothesis VII (a), associations between variables were calculated using Pearson's product moment correlations at each time-point. For Hypothesis VII (b), standard multiple regressions were conducted to examine the ability of anxiety, depression, fatigue, cognitive function and accident frequency at home to predict quality of life. Where demographic variables were significantly correlated with quality of life, hierarchical multiple regressions were conducted with these covariates entered at Step 1.

**Hypothesis VIII**

For Hypothesis VIII, a 3 x 3 mixed ANCOVA with participant group (chemotherapy, radiotherapy, healthy control group) as the between-subjects factor and time (follow-up

time 1, follow-up time 2, follow-up time 3) as the within-subjects factor, with baseline work ability measure as a covariate was conducted. Further adjustment was made to the model with age as an additional covariate. In order to compare the physical work ability and mental work ability scores between participant groups, a 2 x 3 Chi-square test for independence was conducted at each time-point.

**Hypothesis IX (a) and (b)**

For Hypothesis IX (a), associations between variables were calculated using Pearson's product moment correlations at each time-point. For Hypothesis IX (b), standard multiple regressions were conducted to examine the ability of anxiety, depression, fatigue, cognitive function and accident frequency in the work place to predict work ability. Where demographic variables were significantly correlated with work ability, hierarchical multiple regressions were conducted with these covariates entered at Step 1.

Preliminary checks revealed that the assumptions underlying ANCOVA, Chi-square, Pearson's product moment correlations and regressions were met, unless otherwise stated. An alpha level of .05 was used for all analyses, unless otherwise stated.

## 8.3    Findings from Hypothesis VI

*There will be differences in quality of life between breast cancer patients undergoing chemotherapy and the treatment and healthy control groups over time.*

Hypothesis VI compared differences in quality of life scores over time and between participant groups. Since significant differences in age and education exist between the participant groups, correlations were conducted between these demographic variables and overall quality of life for each participant group (see Table 8.1 below). A significant correlation at $p < .05$ was taken to suggest that the demographic variable may have an effect on the DV and therefore should be addressed in further analyses.

Table 8.1

*Correlations Between Demographic Variables and Quality of Life in the Chemotherapy Group*
*(n = 58), Radiotherapy Group (n = 56) and Healthy Control Group (n = 58) at Baseline*

| Variable | Chemotherapy | Radiotherapy[a] | Healthy |
|---|---|---|---|
| | Quality of life | Quality of life | Quality of life |
| Age | -0.01 | 0.14 | -0.08 |
| Education | **0.36\*** | -0.09 | 0.02 |

*Note.* Pearson's product moment correlation performed on age; Spearman's rank order
correlation performed on education.
[a]Radiotherapy group, $n = 55$, due to missing education data.
\**p* < .01.

Table 8.1 shows that age was not significantly correlated with the baseline measure of
quality of life in any participant group and was therefore not included as a covariate in
further analyses. Education was found to be significantly associated with quality of life
in the chemotherapy group and was therefore controlled for in further analyses.

Table 8.2 below presents the results of the 3 x 3 mixed ANCOVA with participant
group (chemotherapy, radiotherapy, healthy control group) as the between-subjects
factor and time (follow-up time 1, follow-up time 2, follow-up time 3) as the within-
subjects factor, with baseline quality of life measure as a covariate. Further analyses
were conducted using a 3 x 3 x 3 mixed ANCOVA with education (none, high school,
university) as an additional between-subjects factor to filter out its effect on the
relationship between participant group and the DV. To correct for the violation of
sphericity, values for the Greenhouse-Geisser Epsilon are reported for both the two-way
and three-way ANCOVAs.

The two-way mixed ANCOVA showed that there was a significant interaction between
time and participant group, $F(3.62, 262.63) = 3.55$, $p = .010$, $\eta_p^2 = .05$. The main effect
for time was not significant, $F(1.81, 262.63) = 0.51$, $p = .582$, $\eta_p^2 < .01$. The main effect
for participant group was significant, $F(2, 145) = 6.49$, $p = .002$, $\eta_p^2 = .08$. Post-hoc
comparisons showed a significant difference in quality of life scores between the
chemotherapy group and radiotherapy group ($p = .001$) and a near significant difference
with the healthy control group ($p = .065$), suggesting that the chemotherapy group
experienced poorer quality of life compared to these groups. There was no significant

difference in quality of life scores between the radiotherapy group and healthy control group ($p = .488$).

The three-way mixed ANCOVA, with additional adjustment for education, showed that there was a significant interaction between time and participant group, $F(3.62, 249.83) = 2.52$, $p = .042$, $\eta_p^2 = .04$ (see Figure 8.1; higher scores indicate better quality of life). The main effect for time was not significant, $F(1.81, 249.83) = 0.43$, $p = .631$, $\eta_p^2 < .01$. The main effect for participant group was significant, $F(2, 138) = 5.98$, $p = .003$, $\eta_p^2 = .08$. Post-hoc comparisons showed a significant difference in quality of life scores between the chemotherapy group and radiotherapy group ($p = .002$). No significant differences were revealed between the chemotherapy group and healthy control group ($p = .642$), or between the radiotherapy group and healthy control group ($p = .620$).

As shown in Figure 8.1 below, the chemotherapy group reported lower scores on the FACT-G, indicating poor quality of life scores compared to the radiotherapy group and healthy control group. At follow-up time 1, quality of life scores improved, and continued to increase at follow-up time 2. In the healthy control group, quality of life scores also increased between follow-up time 1 and follow-up time 2; however, they decreased at follow-up time 3. In contrast, quality of life scores remained relatively stable over time in the radiotherapy group.
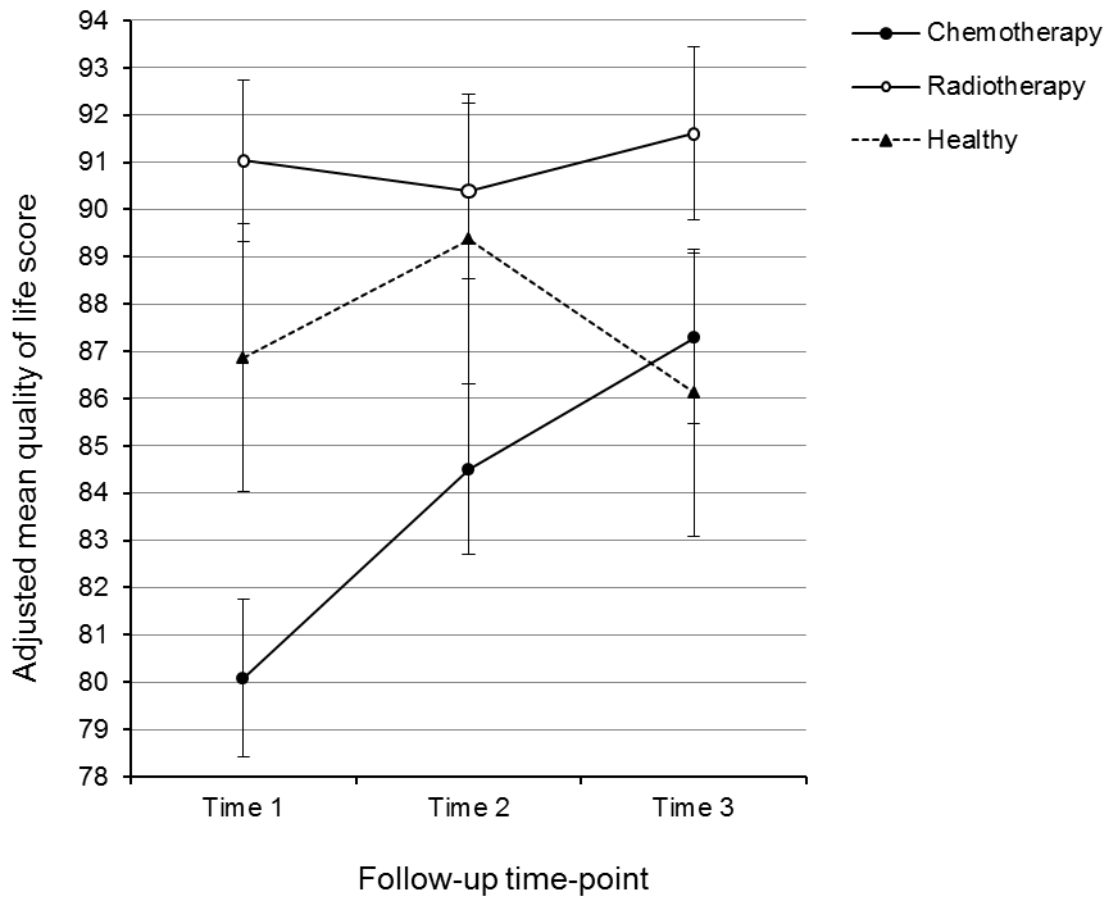
*Figure 8.1.* Adjusted mean quality of life scores (+ *SE*) for the chemotherapy, radiotherapy and healthy control groups at each follow-up time-point.

Table 8.2

*Mixed ANOVA Results for Quality of Life for the Chemotherapy Group (n = 48), Radiotherapy Group (n = 46) and Healthy Control Group (n = 55)*

| Type of analysis | Participant group | Follow-up Time 1 | | Follow-up Time 2 | | Follow-up Time 3 | | Factor | $F$ | $p$ | $\eta_p^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *M* | *SE* | *M* | *SE* | *M* | *SE* | | | | |
| Two-way mixed ANCOVA | Chemotherapy | 80.11 | 1.58 | 84.66 | 1.70 | 87.30 | 1.68 | Time | 0.51 | .582 | <.01 |
| | Radiotherapy | 90.94 | 1.59 | 90.19 | 1.71 | 91.40 | 1.69 | Group | 6.49 | **.002** | .08 |
| | Healthy | 87.77 | 1.45 | 89.58 | 1.57 | 87.53 | 1.55 | Time x Group | 3.55 | **.010** | .05 |
| Three-way mixed ANCOVA | Chemotherapy | 80.08 | 1.67 | 84.50 | 1.81 | 87.28 | 1.80 | Time | 0.43 | .631 | <.01 |
| | Radiotherapy[a] | 91.03 | 1.71 | 90.39 | 1.85 | 91.60 | 1.83 | Group | 5.98 | **.003** | .08 |
| | Healthy | 86.86 | 2.84 | 89.37 | 3.07 | 86.12 | 3.04 | Time x Group | 2.52 | **.048** | .04 |

*Note.* Greenhouse-Geisser reported due to violation of sphericity.

[a]Data missing for one participant due to missing education data.

### 8.3.1   Section Summary

In summary, Hypothesis VI was partially supported. The chemotherapy group reported poorer quality of life scores compared to the radiotherapy group, but scores were not significantly different to those reported in the healthy control group. At follow-up time 1, quality of life scores in the chemotherapy were relatively poor but improved over time to scores more similar to those found in the radiotherapy group and healthy control group.

## 8.4   Findings from Hypothesis VII (a)

***Anxiety, depression, fatigue, cognitive function and frequency of accidents will be significantly associated with quality of life in the chemotherapy group at each time-point.***

A number of studies have found significant associations between psychosocial variables and self-perceived cognitive difficulties with quality of life (e.g. Mehnert et al., 2007). However, to date, the relationship between accident frequency and quality of life has not been considered in the breast cancer population. Therefore, correlations were conducted to examine the relationship between demographic, psychosocial, cognitive and accident variables with quality of life in the chemotherapy group at baseline, follow-up time 1, follow-up time 2 and follow-up time 3 (see Tables 8.3 to 8.6 below).

**Correlations with Quality of Life at Baseline**

As Table 8.3 below shows, quality of life scores in the chemotherapy group were significantly correlated with education, anxiety, depression, fatigue, cognitive function and accident frequency in the home at baseline.

Table 8.3
*Correlations Between Psychosocial Variables, Cognitive Function, Accident Frequency and Quality of Life in the Chemotherapy Group (n = 58) at Baseline*

| Variable | Quality of life |
|---|---|
| Age | -0.01 |
| Education | **0.36\*\*** |
| Anxiety | **-0.75\*\*** |
| Depression | **-0.84\*\*** |
| Fatigue | **0.72\*\*** |
| Cognitive function | **-0.39\*\*** |
| Accidents (home) | **-0.50\*\*** |

*p < .05. ** p < .01.

## Correlations with Quality of Life at Follow-Up Time 1

As Table 8.4 below shows, quality of life scores in the chemotherapy group were significantly correlated with anxiety, depression, fatigue, cognitive function and accident frequency in the home at follow-up time 1.

Table 8.4
*Correlations Between Psychosocial Variables, Cognitive Function, Accident Frequency and Quality of Life in the Chemotherapy Group (n = 53) at Follow-Up Time 1*

| Variable | Quality of life |
|---|---|
| Age | 0.12 |
| Education | 0.25 |
| Anxiety | **-0.67\*\*** |
| Depression | **-0.71\*\*** |
| Fatigue | **0.67\*\*** |
| Cognitive function | **-0.50\*\*** |
| Accidents (home) | **-0.28\*** |

*p < .05. ** p < .01.

## Correlations with Quality of Life at Follow-Up Time 2

As Table 8.5 below shows, quality of life scores in the chemotherapy group were significantly correlated with education, anxiety, depression, fatigue, cognitive function and accident frequency in the home at follow-up time 2.

Table 8.5
*Correlations Between Psychosocial Variables, Cognitive Function, Accident Frequency and Quality of Life in the Chemotherapy Group (n = 57) at Follow-Up Time 2*

| Variable | Quality of life |
| --- | --- |
| Age | 0.14 |
| Education | **0.32*** |
| Anxiety | **-0.83**** |
| Depression | **-0.87**** |
| Fatigue | **0.87**** |
| Cognitive function | **-0.71**** |
| Accidents (home)[a] | **-0.45**** |

[a]Missing data for one participant.
*$p < .05$. ** $p < .01$.

## Correlations with Quality of Life at Follow-Up Time 3

As Table 8.6 below shows, quality of life scores in the chemotherapy group were significantly correlated with education, anxiety, depression, fatigue, cognitive function and accident frequency at follow-up time 3.

Table 8.6
*Correlations Between Psychosocial Variables, Cognitive Function, Accident Frequency and Quality of Life in the Chemotherapy Group (n = 55) at Follow-Up Time 3*

| Variable | Quality of life |
| --- | --- |
| Age | 0.08 |
| Education | **0.29*** |
| Anxiety | **-0.76**** |
| Depression | **-0.89**** |
| Fatigue | **0.79**** |
| Cognitive function | **-0.67**** |
| Accidents (home)[a] | **-0.37**** |

[a]Missing data for one participant.
*$p < .05$. ** $p < .01$.

### 8.4.1   Section Summary

In summary, anxiety, depression, fatigue, cognitive function and accident frequency in the home were significantly correlated with quality of life in the chemotherapy group at each time-point. Increased levels of anxiety, depression, fatigue, cognitive difficulties and accident frequency were associated with poorer quality of life. Education was also

significantly associated with quality of life at baseline, follow-up time 2 and follow-up time 3. This finding supports Hypothesis VII (a).

## 8.5    Findings from Hypothesis VII (b)

*Anxiety, depression, fatigue, cognitive function and frequency of accidents will predict quality of life scores in the chemotherapy group at each time-point.*

**Regressions at Baseline**

Hierarchical regression was used to assess the ability of anxiety, depression, fatigue, cognitive function and accident frequency to predict quality of life after controlling for education (see Table 8.7). Education was entered at Step 1 and explained 8% of the variance in quality of life scores. Anxiety, depression, fatigue, cognitive function and accident frequency were entered at Step 2 and the total variance explained by the model as a whole was 75%, $F$ (6, 51) = 29.39, $p < .001$. Anxiety, depression, fatigue, cognitive function and accident frequency explained an additional 69% of the variance in quality of life, after controlling for education, $R^2$ change = .69, $F$ change (5, 51) = 31.56, $p < .001$. In the final model, anxiety ($\beta = -.29$, $t = -2.55$, $p < .05$), depression ($\beta = -.45$, $t = -3.33$, $p < .005$) and fatigue ($\beta = .30$, $t = 3.02$, $p < .005$) were statistically significant.

Table 8.7

*Hierarchical Regression Analysis for Anxiety, Depression, Fatigue, Cognitive Function and Accident Frequency Predicting Quality of Life in the Chemotherapy Group at Baseline (n = 58)*

| Variable | *B* | *SE B* | B |
|---|---|---|---|
| Step 1 | | | |
| Constant | 77.39 | 3.91 | |
| Education | 6.55 | 2.94 | **.29*** |
| Step 2 | | | |
| Constant | 74.82 | 9.27 | |
| Education | -0.56 | 1.68 | -.03 |
| Anxiety | -1.07 | 0.42 | **-.29*** |
| Depression | -2.15 | 0.65 | **-.45**** |
| Fatigue | 0.53 | 0.18 | **.30**** |
| Cognitive function | 0.15 | 0.10 | .13 |
| Accident frequency | -5.69 | 4.25 | -.10 |

*Note.* $R^2$ = .08 for Step 1 ($p < .05$), $\Delta R^2$ = .75 for Step 2 ($p < .001$).
*$p < .05$. **$p < .005$.

## Regressions at Follow-Up Time 1

Standard multiple regression was used to assess the ability of anxiety, depression, fatigue, cognitive function and accident frequency to predict quality of life (see Table 8.8 below). These predictors explained a significant proportion of the variance in quality of life scores at follow-up time 1, adjusted $R^2$ = .60, $F (5, 47) = 16.88$, $p < .001$. Anxiety ($\beta = -.33$, $t = -2.68$, $p = .01$) and fatigue ($\beta = .33$, $t = 2.54$, $p < .05$) were statistically significant.

Table 8.8
*Standard Multiple Regression Analysis for Anxiety, Depression, Fatigue, Cognitive Function and Accident Frequency Predicting Quality of Life in the Chemotherapy Group at Follow-Up Time 1 (n = 53)*

| Variable | *B* | *SE B* | B |
|---|---|---|---|
| Constant | 80.76 | 8.77 | |
| Anxiety | -1.28 | 0.48 | **-.33**** |
| Depression | -0.79 | 0.58 | -.21 |
| Fatigue | 0.45 | 0.18 | **.33*** |
| Cognitive function | -0.12 | 0.11 | -.12 |
| Frequency of accidents | 1.28 | 3.73 | .03 |

*Note.* $R^2 = .64$, $\Delta R^2 = .60$ ($p < .001$).
*$p < .05$. ** $p = .01$.

## Regressions at Follow-Up Time 2

Hierarchical regression was used to assess the ability of anxiety, depression, fatigue, cognitive function and accident frequency to predict quality of life after controlling for education (see Table 8.9 below). Education was entered at Step 1 and explained 11% of the variance in quality of life scores. Anxiety, depression, fatigue, cognitive function and accident frequency were entered at Step 2 and the total variance explained by the model as a whole was 83%, $F (6, 49) = 46.20$, $p < .001$. Anxiety, depression, fatigue, cognitive function and accident frequency explained an additional 74% of the variance in work ability, after controlling for age, $R^2$ change $= .74$, $F$ change $(5, 49) = 48.55$, $p < .001$. In the final model anxiety ($\beta = -.30$, $t = -2.93$, $p = .005$) and fatigue ($\beta = .42$, $t = 3.51$, $p = .001$) were statistically significant.

Table 8.9

*Hierarchical Regression Analysis for Anxiety, Depression, Fatigue, Cognitive Function and Accident Frequency Predicting Quality of Life in the Chemotherapy Group at Follow-Up Time 2 (n = 57)*

| Variable | *B* | *SE B* | B |
|---|---|---|---|
| Step 1 | | | |
| Constant | 69.09 | 4.72 | |
| Education | 8.97 | 3.55 | **.33*** |
| Step 2 | | | |
| Constant | 75.02 | 9.43 | |
| Education | -0.34 | 1.67 | -.01 |
| Anxiety | -1.22 | 0.42 | **-.30**** |
| Depression | -0.82 | 0.60 | -.19 |
| Fatigue | 0.63 | 0.18 | **.43***** |
| Cognitive function | -0.10 | 0.09 | -.09 |
| Accident frequency | -1.39 | 2.82 | -.03 |

*Note.* $R^2 = .11$ for Step 1 ($p < .05$), $\Delta R^2 = .83$ for Step 2 ($p < .001$).
*$p < .05$. **$p = .005$. ***$p = .001$.

## Regressions at Follow-Up Time 3

Hierarchical regression was used to assess the ability of anxiety, depression, fatigue, cognitive function and accident frequency to predict quality of life after controlling for education (see Table 8.10 below). Education was entered at Step 1 and explained 5% of the variance in quality of life scores. Anxiety, depression, fatigue, cognitive function and accident frequency were entered at Step 2 and the total variance explained by the model as a whole was 80%, $F (6, 27) = 22.78, p < .001$. Anxiety, depression, fatigue, cognitive function and accident frequency explained an additional 76% of the variance in work ability, after controlling for age, $R^2$ change $= .76$, $F$ change $(5, 27) = 24.77, p < .001$. In the final model only depression ($\beta = -.73, t = -3.97, p < .001$) was statistically significant.

Table 8.10
*Hierarchical Regression Analysis for Anxiety, Depression, Fatigue, Cognitive Function and Accident Frequency Predicting Quality of Life in the Chemotherapy Group at Follow-Up Time 3 (n = 54)*

| Variable | *B* | *SE B* | B |
|---|---|---|---|
| Step 1 | | | |
| Constant | 73.74 | 6.31 | |
| Education | 7.86 | 4.76 | .28 |
| Step 2 | | | |
| Constant | 94.73 | 11.71 | |
| Education | -0.15 | 2.40 | -.01 |
| Anxiety | -0.78 | 0.57 | -.17 |
| Depression | -3.18 | 0.80 | **-.73*** |
| Fatigue | 0.17 | 0.22 | .11 |
| Cognitive function | 0.07 | 0.12 | .07 |
| Accident frequency | -4.22 | 2.99 | -.12 |

*Note*. $R^2$ = .08 for Step 1 ($p$ > .10), $\Delta R^2$ = .80 for Step 2 ($p$ < .001).
*$p$ < .001.

### 8.5.1    Section Summary

In summary, Hypothesis VII (b) was partially supported. At baseline, anxiety, depression and fatigue were significant predictors of quality of life. At follow-up time 1 and follow-up time 2, anxiety and fatigue significantly predicted quality of life. Finally, at follow-up time 3, only depression was found to significantly predict quality of life.

## 8.6    Findings from Hypothesis VIII

***There will be significant differences in work ability scores between the chemotherapy group, radiotherapy group and healthy control group, and over time.***

Hypothesis VIII compared differences in work ability scores over time and between participant groups. First, responses to the overall current work ability question were considered (0 = cannot currently work at all; 10 = current work ability is at its best). Responses to current physical work ability and mental work ability were examined separately (Gudbergsson, Torp, Flotten, Fossa, Nielsen, & Dahl, 2011). Preliminary

analyses considered the effect of age and education on work ability (see Table 8.11

below). A significant correlation at $p < .05$ was taken to suggest that the demographic

variable may have an effect on the DV and therefore should be controlled for in further

analyses.

Table 8.11

*Correlations Between Demographic Variables and Work Ability in the Chemotherapy Group (n = 15), Radiotherapy Group (n = 15) and Healthy Control Group (n = 45) at Baseline*

|  | Chemotherapy | Radiotherapy | Healthy |
|---|---|---|---|
| Variable | Work ability | Work ability | Work ability |
| Age | 0.18 | **0.61*** | 0.16 |
| Education | -0.38 | 0.13 | -0.25 |

*Note.* Pearson's product moment correlation performed on age; Spearman's rank order correlation performed on education.
*$p < .05$.

Table 8.11 shows that age was significantly correlated with work ability in the

radiotherapy group. Table 8.12 below presents the results of the 3 x 3 mixed ANCOVA

with participant group (chemotherapy, radiotherapy, healthy control group) as the

between-subjects factor and time (follow-up time 1, follow-up time 2, follow-up time 3)

as the within-subjects factor, with baseline work ability measure as a covariate. Further

analyses were conducted with age as an additional covariate. To correct for the

violation of sphericity, values for the Greenhouse-Geisser Epsilon are reported for both

ANCOVAs.

The two-way mixed ANCOVA showed that there was a significant interaction between

time and participant group, $F(3.51, 101.80) = 3.12$, $p = .023$, $\eta_p^2 = .10$. The main effect

for time was not significant, $F(1.76, 101.80) = 0.44$, $p = .618$, $\eta_p^2 = .01$. The main effect

for participant group was not significant, $F(2, 58) = 0.56$, $p = .577$, $\eta_p^2 = .02$.

After additional adjustment for age, there was a significant interaction between time

and participant group, $F(3.52, 100.33) = 3.15$, $p = .022$, $\eta_p^2 = .10$ (see Figure 8.2

below). The main effect for time was not significant, $F(1.76, 100.33) = 0.79$, $p = .444$,

$\eta_p^2 < .01$. The main effect for participant group was not significant, $F(2, 57) = 0.47$, $p = .628$, $\eta_p^2 = .02$.
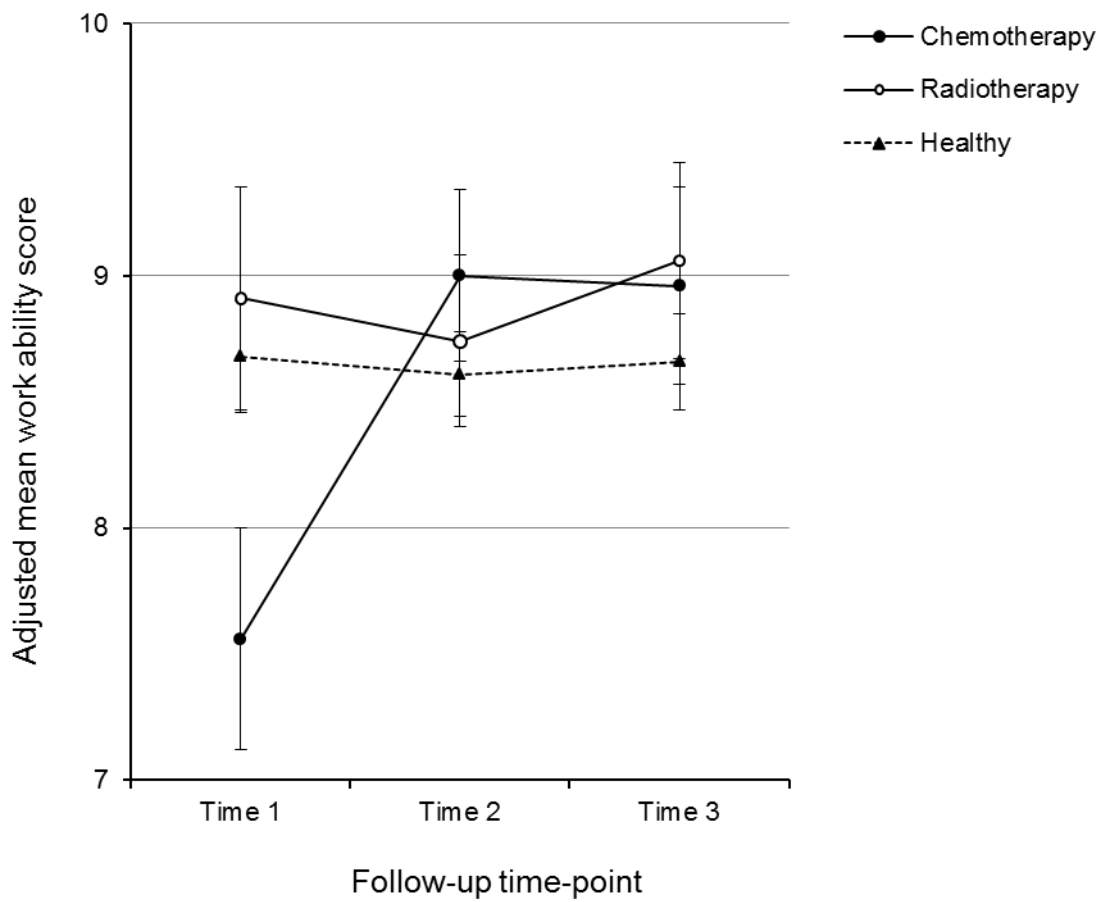
*Figure 8.2.* Adjusted mean work ability scores (+ *SE*) for the chemotherapy, radiotherapy and healthy control groups at each follow-up time-point.

Table 8.12

*Mixed ANOVA Results for Current Work Ability for the Chemotherapy Group (n = 10), Radiotherapy Group (n = 10) and Healthy Control Group (n = 42)*

| Type of analysis | Participant group | Follow-up Time 1 | | Follow-up Time 2 | | Follow-up Time 3 | | Factor | $F$ | $p$ | $\eta_p^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *M* | *SE* | *M* | *SE* | *M* | *SE* | | | | |
| Two-way ANCOVA | Chemotherapy | 7.57 | .44 | 9.01 | .34 | 8.95 | .38 | Time | 0.44 | .643 | .01 |
| | Radiotherapy | 8.96 | .44 | 8.78 | .34 | 9.05 | .38 | Group | 0.56 | .577 | .02 |
| | Healthy | 8.66 | .21 | 8.60 | .16 | 8.67 | .19 | Time x Group | 3.12 | **.023** | .10 |
| Two-way ANCOVA[a] | Chemotherapy | 7.56 | .44 | 9.00 | .34 | 8.96 | .39 | Time | 0.79 | .444 | .01 |
| | Radiotherapy[b] | 8.91 | .44 | 8.74 | .34 | 9.06 | .39 | Group | 0.47 | .628 | .02 |
| | Healthy | 8.68 | .22 | 8.61 | .17 | 8.66 | .19 | Time x Group | 3.15 | **.022** | .10 |

*Note.* Greenhouse-Geisser reported due to violation of sphericity.

[a]ANCOVA with age as additional covariate.

[b]Data missing for one participant due to missing education data.

The following section describes the proportion of participants working full-time, part-time or on sick leave at each time-point in order to understand the impact of chemotherapy on work status. The remaining proportion (those retired, unemployed or who did not answer) is not presented. Current physical work ability and mental work ability were rated on 5-point Likert scales (1 = very poor; 5 = very good) and dichotomised to very good/rather good versus moderate/rather poor/very poor, an approach taken by previous researchers (e.g. Gudbergsson, Torp, Flotten, Fossa, Nielsen, & Dahl, 2011). Chi-square analyses were conducted to compare physical work ability and mental work ability scores between participant groups at each time-point (see Table 8.13 below).

At baseline, 7 (11.67%) breast cancer patients about to undergo chemotherapy were working full-time, 8 (13.33%) were working part-time, and 21 (35.00%) were on sick leave. In the radiotherapy group, 6 (10.71%) were working full-time, 10 (17.86%) were working part-time and 5 (8.93%) were on sick leave. In the healthy control group, 31 (53.45%) were working full-time, 14 (24.14%) were working part-time and there were no healthy controls on sick leave. As Table 8.13 below shows, of those working, there were no significant differences in physical work ability between participant groups at baseline, $\chi^2(2, N = 75) = 4.45$, exact $p = .144$. However, there was a significant difference in mental work ability, $\chi^2(2, N = 75) = 8.85$, exact $p = .010$.

At follow-up time 1, 7 (12.73%) patients in the chemotherapy group were working full-time, 5 (9.09%) were working part-time and 22 (40.00%) were on sick leave. In the radiotherapy group, 5 (9.62%) were working full-time, 16 (30.77%) were working part-time and 1 (1.92%) patient was on sick leave. In the healthy control group, 31 (53.45%) participants were working full-time, 14 (24.14%) were working part-time and there were no healthy controls on sick leave. As Table 8.13 shows, of those working, there were significant differences in physical work ability between participant groups at follow-up time 1, $\chi^2(2, N = 80) = 8.16$, exact $p = .016$, and also in mental work ability, $\chi^2(2, N = 80) = 10.58$, exact $p = .007$.

At follow-up time 2, 13 (22.03%) patients in the chemotherapy group were working full-time, 14 (23.73%) were working part-time, and 11 (18.64%) were on sick leave. In the radiotherapy group, 6 (11.54%) were working full-time, 13 (25.00%) were working

part-time, and no patients were on sick leave. In the healthy control group, 28 (48.28%) were working full-time, 17 (29.31%) were working part-time, and there were no controls on sick leave. As Table 8.13 shows, of those working, there was no significant difference in physical work ability between participant groups at follow-up time 2, $\chi^2(2, N = 92) = 2.58$, $p = .275$, but there was a significant difference in mental work ability, $\chi^2(2, N = 93) = 11.64$, $p = .003$.

At follow up time 3, 12 (21.05%) patients in the chemotherapy group were working full-time, 21 (36.84%) were working part-time, and 5 (8.77%) were on sick leave. In the radiotherapy group, 7 (14.29%) patients were working full-time, 7 (14.29%) were working part-time, and there were no patients on sick leave. In the healthy control group, there were 24 (41.38%) working full-time, 19 (32.76%) working part-time, and again no cases of sick leave. As Table 8.13 shows, of those working, there was a significant difference in physical work ability between participant groups at follow-up time 2, $\chi^2(2, N = 92) = 7.88$, $p = .019$, and also in mental work ability, $\chi^2(2, N = 93) = 10.46$, $p = .005$.

Table 8.13

*Physical Work Ability and Mental Work Ability*

| Variable | Chemotherapy | | Radiotherapy | | Healthy | | *p* |
|---|---|---|---|---|---|---|---|
| | *n* | % | *N* | % | *n* | % | |
| Baseline | | | | | | | |
| Physical work ability | | | | | | | .144[a] |
| Very good/Rather good | 11 | 73.3 | 10 | 66.7 | 40 | 88.9 | |
| Moderate/Rather poor/Very poor | 4 | 26.7 | 5 | 33.3 | 5 | 11.1 | |
| | | | | | | | |
| Mental work ability | | | | | | | **.010**[a] |
| Very good/Rather good | 10 | 66.7 | 12 | 80.0 | 43 | 95.6 | |
| Moderate/Rather poor/Very poor | 5 | 33.3 | 3 | 20.0 | 2 | 4.4 | |
| | | | | | | | |
| Follow-up time 1 | | | | | | | |
| Physical work ability | | | | | | | **.016**[a] |
| Very good/Rather good | 8 | 61.5 | 15 | 68.2 | 41 | 91.1 | |
| Moderate/Rather poor/Very poor | 5 | 38.5 | 7 | 31.8 | 4 | 8.9 | |
| | | | | | | | |
| Mental work ability | | | | | | | **.007**[a] |
| Very good/Rather good | 8 | 61.5 | 17 | 77.3 | 43 | 95.6 | |
| Moderate/Rather poor/Very poor | 5 | 38.5 | 5 | 22.7 | 2 | 4.4 | |

| Variable | Chemotherapy | | Radiotherapy | | Healthy | | p |
|---|---|---|---|---|---|---|---|
| | *n* | % | *N* | % | *n* | % | |
| Follow-up time 2 | | | | | | | |
| Physical work ability | | | | | | | .275 |
| Very good/Rather good | 20 | 71.4 | 15 | 78.9 | 39 | 86.7 | |
| Moderate/Rather poor/Very poor | 8 | 28.6 | 4 | 21.1 | 6 | 13.3 | |
| Mental work ability | | | | | | | **.003** |
| Very good/Rather good | 18 | 62.1 | 16 | 84.2 | 42 | 93.3 | |
| Moderate/Rather poor/Very poor | 11 | 37.9 | 3 | 15.8 | 3 | 6.7 | |
| Follow-up time 3 | | | | | | | |
| Physical work ability | | | | | | | **.019** |
| Very good/Rather good | 21 | 61.8 | 11 | 78.6 | 39 | 88.6 | |
| Moderate/Rather poor/Very poor | 13 | 38.2 | 3 | 21.4 | 5 | 11.4 | |
| Mental work ability | | | | | | | **.005** |
| Very good/Rather good | 19 | 54.3 | 11 | 78.6 | 38 | 86.4 | |
| Moderate/Rather poor/Very poor | 16 | 45.7 | 3 | 21.4 | 6 | 13.6 | |

[a]Exact significance test due to minimum expected cell frequency assumption violated

**8.6.1   Section Summary**

In summary, Hypothesis VIII was partially supported. At baseline, physical work ability scores were similar between participant groups. However, healthy controls rated their mental work better, whereas a relatively high proportion of chemotherapy patients rated their mental work ability as poor.

At follow-up time 1, a higher proportion of chemotherapy patients rated their physical work ability and mental work ability as poor. This finding was reflected in ANOVA analysis comparing overall current work ability scores.

At follow-up time 2, current work ability scores improved and reached a similar level found in the control groups. However, Chi-square analyses revealed significant differences for both physical work ability and mental work ability. As before, a high proportion of healthy controls rated their physical work ability and mental work ability as good, whereas chemotherapy patients were more likely to rate their work ability as poor.

The level of current work ability remained consistent at follow-up time 3. However, significant differences in physical work ability and mental work ability were found. A higher proportion of chemotherapy patients rated their physical work ability and mental work ability as poor compared the radiotherapy group and healthy control group.

## 8.7    Findings from Hypothesis IX (a)

***Demographic, psychosocial, cognitive function and accident frequency variables will be significantly correlated with work ability scores in the chemotherapy group at each time-point.***

Correlations were conducted to examine the relationship between demographic, psychosocial, cognitive and accident variables with work ability for each participant group at baseline (see Table 8.14), follow-up time 1 (see Table 8.15), follow-up time 2 (see Table 8.16) and follow-up time 3 (see Table 8.17).

### Correlations at Baseline

Work ability scores at baseline were significantly correlated with employment ($r = -0.56$, $p < .05$) in the chemotherapy group (see Table 8.14 below).

Table 8.14
*Correlations Between Demographic Variables, Psychosocial Variables, Cognitive Function, Accident Frequency at Work and Work Ability in the Chemotherapy Group (n = 15) at Baseline*

| Variable | Work ability |
| --- | :---: |
| Age | 0.18 |
| Education | -0.38 |
| Employment pt/ft | **-0.56\*** |
| Anxiety | -0.51 |
| Depression | -0.25 |
| Fatigue | 0.02 |
| Cognitive function | 0.26 |
| Accidents (work)[a] | 0.01 |

\*$p < .05$. [a]$n = 12$

### Correlations at Follow-Up Time 1

Work ability scores at follow-up time 1 were not significantly correlated with any of the study variables in the chemotherapy group (see Table 8.15 below).

Table 8.15
*Correlations Between Demographic Variables, Psychosocial Variables, Cognitive Function, Accident Frequency at Work and Work Ability in the Chemotherapy Group (n = 14) at Follow-Up Time 1*

| Variable | Work ability |
| --- | :---: |
| Age | 0.10 |
| Education | 0.10 |
| Employment pt/ft | 0.39 |
| Anxiety | 0.02 |
| Depression | 0.38 |
| Fatigue | -0.13 |
| Cognitive function | 0.15 |
| Accidents (work)[a] | 0.00 |

[a]$n = 12$

**Correlations at Follow-Up Time 2**

Work ability scores at follow-up time 2 were shown to have a medium, positive relationship between age and work ability ($r = 0.40$, $p < .05$) and a large, positive relationship between fatigue and work ability ($r = 0.65$, $p < .01$) in the chemotherapy group (see Table 8.16 below). There were also large, negative associations between work ability and anxiety ($r = -0.66$, $p < .01$), depression ($r = -0.63$, $p < .01$) and cognitive function ($r = -0.61$, $p < .01$) in this group.

Table 8.16
*Correlations Between Demographic Variables, Psychosocial Variables, Cognitive Function, Accident Frequency at Work and Work Ability in the Chemotherapy Group (n = 29) at Follow-Up Time 2*

| Variable | Work ability |
|---|---|
| Age | **0.40*** |
| Education | 0.16 |
| Employment pt/ft | 0.33 |
| Anxiety | **-0.66**** |
| Depression | **-0.63**** |
| Fatigue | **0.65**** |
| Cognitive function | **-0.61**** |
| Accidents (work) | -0.37 |

*$p < .05$. ** $p < .01$.

**Correlations at Follow-Up Time 3**

Work ability scores at follow-up time 3 were shown to have a medium, positive relationship between work ability and fatigue ($r = 0.43$, $p < .01$) and a medium, negative relationship between work ability and depression ($r = -0.36$, $p < .05$) in the chemotherapy group (see Table 8.17 below).

Table 8.17

*Correlations Between Demographic Variables, Psychosocial Variables, Cognitive Function, Accident Frequency at Work and Work Ability in the Chemotherapy Group (n = 35) at Follow-Up Time 3*

| Variable | Work ability |
|---|---|
| Age | 0.30 |
| Education | 0.05 |
| Employment pt/ft | 0.24 |
| Anxiety | -0.31 |
| Depression | **-0.36*** |
| Fatigue | **0.43**** |
| Cognitive function | -0.21 |
| Accidents (work)[a] | -0.11 |

*$p < .05$. ** $p < .01$.
[a]$n = 34$

### 8.7.1   Section Summary

In summary, Hypothesis VIII (a) was partially supported. The relationship between variables and work ability in the chemotherapy group varied at each time-point. This may reflect the fluctuation in sample size over time due to many breast cancer patients going on sick leave during chemotherapy treatment. Increased levels of anxiety, depression, fatigue and cognitive difficulties were associated with poorer work ability.

## 8.8    Findings from Hypothesis IX (b)

*Demographic, psychosocial, cognitive function and accident frequency variables will predict work ability scores in the chemotherapy group at each time-point.*

Regressions were not conducted at baseline, follow-up time 1 or follow-up time 2. A regression analysis could not be run at baseline because the only variable significantly associated with work ability was dichotomous. At follow-up time 1, none of the variables were significantly correlated with work ability. At follow-up time 2, the sample size was too small considering the number of predictor variables.

**Regression at Follow-Up Time 3**

Standard multiple regression was used to assess the ability of depression and fatigue to predict work ability (see Table 8.18 below). Depression and fatigue explained a significant proportion of the variance in work ability scores at follow-up time 3, adjusted $R^2 = .14$, $F (2, 32) = 3.65$, $p < .05$. Depression and fatigue did not make a significant unique contribution to the model. This may result from overlap between depression and fatigue. Hypothesis IX (b) was not supported.

Table 8.18
*Standard Multiple Regression Analysis for Depression and Fatigue Predicting Work Ability in the Chemotherapy Group (n = 35) at Follow-Up Time 3*

| Variable | $B$ | $SE\ B$ | B |
|---|---|---|---|
| Constant | 5.64 | 1.75 | |
| Depression | -0.01 | 0.10 | -.02 |
| Fatigue | 0.06 | 0.04 | .42 |

*Note.* $R^2 = .19$, $\Delta R^2 = .14$ ($p < .05$).

## 8.9    Chapter Summary

This chapter presented the results of the third objective, which examined the impact of chemotherapy for breast cancer on quality of life and work ability during and shortly after treatment. Findings from Hypothesis VI suggested that at four months post-diagnosis, breast cancer patients undergoing chemotherapy experience relatively poor levels of quality of life, compared to treatment and healthy controls. However, over time quality of life improved and by follow-up time 3, scores were comparable to those in the treatment and healthy control groups. This supports the existing literature. As expected, Hypothesis VII found that poorer anxiety, depression, fatigue and cognitive function were significantly correlated with poorer quality of life. Interestingly, frequency of accidents in the home was also related to quality of life, but only in the chemotherapy group. This may be explained by chemotherapy patients generally experiencing more accidents compared to radiotherapy and healthy controls, and this was found to be related to poorer quality of life.

Findings from Hypothesis VIII suggested that breast cancer patients in the chemotherapy group reported impaired work ability scores at four months into

treatment; however, work ability scores increased to levels comparable to those demonstrated by the treatment and healthy control groups by follow-up time 2. Work ability scores remained consistent between follow-up time 2 and time 3, which suggests that chemotherapy does not appear to have a long-term impact on work ability. Work ability scores in the radiotherapy group and healthy control group remained relatively stable over time. In addition, significant differences were found in mental work ability between participant groups at baseline, follow-up time 1, follow-up time 2 and follow-up time 3, with a higher proportion of chemotherapy patients generally reporting poorer work ability. In relation to physical work ability, significant differences were found between participant groups at follow-up time 1 and follow-up time 3.

Finally, Hypothesis IX found that generally psychosocial variables were strongly associated with work ability in the chemotherapy group, but only in later follow-up time-points. This may be explained by those experiencing higher levels of psychosocial and cognitive impairment being on sick leave.

See Table 8.19 below for a summary of the findings from the quantitative analyses of the questionnaire data. Although the quantitative results chapters (Chapters Six, Seven and Eight) have provided evidence for some impact of chemotherapy on daily functioning, some findings are inconsistent. However, in-depth findings from the qualitative analysis of the diary entries may further elucidate the impact of treatment of patients' daily lives (see Chapter Nine). A comprehensive discussion of these results is presented in Chapter Ten.

Table 8.19

*Summary of the Findings from the Quantitative Analyses of the Questionnaire Data*

**Objective One:** Examine the impact of chemotherapy for breast cancer on psychosocial well-being and subjective cognitive function

| Hypothesis | Summary of findings |
|---|---|
| **Preliminary analyses:** Identify any differences between participant groups on anxiety, depression, fatigue and cognitive function scores at baseline. | The chemotherapy group reported significantly higher levels of anxiety compared to the radiotherapy group, but not significantly different to the healthy control group at baseline. <br><br> No significant differences between participant groups relating to depression, fatigue and cognitive function scores at baseline. |
| **Hypothesis I:** There will be differences in levels of anxiety, depression and fatigue between the chemotherapy group, radiotherapy group and healthy control group, and over time *(partially supported)*. | Anxiety: no significant differences between groups or over time. <br><br> Depression: significant main effect for group and time x group interaction. Chemotherapy group reported higher levels of depression compared to the radiotherapy group and the healthy control group. <br><br> Fatigue: significant main effect for group and time x group interaction. Chemotherapy group reported higher levels of fatigue compared to the radiotherapy group and the healthy control group. |
| **Hypothesis II:** There will be differences in subjective cognitive function scores between the chemotherapy group, radiotherapy group and healthy control group, and over time *(not supported)*. | Subtle differences in cognitive function scores between groups, but did not reach statistical significance level. |
| **Hypothesis III (a):** Anxiety, depression and fatigue scores will be significantly associated with each other and with subjective cognitive function scores in the chemotherapy group at each time-point *(supported)*. | At each time-point, anxiety, depression and fatigue scores were significantly associated with each other and will cognitive function scores. |
| **Hypothesis III (b):** Anxiety, depression and fatigue scores will predict subjective cognitive function scores in the chemotherapy group at each time-point *(partially supported)*. | *Baseline:* there were no significant predictors of cognitive function scores. <br> *Follow-up time 1:* anxiety significantly predicted cognitive function scores. <br> *Follow-up time 2:* age and anxiety significantly predicted cognitive function scores. <br> *Follow-up time 3:* depression significantly predicted cognitive function scores. |

**Objective Two:** Examine the impact of chemotherapy for breast cancer on safety outcomes in the home and workplace

| Hypothesis | Summary of findings |
|---|---|
| **Hypothesis IV:** Breast cancer patients undergoing chemotherapy will report more incidences of accidents at all follow-up time-points compared to treatment and healthy controls *(partially supported)*. | *Home*<br>*Baseline:* no difference in accident frequency between groups.<br>*Follow-up time 1:* marginal difference in accident frequency between groups.<br>*Follow-up time 2:* no difference in accident frequency between groups.<br>*Follow-up time 3:* significant difference in accident frequency between groups.<br><br>*Workplace*<br>*Baseline:* no significant difference in accident frequency between groups.<br>*Follow-up time 1:* no significant difference in accident frequency between groups.<br>*Follow-up time 2:* no significant difference in accident frequency between groups.<br>*Follow-up time 3:* no significant difference in accident frequency between groups. |
| **Hypothesis V (a):** Demographic, psychosocial, and cognitive function variables will be significantly associated with accident frequency in the chemotherapy group at each time-point *(partially supported)*. | *Baseline:* depression and cognitive function scores were significantly associated with accident frequency.<br>*Follow-up time 1:* fatigue and cognitive function scores were significantly associated with accident frequency.<br>*Follow-up time 2* anxiety, depression, fatigue and cognitive function scores were significantly associated with accident frequency.<br>*Follow-up time 3:* anxiety and cognitive function scores were significantly associated with accident frequency. |
| **Hypothesis V (b):** Demographic, psychosocial, and cognitive function variables will predict accident frequency in the chemotherapy group at each time-point *(partially supported)*. | *Baseline:* no variables significantly predicted accident frequency.<br>*Follow-up time 1:* cognitive function scores predicted accident frequency.<br>*Follow-up time 2:* no variables significantly predicted accident frequency.<br>*Follow-up time 3:* no variables significantly predicted accident frequency. |

**Objective Three:** Examine the impact of chemotherapy for breast cancer on quality of life and work ability

| Hypothesis | Summary of findings |
|---|---|
| **Hypothesis VI:** There will be significant differences in quality of life scores between the chemotherapy group, radiotherapy group and healthy control group, and over time (***partially supported***). | Significant main effect for group and time x group interaction. The chemotherapy group reported significantly lower quality of life scores compared to the radiotherapy group, but scores were not significantly different to the healthy control group. |
| **Hypothesis VII (a**): Anxiety, depression, fatigue, cognitive function and frequency of accidents will be significantly associated with quality of life in the chemotherapy group at each time-point (***supported***). | *Baseline:* anxiety, depression, fatigue, cognitive function and accident frequency were significantly associated with quality of life scores. <br> *Follow-up time 1:* anxiety, depression, fatigue, cognitive function and accident frequency were significantly associated with quality of life scores. <br> *Follow-up time 2:* anxiety, depression, fatigue, cognitive function and accident frequency were significantly associated with quality of life scores. <br> *Follow-up time 3:* anxiety, depression, fatigue, cognitive function and accident frequency were significantly associated with quality of life scores. |
| **Hypothesis VII (b):** Anxiety, depression, fatigue, cognitive function and frequency of accidents will predict quality of life scores in the chemotherapy group at each time-point (***partially supported***). | *Baseline:* anxiety, depression and fatigue scores predicted quality of life scores. <br> *Follow-up time 1:* anxiety and fatigue scores predicted quality of life scores. <br> *Follow-up time 2:* anxiety and fatigue scores predicted quality of life scores. <br> *Follow-up time 3:* depression scores significant predicted quality of life scores. |
| **Hypothesis VIII:** There will be significant differences in work ability scores between the chemotherapy group, radiotherapy group and healthy control group, and over time (***partially supported***). | Significant time x group interaction. <br> *Baseline:* significant differences in mental work ability. <br> *Follow-up time 1:* significant differences in physical and mental work ability. <br> *Follow-up time 2:* significant differences in mental work ability. <br> *Follow-up time 3:* significant differences in physical and mental work ability. |

**Objective Three:** Examine the impact of chemotherapy for breast cancer on quality of life and work ability

| | Summary of findings |
|---|---|
| **Hypothesis IX (a):** Demographic, psychosocial, cognitive function and accident frequency variables will be significantly correlated with work ability scores in the chemotherapy group at each time-point (*partially supported*). | *Baseline:* employment was significantly correlated with workability.<br>*Follow-up time 1:* no variables were significantly correlated with workability.<br>*Follow-up time 2:* age, anxiety, depression, fatigue and cognitive function were significantly correlated with workability.<br>*Follow-up time 3:* depression and fatigue were significantly correlated with workability.. |
| **Hypothesis IX (b):** Demographic, psychosocial, cognitive function and accident frequency variables will predict work ability scores in the chemotherapy group at each time-point (*not supported*). | *Baseline:* n/a (dichotomous predictor variable).<br>*Follow-up time 1:* n/a (no predictor variables).<br>*Follow-up time 2:* n/a (insufficient sample size).<br>*Follow-up time 3:* no significant predictors of work ability. |

# Chapter Nine

# The Impact of Chemotherapy for Breast Cancer on Patients' Daily Lives During and Shortly Following Treatment

## 9.1    Chapter Introduction

To expand and develop the findings from the quantitative analyses in Chapters Six, Seven and Eight, a more in-depth account of the impact of chemotherapy on daily functioning was sought by asking participants to provide a narrative of their individual experiences. The objective of this study was to explore the impact of chemotherapy for breast cancer on patients' daily life during and shortly following treatment. In particular, the aim was to:

***Describe the experience of cognitive failures, psychosocial difficulties and accidents in breast cancer patients undergoing chemotherapy in the home and workplace.***

The measures and procedures specific to the diary phase are presented in this chapter (see Chapter Five for information relating to the questionnaire phase). This is followed by the findings from the thematic analysis of the diary data and the open-ended questionnaire data.

## 9.2    Method

Qualitative methods of data collection, such as interviews, focus groups and dairies, can provide the means of capturing rich, in-depth data. Focus groups and interviews can be advantageous due to the presence of the researcher during data collection, which can enable participants' responses to be probed in greater depth. However, these methods also require the participant(s) to be available at a pre-scheduled appointment. Following a review of the documented chemotherapy-related side effects in Chapter Two and Chapter Three, it was anticipated that participants receiving chemotherapy may not feel sufficiently well to be interviewed or to attend a focus group on several occasions throughout their treatment. Interviews conducted at participants' homes may have been intrusive for participants at a particularly vulnerable time, while interviews and focus

groups at the University would impose travelling time and costs on participants. Therefore, diaries were considered to be most advantageous as they were not intrusive and there was some flexibility relating to when participants could record data (time- and event-based) should relevant incidences occur when they felt unwell or during an inopportune moment. Diaries are also a valuable research tool for capturing longitudinal insight into the lived experiences of participants (Broom & Tovey, 2008) and were therefore a useful tool to address Objective Four. They enable participants to provide frequent reports on events and experiences in their natural context, thereby offering an ecologically valid method of data collection (Bolger, Davis, & Rafaeli, 2003; Stone & Shiffman, 2004). Diaries have previously been used within psycho-oncology research to measure breast cancer patients' experiences of their side effects following chemotherapy, particularly in relation to fatigue (Greene, Nail, Fieler, Dudgeon, & Jones 1994). They have been established as an effective tool for use in other patient populations, such as to evaluate insomnia and chronic pain (e.g. Jungquist et al., 2010). Participants in the current study were instructed to record entries in a structured diary as previous research has shown that a structured diary content, in comparison to free report, can enhance the accuracy and completeness of recorded data (Richardson & Ream, 1997). In addition, participants were asked to make entries either immediately following incidences (event-based design) or at the end of the day if more convenient (time-based design). The event-based design can reduce retrospection and recall bias (Reason, 1984); however, this can be intrusive if an event occurs during an inopportune moment (Bolger, Davis & Rafaeli, 2003), such as whilst driving during a long car journey. Combining time- and event-based scheduling for diary entry-making can strengthen the study design (Bolger, Davis, & Rafaeli, 2003; Mohr et al., 2001).

The final section in the questionnaire survey invited participants to provide any additional comments they wished to share (see Appendix 12). This aimed to elicit meaningful data from participants that may not have been captured elsewhere by the study materials. Therefore, in addition to the diary data, some questionnaire data were analysed qualitatively, and the findings from both sources are presented in this chapter. It has been noted that using a combination of data sources enables the triangulation of findings (Denzin & Lincoln, 1994; Teddlie & Tashakkori, 2009), as this can help to improve the reliability of a study's findings (Gifford, 1996). Furthermore, mutual

validation of the data was achieved by drawing together the findings from the qualitative data analysis and the quantitative data analysis (see Chapter Ten).

## 9.3    Participants

A subsample of participants from the questionnaire phase elected to keep personal solicited diaries. The initial sample comprised of 21 chemotherapy patients, 11 radiotherapy patients, and 27 healthy controls. It was anticipated that time demands as well as the commitment involved in keeping the diary would result in a high attrition rate. Therefore, all participants who expressed an interest in keeping a diary were given the opportunity to do so, with the aim of collating as many completed diaries as possible. In total, 10 chemotherapy patients, 5 radiotherapy patients and 12 healthy controls withdrew from the diary phase. In the chemotherapy group, reasons for withdrawing included feeling too ill to continue ($n = 3$); experiencing cognitive difficulties resulting in forgetting to make entries or being unable to concentrate to make entries ($n = 2$), and no reason provided ($n = 5$). In the radiotherapy group, reasons for withdrawing included fatigue and not wanting to be reminded of the disease and its treatment ($n = 1$); lack of time ($n = 2$), and no reason provided ($n = 2$). In the healthy control group, reasons for withdrawing included lack of interest in keeping the diary ($n = 1$) and no reason provided ($n = 11$).

The final sample size included 11 breast cancer patients undergoing chemotherapy treatment, 6 breast cancer patients undergoing radiotherapy treatment, and 15 healthy controls. This sample size was considered sufficient for the qualitative phase of this study due to the rich data that can be obtained from qualitative methods (Castro et al., 2010). Demographic details of the final sample are presented in Tables 9.1 to 9.3. Participants' ages ranged from 28 to 65 years in the chemotherapy group, from 51 to 66 years in the radiotherapy group, and from 29 to 70 years in the healthy control group.

Table 9.1

*Participant Characteristics for the Chemotherapy Group (n = 11)*

| Participant identification | Age | Nationality | Marital status | Diary format | Employment status prior to diagnosis | Employment status during diary phase | Diary data collection period | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Baseline to T1 | T1 to T2 | T2 to T3 |
| CT01 | 42 | White British | Single | Paper | Occupational Therapist | Full-time | | | • |
| CT07 | 53 | White British | Married/living with partner | Audio | Social Care Consultant | Sick leave | | | • |
| CT10 | 58 | White British | Married/living with partner | Audio | Supply Teacher | Not stated | | • | |
| CT16 | 65 | White British | Married/living with partner | Paper | Retired | Retired | | | • |
| CT18 | 28 | White British | Married/living with partner | Paper | Unemployed | Unemployed | | • | |
| CT26 | 50 | Indian | Married/living with partner | Audio | Regional Development Officer | Sick leave | • | | |
| CT34 | 42 | White British | Married/living with partner | Paper | Teacher | Sick leave | | • | |
| CT54 | 60 | White British | Married/living with partner | Paper | Learning Difficulties Support Officer | Sick leave | • | | |
| CT55 | 58 | White British | Married/living with partner | Paper | Administrator | Part-time | • | | |
| CT57 | 33 | White British | Separated/divorced | Paper | Admin Assistant | Sick leave | • | | |
| CT60 | 51 | White British | Married/living with partner | Paper | Catering Manager | Full-time | • | | |

Table 9.2

*Participant Characteristics for the Radiotherapy Group (n = 6)*

| Participant identification | Age | Nationality | Marital status | Diary format | Employment status prior to diagnosis | Employment status during diary phase | Diary data collection period | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Baseline to T1 | T1 to T2 | T2 to T3 |
| RT20 | 65 | White British | Separated/divorced | Paper | Retired | Retired | | | • |
| RT25 | 51 | White British | Married/living with partner | Paper | Pre-School Supervisor | Part-time | • | | |
| RT33 | 54 | White British | Separated/divorced | Paper | Promotions[a] | Not working | • | | |
| RT45 | 66 | White British | Married/living with partner | Paper | Retired | Retired | • | | |
| RT60 | 62 | White British | Married/living with partner | Paper | Retired | Retired | • | | |
| RT61 | 59 | White British | Married/living with partner | Paper | Unemployed | Unemployed | • | | |

[a]Self-employed.

Table 9.3

*Participant Characteristics for the Healthy Control Group (n = 15)*

| Participant identification | Age | Nationality | Marital status | Diary format | Employment at baseline | Employment status during diary phase | Diary data collection period | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Baseline to T1 | T1 to T2 | T2 to T3 |
| HC09 | 29 | White British | Married/living with partner | Paper | Psych. Well-Being Practitioner[a] | Part-time | | | • |
| HC30 | 53 | White British | Married/living with partner | Paper | Administrator | Full-time | | | • |
| HC33 | 64 | White British | Single/windowed | Paper | Administrator | Part-time | | | • |
| HC60 | 50 | White British | Married/living with partner | Paper | Physiotherapist | Part-time | | | • |
| HC63 | 70 | White British | Married/living with partner | Paper | Retired | Retired | • | | |
| HC67 | 33 | White British | Married/living with partner | Paper | Engineer | Part-time | | | • |
| HC68 | 37 | American | Married/living with partner | Paper | Administrator | Full-time | | | • |
| HC78 | 34 | White British | Married/living with partner | Paper | Research Associate | Full-time | | • | |
| HC80 | 58 | White British | Married/living with partner | Paper | Lab Technician | Full-time | | • | |
| HC88 | 47 | White British | Single | Electronic | Unemployed | Unemployed | • | | |
| HC90 | 43 | English/South African | Married/living with partner | Paper | Administrative Officer | Full-time | | • | |
| HC91 | 58 | White British | Married/living with partner | Paper | Translator[b] | Full-time | | • | |

| Participant identification | Age | Nationality | Marital status | Diary format | Employment at baseline | Employment status during diary phase | Diary data collection period | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Baseline to T1 | T1 to T2 | T2 to T3 |
| HC92 | 45 | White British | Married/living with partner | Paper | PhD Student | Full-time | | • | |
| HC95 | 62 | White British | Married/living with partner | Paper | Supply Teacher | Part-time | | • | |
| HC104 | 57 | White British | Married/living with partner | Paper | Administrator | Full-time | • | | |

[a]Trainee. [b]Self-employed.

## 9.4    Measures

Participants were invited to keep a four-month diary, available in paper, electronic or audio format (see Appendices 13 and 14). This variety in format ensured that the use of a diary was more accessible and appealing, with the overall aim of increasing participation. All diary formats were portable so that they could be carried with the participant while undertaking daily tasks with relative ease and unobtrusiveness. All three formats were employed by the subsample (see Table 9.4).

Table 9.4

*Proportion of Participants Using Each Type of Diary Format*

| Diary format | Chemotherapy group ($n = 11$) | | Radiotherapy group ($n = 6$) | | Healthy control group ($n = 15$) | |
|---|---|---|---|---|---|---|
| | *n* | (%) | *n* | (%) | *n* | (%) |
| Paper diary | 8 | (72.73) | 6 | (100.00) | 14 | (93.33) |
| Electronic diary | 0 | - | 0 | - | 1 | (6.67) |
| Audio diary | 3 | (27.27) | 0 | - | 0 | - |

### 9.4.1    Paper and Electronic Diary

A diary booklet was designed providing space for entries over a four-week period (see Appendix 14). A section at the end of each week allowed participants to reflect and comment on some of their entries in more detail. The diary booklet was posted or emailed to participants on four occasions in order to collate data over a four-month period in total. Although this was more costly and time-demanding compared to a single four-month diary booklet, four monthly booklets were considered advantageous for the following reasons. Firstly, a shorter monthly diary booklet was small enough to be portable whilst the participants carried out their daily tasks. Secondly, this booklet was considered to motivate participants and to optimise participation as completing and returning a monthly diary booklet may have provided a sense of achievement, which may have helped to sustain participant compliance.

The paper and pencil diary format was considered to resemble a standard off-the-shelf diary and due to its familiar layout it was a relatively simple design for participants to

record their entries (Bolger, Davis & Rafaeli, 2003). Alternatively, an electronic version of the diary booklet that could be emailed to participants was available. The electronic format remained the same as the paper diary; however, as it was emailed to participants it required them to download the electronic diary as a Microsoft Word document and to type in entries using a computer. This was deemed a feasible method as approximately 19 million households in the UK have an internet connection  and there is an annual trend of increasing usage (Office for National Statistics, 2011b). However, although this method can be time-saving for the participant it does rely on the accessibility of technology.

### 9.4.2   Audio diary

For the audio diary, participants recorded entries using a battery-operated Sony ICD-MX20 digital recorder. Participants were asked to make entries by following an instruction guideline sheet (shown in Appendix 13). This format required knowledge of operating the digital recorder correctly, but was considered to be less time-demanding compared to the booklet formats (since speaking is generally faster than writing), thus making it a suitable option for those who were experiencing physical difficulties (e.g. lymphoedema) and/or psychosocial difficulties (e.g. fatigue).

## 9.5   Procedure

Informed consent to participate in the diary phase was obtained at the point of recruitment to the questionnaire phase. Participants were informed of the research aims and were provided with an information sheet (see Appendix 5). The researcher contacted participants after approximately seven days and participants were given the opportunity to ask any questions. Participants were asked to sign and return the Consent Form and initial the appropriate box indicating their consent to participant in the diary phase and then asked to choose a preferred diary format. For those participants who wished to make entries in a diary booklet, either an electronic copy was sent by email or a paper copy was sent by post, depending upon their preference. The researcher contacted these participants approximately seven days later to check they had received the diary booklet. This contact allowed the researcher to develop rapport with participants as well as confirm that they understood what was required of them. Participants were asked to inform the researcher of the date of the first diary entry. This

was recorded into a Microsoft Excel spreadsheet to aid the scheduling of distributing subsequent diary booklets.

For those participants who wished to keep an audio diary, a meeting was arranged at a convenient time and location where the researcher explained how to operate the digital recorder and outlined the instructions for making entries. This meeting ensured that participants were given the opportunity to ask any questions and to practice making entries. The researcher contacted participants seven days later to check the progress of recording entries and to answer any further questions. Participants were contacted every couple of weeks to maintain rapport. At the end of the four-month period, the researcher met with each participant to collect the digital recorder. At the end of the research, all participants were thanked for their time and sent a summary of the research findings.

## 9.6    Data Compilation and Analysis

All entries from the diaries were converted to electronic form in a Microsoft Excel spreadsheet: written entries from the paper diaries were typed into the spreadsheet; typed entries from the electronic diaries were downloaded, copied and pasted to the spreadsheet, and audio entries on the digital recorders were transcribed verbatim and typed into the spreadsheet. All diary data and additional questionnaire data were analysed using thematic analysis, following a six-step process described by Braun and Clarke (2006). Thematic analysis has been employed by other researchers examining the impact of chemotherapy-related cognitive impairment on breast cancer patients' daily functioning (e.g. Cheung, Shwe, Tan, Fan, Ng, & Chan, 2012). The participant group (chemotherapy, radiotherapy or healthy control) and time-point (baseline, follow-up time 1, follow-up time 2 or follow-up time 3) were taken into account so that comparisons between participant group and temporal fluctuations could be explored. In this chapter, differences in the identified subthemes between participant group and changes over time are described, where relevant, and it is noted where there are no apparent differences. These qualitative findings are discussed alongside the quantitative findings in Chapter Ten.

Thematic analysis is considered "a flexible and useful research tool that can potentially provide a rich and detailed, yet complex, account of data" (Braun & Clarke, 2006, p.

78). The first step during analysis involved familiarisation with the data. This was achieved by transcribing audio diaries and typing up paper diary entries, re-reading the data and noting initial ideas. The second step involved systematically organising the entire data set into meaningful groups and developing initial codes. Next, broader themes were developed by collating similar codes together. Examination of the relationships between the codes led to the identification of overarching patterns and the development of a codebook. A second researcher, experienced in qualitative data analysis, independently analysed a subsample (25%) of the data in order to validate the coding. The researchers compared the labelling of themes and differences in opinion were resolved through discussion. The codebook was then further developed. The fourth step of the analysis involved reviewing and refining the themes. Finally, clear definitions of the themes were generated. The following section presents verbatim extracts from the diary data to illustrate the themes and subthemes. This method acts as a reliability check to demonstrate how the data fits the analysis (Smith, 1996; Elliot, Fischer & Rennie, 1999). The section also presents key verbatim extracts from the data in the questionnaire surveys that support or oppose findings from the diary analysis.

## 9.7  Findings from Objective Four

Following the thematic analysis of the data, four core themes were identified and are presented (with their subthemes) in Table 9.5. Three of the core themes were associated with difficulties experienced in the home and were labelled as follows: 'managing cognitive function at home', 'managing psychosocial well-being at home', and 'managing physical ability at home'. A fourth core theme was associated with difficulties experienced in the workplace and was labelled 'managing working life'. The labelling of these core themes identifies the context of difficulties faced by participants. Since three of these core themes represent experiences in the home, this may reflect the fact that many breast cancer patients were on sick leave in the chemotherapy group and a number of participants in the radiotherapy group were retired. The context and temporal fluctuations within each theme and subtheme are discussed below. As this thesis is concerned with the impact of chemotherapy treatment on breast cancer patients' daily functioning, the results focus on the experiences of participants in the chemotherapy group with comparisons made between the radiotherapy group and healthy control group.

Table 9.5
*Themes and Subthemes*

| Theme | Subtheme |
|-------|----------|
| Managing psychosocial well-being at home | Anxiety and depression |
| | Fatigue |
| | Quality of life |
| Managing cognitive function at home | Memory difficulties |
| | Concentration difficulties |
| | Psychomotor difficulties |
| | Difficulty in decision making |
| | Language difficulties |
| Managing physical ability at home | Pain |
| | Numbness |
| Managing working life | The impact of treatment, cognitive, psychosocial, and physical difficulties on RTW intentions |
| | The impact of treatment, cognitive, psychosocial, and  physical difficulties on WA and adjustments |

**Managing cognitive difficulties at home**

The first key theme 'managing cognitive difficulties at home' relates to participants' experiences of cognitive difficulties whilst carrying out daily tasks in the home, as described by a 58-year-old chemotherapy patient three months after starting chemotherapy treatment:

> *"I can't seem to hold a thought. I think something like I'll go and take this upstairs, turn round and have instantly forgotten my thought. I have let things boil over when cooking nearly every day as I can't remember to turn them down to a simmer. I open 3 days (whoops 'doors') (I do that a lot too) to find a cup or cereal" (Participant CT55, baseline, week 12).*

This quote illustrates the range of cognitive difficulties reported by the majority of chemotherapy patients. These included memory difficulties, concentration difficulties, language difficulties, as well as psychomotor difficulties and difficulty in decision making. These types of cognitive impairment were identified as subthemes and were also evident in the diary entries made by participants in the radiotherapy group and healthy control group. However, despite a commonality and normalcy relating to these types of cognitive difficulties, key differences across groups were identified regarding the frequency, temporal changes and perceived potential cause(s) of impairment, as well as the emotional response, as described below.

*Memory difficulties*

The subtheme 'memory difficulties' refers to the problems that participants experienced with remembering, particularly relating to intentions and past events. The majority of participants experienced memory difficulties during chemotherapy treatment (see Table 9.6 for typical examples). The vast majority of memory difficulties occurred in the home, although some memory lapses also occurred whilst driving. Similar findings were present in the radiotherapy group and healthy control group.

Table 9.6

*Typical Examples of Memory Difficulties Reported in the Chemotherapy Group*

| Types of memory difficulties | Diary extract |
|---|---|
| Going from one room to another and forgetting why | *"I just forget everything like going upstairs and can't remember why etc. v annoying"* (Participant CT60, baseline, week 3) |
| Forgetting to complete tasks | *"Came upstairs to get laundry, came down without it"* (Participant CT34, follow-up time 1, week 16) |
| Forgetting past events | *"Mislaid glasses, found them on my head"* (Participant CT54, baseline, week 1) |
| Memory difficulties whilst driving | *"Returned from a few days with our in-laws today. Umm just took the complete wrong turning at a roundabout a journey I've done countless times and ended up umm coming off the A1 umm went back onto it and was heading south before my husband had to find a umm a sort of journey around, which we did, we got back, took us another extra 25 minutes on the journey. Something I'd never done before"* (Participant CT10, aged 58 years, follow-up time 1 to follow-up time 2). |

The vast majority of memory complaints reported by participants across all groups were non-hazardous. However, in some contexts, memory difficulties were associated with potentially harmful consequences, particularly for chemotherapy patients in the kitchen. For example, a 60-year-old chemotherapy patient who *"Forgot to switch electric ring off after making breakfast"* and *"also switched the wrong one [electric ring] off at dinner time so veg weren't cooked"* (Participant CT54, baseline, week 6). This chemotherapy patient also reported *"Double checking cooker all the time"* and *"Stuck note on fridge to remind me to switch ring OFF!"* due to her persistent forgetfulness. In contrast, healthy controls tended to report isolated incidences.

A small number of participants from each group reported forgetting to take medication. This incident had an emotional impact for one chemotherapy patient:

> *"Does everyone take these Tamoxifen? Can they remember to take them every day I have to write on the packet days of the week. Things like this make me worried that I might be losing my marbles. The constant 'insane' feeling is playing heavily on my mind…I worry about concentrating on not losing it all round"* (Participant CT05, questionnaire at follow-up time 2).

A 34-year-old healthy control participant commented that she forgot to take her medication, however she attributed this occurrence to being distracted and not due to difficulties in remembering the task that she had to undertake: *"Forgot to put on deodorant and take medication. Had to wash hair so got distracted"* (Participant HC78, follow-up time 1, week 11). Memory difficulties impacted upon other aspects of treatment, as one 65-year-old chemotherapy patient commented that she *"Forgot to ask consultant doctor a couple of questions at hospital"* (Participant CT16, follow-up time 2, week 2).

In contrast, a handful of chemotherapy patients shared positive reports relating to their cognitive function, as a 58-year-old chemotherapy patient stated: *"Brain fairly OK"* (Participant CT55, baseline, week 10). However, it is important to consider the contextual information surrounding this absence of impairment, as she added *" but not needing to think or do much"*. This suggests that cognitive difficulties may arise if task demands were greater.

Chemotherapy patients documented temporal changes to memory ability following the completion of chemotherapy treatment. In particular, at follow-up time 2, soon after completing chemotherapy treatment, several patients reflected on how their memory ability had deteriorated while undergoing chemotherapy treatment, and although they had experienced improvements since treatment completion, their memory ability had not fully resumed to pre-diagnosis levels:

> *"Memory and concentration issues have been much reduced since chemo finished: I do sometimes find I forget things at work or confuse when things might be happening at home e.g. I think something is on Saturday when it's Sunday. This tends to happen if I don't get time to make a note in my notebook – where I write my 'To do list' – or if I'm told something while concentrating on another thing. This is slightly more frequent than before chemo – and I need the calendar more than before too. Emotionally I am fine. I get a little worried when I get breast pain – this can also affect my concentration as I become preoccupied by it"* (Participant CT32, questionnaire at follow-up time 2).

Another chemotherapy patient commented that *"Forgetting why/what am doing is a daily occurrence 'the norm' for now"* (Participant CT01, follow-up time 2, week 3). This shows a change in perception and acceptance of this side effect. In contrast, another chemotherapy patient longed for her pre-treatment level of functioning as she struggles to cope with her memory difficulties: *"I just want to be 'the old me'"* (Participant CT35,

questionnaire at follow-up time 2). However, for some chemotherapy patients, a feeling of being *"back to normal"* several months following the completion of treatment was noted: *"Since finishing treatment my memory has got a lot better"* (Participant CT58, questionnaire at follow-up time 3). This suggests that chemotherapy may have a subtle enduring impact on memory ability as resumption to normality in memory ability was not acknowledged until follow-up time 3. Several radiotherapy patients also described changes over time, but healthy controls did not. This suggests that a diagnosis of breast cancer and/or its treatment may have had an impact on patients' memory ability.

Participants described a number of factors that they believed to have contributed to their change in memory ability (see Table 9.7). Several chemotherapy patients acknowledged that they had experienced memory difficulties prior to the commencement of treatment and were age-related. However, many also commented on an association between chemotherapy and memory difficulties. There was little consensus within the chemotherapy group and so the main cause of cognitive difficulties in this group was inconclusive. Age and fatigue were identified as potential factors across all participant groups, suggesting some normalcy.

Table 9.7

*Factors Participants Perceived to be the Potential Causes of Memory Difficulties*

| Potential causes of memory difficulties | Chemotherapy group | Radiotherapy group | Healthy control group |
|---|---|---|---|
| Age | *"Some of the memory things e.g. not seeing things in the supermarket, forgetting someone's name after being introduced, forgetting what I've gone to fetch in the house etc., I feel are not to do with my illness as I did these things before – I feel it is old age and sometimes just not concentrating on what you are doing!!"* (Participant CT2, questionnaire at follow-up time 1) | *"Some of these things I would attribute to my age as much as or more than my operation and radiotherapy treatment"* (Participant RT10, questionnaire at follow-up time 3) | *"My memory is getting worse as I get older; I also don't concentrate as much as I should, and therefore forget some things – e.g. something someone has mentioned"* (Participant HC33, questionnaire at follow-up time 1) |
| Fatigue | *"Just one instance to record today, although I have been dozing on and off all day very tired due to endo mastrics chemo. Umm half past six when I was serving up dinner umm went back into the kitchen to switch off the oven which I'd already done"* (CT10, audio diary, follow-up time 1 to follow-up time 2) | *"I am really struggling with my short term memory - not sure if it is linked to the very great fatigue I am suffering with at the present - I am sincerely hoping this will all pass soon"* (Participant RT45, baseline, week 15) | *"Feeling tired today and forgot a number of things when food shopping"* (Participant HC30, follow-up time 2, week 6) |
| Treatment-related | *"…a bit absent minded due to everything happening so fast and chemo starting, side effects that I will have from chemo"* (Participant CT42, questionnaire at baseline) | *"Most of my problems have been connected to memory and organisation which are usually very good. I think whilst the treatment is happening, the problems arise from lack of time going to the hospital every day, and being out of routine"* (Participant RT60, questionnaire at follow-up time 1) | |

In order to help manage memory difficulties, a number of compensatory strategies were employed by participants (see Table 9.8). It is interesting to note that while chemotherapy patients used a wider range of memory aids compared to the radiotherapy group and healthy control group, chemotherapy patients also reported experiencing more pronounced cognitive difficulties. This is illustrated by a 42-year-old chemotherapy patient who commented that writing to do lists made her feel *"relieved and more relaxed"*, however she went on to state that she would *"Still keep forgetting why I have gone to a cupboard. Keep saying to myself 'what am I doing'"* (Participant CT01, follow-up time 2, week 15). This suggests that memory aids were not always effective for those in the chemotherapy group. Indeed, despite efforts to use compensatory strategies, the inherent nature of memory difficulties meant that efforts were not always rewarded, as a 60-year-old chemotherapy patient noted: *"Made shopping list then left it at home"* (Participant CT54, baseline, week 2). Another 42-year-old chemotherapy patient showed her reliance on using compensatory aids and without them she would forget to complete daily tasks: *"Forgot to go to friend's house for coffee in afternoon because I hadn't written it on the calendar"* (Participant CT34, follow-up time 1, week 8). In contrast, a 58-year-old healthy control commented that although sometimes forgetting to take her shopping list with her, this did not have a significant impact on her memory ability as she could *"usually remember 8 or 9 things out of 10"* (Participant HC80, follow-up time 1, week 3).

Table 9.8

*Types of Memory Aids used in the Home by the Chemotherapy Group, Radiotherapy Group and Healthy Control Group*

| Type of memory aid | Participant group | | |
|---|---|---|---|
| | Chemotherapy group | Radiotherapy group | Healthy control group |
| Writing lists (e.g. 'to do' list, shopping list) | ● | ● | ● |
| Diary | ● | ● | ● |
| Calendar (paper and electronic) | ● | ● | ● |
| Visual reminder (e.g. putting medication in a visually prominent location) | ● | | ● |
| Reminders in phone and Outlook | ● | | ● |
| Mental rehearsal | ● | | ● |
| Timer | ● | | |
| Complete one task at a time | ● | | |
| Family organiser | ● | | |

### Concentration difficulties

The subtheme 'concentration difficulties' refers to the problems that participants experienced with focussing on managing and completing their daily tasks. There were more accounts of concentration difficulties reported by the chemotherapy group than by the radiotherapy group and healthy control group. Typically, chemotherapy patients reported that an *"Idea comes into my head, then I lost it!"* (Participant CT55, baseline, week 4).

Chemotherapy patients often found it difficult to complete relatively simple everyday tasks during the first few weeks of their chemotherapy treatment, such as being *"Unable to watch television for long periods of time and to read. Can concentrate in small batches"* (Participant CT60, baseline, week 9). The impact of these difficulties was noted by family members, as a 58-year-old chemotherapy patient describes: *"Actually difficulty single tasking. For first time in 35 years my husband had to wait for me instead of the other way round. He said 'you're not your usual efficient self'"* (Participant CT55, baseline, week 2). There was no marked difference in the reporting of concentration difficulties over time in the radiotherapy group and healthy control group.

Several participants across all groups discussed what they perceived to be the causes of their concentration difficulties. Table 9.10 summarises the range of causes documented in the diary extracts and questionnaire responses. Chemotherapy patients described a variety of methods to manage concentration difficulties, such as technology, as a 51-year-old chemotherapy patient commented: *"Using Kindle…has eased the problem"* and also that she *"Can't deal with a lot of noise and need some peace and quiet. Difficult with a busy family"* (Participant CT60, baseline, week 4). Other breast cancer patients described adapting their daily routine: *"If I adapt e.g. slower pace, regular rest or sleep in daytime I do better"* (Participant CT28, questionnaire at follow-up time 3). Radiotherapy patients also described *"Seem to be only able to concentrate on one thing at a time. If I'm doing more than one thing I forget"* (Participant RT60, baseline, week 1).

Table 9.9

*Factors Participants Perceived to be the Potential Causes of Concentration Difficulties*

| Causes of concentration difficulties | Chemotherapy group | Radiotherapy group | Healthy control group |
|---|---|---|---|
| Looking after others | *"I have 3 young children and our house is very noisy, so concentration is a problem, because there are so many distractions"* (Participant CT40, questionnaire at follow-up time 2) | | *"Currently rather distracted because I have been caring for my daughter and her new born baby. Baby fine, but daughter had some complications, so I have been worried about her"* (Participant HC118, questionnaire at baseline) |
| Illness (non-cancer-related) | | *"stressful incidents that have occurred over this month that may have affected my concentration etc., rather than the radiotherapy…I developed a very nasty cold virus which has pretty much knocked the wind out of me and I am still fighting to be rid of it, 10 days later and no sign of getting better"* (Participant RT33, baseline, week 8) | |
| Age | *"Some concentration/memory problems existed before treatment, probably age-related (60)"* (Participant CT28, questionnaire at follow-up time 3) | *"I am not sure if my memory los[s] is natural and lack of concentration is due to the radiotherapy or not"* (Participant RT20, questionnaire at baseline) | *"My memory is getting worse as I get older; I also don't concentrate as much as I should, and therefore forget some things"* (HC33, questionnaire at follow-up time 1) |

| Causes of concentration difficulties | Chemotherapy group | Radiotherapy group | Healthy control group |
|---|---|---|---|
| Anxiety | *"Can only think about treatment tomorrow"* (Participant CT60, baseline, week 3) | *"Currently the lost concentration I believe is all down to my anxiety concerning the treatment. It is not caused by the actual treatment"* (Participant RT3, baseline, week 1) | *"Currently rather distracted because I have been caring for my daughter and her new born baby. Baby fine, but daughter had some complications, so I have been worried about her"* (Participant HC118, questionnaire at baseline) |
| Fatigue | | *"Had great difficulty concentrating on sorting and writing Christmas card. Felt myself getting very uptight - very tired"* (Participant RT45, baseline, week 7) | *"Struggling to concentrate as quite tired today"* (Participant HC30, follow-up time 2, week 12) |

*Psychomotor difficulties*

The subtheme 'psychomotor difficulties' relates to participants' experiences of problems with movement and co-ordination. Chemotherapy patients, radiotherapy patients and healthy controls all reported psychomotor difficulties. In particular, reports of being clumsy were reported by chemotherapy patients over several weeks, such as *"dropping things quite a lot"* (Participant CT16, follow-up time 2, week 9), as well as in the radiotherapy group, as described by a 66-year-old radiotherapy patient: *"seem to miss things or just catch the edge of things and then knock them off a top of over onto the floor"* (Participant RT45, baseline, week 5).

The impact of psychomotor difficulties sometimes resulted in injury, for example a 60-year-old chemotherapy patient commented: *"Bruised leg after hitting it on kitchen table"* (Participant CT54, baseline, week 4), while in other accounts no injury was sustained, as illustrated by a 53-year-old chemotherapy patient's first entry in her audio diary:

> *"...this is Day One the 24th of May. And I can't believe it I've already had my first incident. Umm this morning about 11:30 between 11:30 and 12 noon I was reversing out of a car park space and I managed to reverse into a tree. So that's a pretty dramatic start isn't it. Thankfully the car isn't too damaged and I wasn't damaged at all. Umm just to my umm my umm I guess feeling a bit stupid about doing it really. Anyway that's incident one. Hope there not too many more like that"* (Participant CT07, audio diary, follow-up time 2 to time 3).

In addition to *"stupid"*, the words *"daft"* and *"silly"* were used in the chemotherapy group to describe how their cognitive difficulties made them feel.

One chemotherapy patient commented in the questionnaire survey that she had noticed a change in her clumsiness over time: *"...during treatment I found I became clumsy (dropping things) – now I have finished treatment they do seem to have become much, much, better and I feel I'm virtually back to normal"* (Participant CT24, questionnaire at follow-up time 2). In contrast, no temporal pattern emerged within this subtheme for the radiotherapy group or healthy control group. A number of causes of psychomotor impairment were suggested by participants (see Table 9.11 below). For example, healthy controls reported environmental influences as a contributory factor, whereas chemotherapy patients often suggested cognitive and psychosocial causes. In an attempt to manage psychomotor difficulties, a 51-year-old chemotherapy patient described: *"Wobbly legs when out of bed so don't attempt anything"* (Participant CT60, baseline, week 7).

Table 9.10

*Factors Participants Perceived to be the Causes of Psychomotor Difficulties*

| Potential causes of psychomotor difficulties | Chemotherapy group | Radiotherapy group | Healthy control group |
|---|---|---|---|
| **Unfavourable environmental condition** | | | *"Tripped slightly when walking on rough ground"* (Participant HC3, follow-up time 2, week 5) |
| **Cognitive domain** <br> Lack of spatial awareness | *"Cut right thumb whilst in kitchen. Can't judge distances i.e. knife to thumb"* (Participant CT60, baseline, week 7) <br><br> *"Burnt elbow twice because not aware of pan on stove when standing next to it - changed kitchen layout to move me away from heat"* (Participant CT60, baseline, week 10) | | |
| Loss of balance | *"Lost balance getting out of shower (didn't fall, just stumbled)"* (Participant CT34, follow-up time 1 to time 2, week 3) | | |
| **Psychosocial domain** <br> Fatigue | *"Felt very tired this week and a bit clumsy with it"* (Participant CT01, follow-up time 1, week 14) | *"very tired and keep tripping over nothing in particular"* (Participant RT45, baseline, week 6) | |

### *Difficulty in decision making*

The subtheme 'difficulty in decision making' refers to the problems participants had with making choices. Healthy controls reported far more accounts of experiencing difficulty in this cognitive domain than the chemotherapy patients and radiotherapy patients. Examples of the types of decision making difficulties are illustrated in Table 9.11 below.

Table 9.11

*Typical Examples of Difficulties in Decision Making Reported in the Chemotherapy Group, Radiotherapy Group and Healthy Control Group*

| Chemotherapy group | Radiotherapy group | Healthy control group |
| --- | --- | --- |
| *"Overall - have had an ISA bond matured - just can't decide what to do with it"* (Participant CT55, baseline, week 8) | *"Usually decide what to wear in the morning at night but struggle to decide"* (Participant RT45, baseline, week 3) | *"Hosted a dinner party and spent lots of time in indecision over what to make and how much would be required so everyone had enough"* (Participant HC09, follow-up time 2, week 2) |

Two chemotherapy patients described difficulties making decisions during certain parts of the week, related to chemotherapy treatment. A 58-year-old chemotherapy patient described: *"Too much to fit into the good week. Too hard to decide rest of time. Part of the problem is lack of visual focus for close work in early days after chemo, but main problem is inability to concentrate"* (Participant CT55, baseline, week 8), while a 51-year-old chemotherapy patient revealed that she *"Only make decisions on good days"* (Participant CT60, baseline, week 10). A 62-year-old radiotherapy patient revealed that she was *"All day very weepy, unable to concentrate or make decisions"* (Participant RT60, baseline, week 1). In contrast, there was no temporal pattern in the reports of this subtheme in the healthy control group, which suggests that cancer treatment may have an impact on decision-making ability in breast cancer patients.

### *Language difficulties*

The subtheme 'language difficulties' relates to the problems participants had with communicating, in particular mixing up words, word finding ability, spelling, comprehension and conversation, which were evident across all participant groups. However, there were no temporal changes apparent for this subtheme in each

participant group. In particular, in the audio diary of a 58-year-old chemotherapy patient, there were frequent reports of mixing up words, particularly in the kitchen, for example:

> *"Wednesday 3ʳᵈ March. I was preparing lunch talking to my husband I used the word oven when I meant fridge when I was telling him where where something was. And then likewise tonight when when doing dinner I confused the word freezer instead of oven umm again telling him something was in the freezer when it was already in the oven. And the third thing was talking with my daughter today had been sorting umm some clothes out ready to give to charity shops and I asked her to check some jackets she'd got in the and my mind just went blank and it took a good 30 40 seconds to think of the word cupboard under the stairs"* (Participant CT10, audio diary, follow-up time 1 to time 2).

Chemotherapy patients often documented persistent difficulties regarding language ability and the emotional impact this had, as evident by the diary extract from a 51-year-old breast cancer patient (Participant CT60):

> *"Start a sentence and forget what I was saying…Inability to judge conversation, misjudged body language and social conversation leading to upset family and tears"* (baseline, week 1)

> *"Keep saying the same thing over again"* (baseline, week 2)

> *"Just keep asking the same question over and over again…Terrible time when talking to people - forget train of thought"* (baseline, week 4)

> *"Constantly repeating self"* (baseline, week 7)

> *"Terrible memory loss. Keep repeating things to people I have already told. Can be v boring…Think of things to say to people and then forget then by the time I have gone to see the person. Makes me look like an idiot and is frustrating for others"* (baseline, week 8)

> *"Say what is on my mind regardless of the recipient which can be very embarrassing - especially when it is a personal statement"* (baseline, week 9)

There were different reactions to the experience of language difficulties, which may reflect the length of time living with the impairment. For example, a 58-year-old chemotherapy patient recorded the following entry in her audio diary, shortly following the end of her chemotherapy treatment:

> *"Monday 31ˢᵗ May. Nothing really to report. Just, you know, just seems to be general sometimes umm not being able to think immediately the word I wanted to say umm but it comes within a few seconds and that seems to happen I suppose most days I don't really tend to think about it, you know"* (Participant CT10, audio diary, follow-up time 1 to time 2).

In contrast, a 50-year-old chemotherapy patient described the lack of confidence she felt after experiencing difficulties with her language ability at the start of her chemotherapy treatment:

> *"15ᵗʰ of April at 1 o'clock. Just been out for a meal with my sister and brother-in-law from London umm and tried to recall some words that were appropriate in sentences that I hadn't been using over the last few weeks and struggled really to find the umm right word a couple of times for the sentence. Umm appropriate words. So umm feeling a little bit less confident. I don't know whether that's because I've not used umm that the type of vocabulary that I'd be using in those sentences umm in that type of conversation or whether it's that I can't recall them, but once umm the word was pointed out to me what it was I sorted of remembered that again. Umm and used that again in the same conversation"* (Participant CT26, audio diary, baseline to follow-up time 1).

Participants across all groups discussed the potential causes of their language difficulties (see Table 9.12 below). These included psychosocial influences relating to anxiety and depression.

Table 9.12

*Factors Participants Perceived to be the Causes of Language Difficulties*

| Causes of language difficulties | Chemotherapy group | Radiotherapy group | Healthy control group |
|---|---|---|---|
| Anxiety | *"There have been several times today when I've actually got words sort of mixed up or umm sometimes sort of started with one word and finished with another. Umm I'm putting it down to the fact that my daughter has actually gone off in holiday at the minute in Morocco and due back on Wednesday. And umm cos I'm worried about how she'll get home"* (Participant CT10, audio diary, follow-up time 1 to time 2) | *"Talking to my daughter in law early evening my concentration lapses on what she was saying as my mind was anxious relating to my future treatment"* (Participant RT33, baseline, week 1) | *"I work as a translator, sometimes with very tight deadlines and multiple jobs which causes stress. I find myself using the dictionary to check spellings more and more - memory getting worse with age. When speaking, I have a big problem with not finishing my sentences - the last word or two just won't come out of my mouth"* (Participant HC91, questionnaire at baseline) |
| Fatigue | *"Have felt tired this week and can't be bothered to think or talk to people - not like me"* (Participant CT01, follow-up time 2, week 16) | *"Since having the two operations for lumpectomy I have noticed I am tired and sometimes struggle finding the correct word"* (Participant RT45, questionnaire at baseline) | |

**Managing psychosocial well-being at home**

The second key theme 'managing psychosocial well-being at home' relates to participants' experiences of psychosocial difficulties whilst carrying out daily tasks. In particular, participants recorded accounts of anxiety, depression and fatigue. Anxiety and depression were considered together as one subtheme due to participants' interchangeable descriptions of both.

*Anxiety and depression*

A number of chemotherapy patients reported feeling overwhelmed over nothing in particular, for example: *"Feel low, muddled up, everything seems a big deal"* (Participant CT54, baseline, week 2) and *"Getting up tight/upset about small things which are easily solved"* (Participant CT60, baseline, week 2). In comparison, one healthy control participant's anxiety was caused by a relatively significant event, such as selling and buying a house, while another's emanated from *"caring for my 91 year old father, juggling daily routine and lack of 'me' time causes stress"* (Participant HC77, questionnaire at baseline). Other participants attributed their feelings of anxiety and depression to the commencement of treatment. However, opinions varied regarding which treatment contributed to these psychosocial side effects. One chemotherapy patient attributed her anxiety to chemotherapy treatment, although this was short-lived, whereas another participant attributed her feelings of depression to lymphoedema and surgery. Depression was also experienced in the radiotherapy group.

Several participants commented on the relationship between anxiety and memory difficulties. For example, anxiety was also triggered by the consequences of memory difficulties, as one chemotherapy patient described that she felt *"In a flap over losing tablets - rang sister to ask what to do"* (Participant CT54, baseline, week 2). Furthermore, a 53-year-old chemotherapy patient verbally recorded in her audio diary:

> *"26th of August. Umm had lots of things on today which feels quite daunting compared to my relaxed lifestyle. Didn't exactly forget about anything but I don't know if this counts but I worry about forgetting stuff especially when I've got a lot on. In the event managed to do four different things today without getting anything wrong which felt quite an achievement"* (Participant CT07, audio diary, follow-up time 2 to time 3).

Both chemotherapy and radiotherapy patients reported an association between anxiety and fatigue, as illustrated by the following two extracts:

*"Temp v low so was in bed all weekend, therefore didn't have to worry about making decisions etc. Doing too much caused this fatigue. My husband was concerned because although physically fit my "behaviour" was not normal. So could class this as all the questions rolled into one i.e. clumsy, mixing words up etc. I put it down to being stressed because my hair was falling out so I shaved my head"* (Participant CT60, baseline, week 3).

*"The most significant experience since receiving treatment has been odd days of chronic fatigue/exhaustion. These appear to be getting fewer but any extra 'stress' appears to re-activate the exhaustion very quickly"* (Participant RT19, questionnaire at follow-up time 1).

Chemotherapy patients described a number of strategies they used to minimise anxiety, such writing things down: *"Too many things to think of - relief when I write them down"* (Participant CT01, follow-up time 2), pacing oneself: *"I'm back to normal fitness wise but feel anxious if I try to do as much in a day as I used to, so I'm having to pace myself a bit (others say that makes me more normal!)"* (Participant CT55, questionnaire at follow-up time 2), and going on sick leave: *"I have felt more relaxed and less stressed since my diagnosis because I have not had to think about work (teaching) and all the <u>many</u> stresses which go with it. I have had lots more time to enjoy leisure activities such as walking and spending time with family, despite the obvious worry of the illness and surgery etc."* (Participant CT34, questionnaire at baseline).

Table 9.13
*Factors Participants Perceived to be the Causes of Anxiety and Depression*

| Causes of anxiety and depression | Chemotherapy group | Radiotherapy group | Healthy control group |
| --- | --- | --- | --- |
| Multi-tasking | *"I'm back to normal fitness wise but feel anxious if I try to do as much in a day as I used to"* (Participant CT55, questionnaire at follow-up time 2) | *"I found getting ready to go away, packing etc. very stressful. I am usually very organised. The same happened when I returned with unpacking, washing etc. Was away 19-23rd felt much more relaxed, no real problems"* (Participant RT60, baseline, week 6) | "I work as a translator, sometimes with very tight deadlines and multiple jobs which causes stress" (Participant HC91, questionnaire at baseline) |
| Caring for others | *"Overall I've found I coped fairly well through chemo and very well through radio but I'm feeling a bit down at times now – not helped by living with my severely depressed son"* (Participant CT55, questionnaire at follow-up time 2) | | *"I have had a very stressful two weeks dealing with my daughter who lost her partner, job and home all at once. She has had to come back to live with us whilst trying to rebuild her life and career"* (Participant HC61, questionnaire at follow-up time 2) |
| Memory difficulties | *"In a flap over losing tablets - rang sister to ask what to do"* (Participant CT54, baseline, week 2)<br><br>*"I worry about forgetting stuff especially when I've got a lot on. In the event managed to do four different things today without getting anything wrong which felt quite an achievement"* (Participant CT07, audio diary, follow-up time 2 to time 3) | *"Also feeling a little down - feeling old - I am never normally like this"* (Participant RT45, baseline, week 7) | |

| Causes of anxiety and depression | Chemotherapy group | Radiotherapy group | Healthy control group |
|---|---|---|---|
| Lymphoedema | *"I am experiencing depression due to the possible effects of lymphoedema and after surgery but I don't believe this has anything to do with the effects of chemotherapy"* (Participant CT49, questionnaire at follow-up tie 3) | | |
| Chemotherapy/radiotherapy | *"Starting chemotherapy first session I was rather anxious, but this soon diminished further into the treatment"* (Participant CT29, questionnaire at follow-up time 1)<br><br>*"During the past few months I have been experiencing bad side effects from the medication I have been taking for the cancer…I had to have a brain scan and had the stress of waiting for the results, all of which were thankfully OK"* (Participant CT58, questionnaire at follow-up time 2) | *"My stress levels were worse during the time I was first diagnosed until after I'd had an MRI scan to confirm the size of the cancer…After the news that the cancer was small enough for 'lumpectomy', and after the surgery, finding that the cancer had not spread, has been a huge relief"* (Participant RT57, questionnaire at baseline)<br><br>*"Thought I had coped very well. But during February had a bit of a wobble got it into my head it was back touching and feeling myself all the time thought found swellings. Went to the doctor on two occasions was nothing to worry about, but needed peace of mind, lost a bit of confidence, but OK now. Just a bit of a dark phase. That [h]as now passed"* (Participant RT23, questionnaire at follow-up time 2) | |

*Fatigue*

The subtheme 'fatigue' relates to the problems that participants experienced with regards to feelings of tiredness. There were numerous accounts of feeling fatigued and this having an impact on everyday tasks, such as reading a book and watching the television, across all participant groups. Although fatigue was common across all participant groups, the impact seemed to be more severe in the chemotherapy group as several breast cancer patients reported wanting to "*sleep all day if I could*" (Participant CT57, baseline, week 4). In addition, participants in the chemotherapy group and radiotherapy group commented on a link between fatigue and potentially hazardous events. For example, a chemotherapy patient commented that she "*Carried on going when tired and should have stopped. Got wobbly on feet*" (Participant CT60, baseline, week 2). A radiotherapy patient commented: "*I am feeling much tireder. Do not seem to have any energy. I am so very frustrated with my memory - it's really driving me mad - my short term memory is non-existent! Started to trip over things or bump into things and think it's because I feel so tired*" (Participant RT45, baseline, week 6).

Table 9.14

*Typical Examples of Fatigue Reported in the Chemotherapy Group, Radiotherapy Group and Healthy Control Group*

| Chemotherapy group | Radiotherapy group | Healthy control group |
| --- | --- | --- |
| "*Have felt tired this week and can't be bothered to think or talk to people - not like me*" (CT01, follow-up time 2, week 16) | "*Difficulty doing household chores mainly because I'm very tired*" (Participant RT60, baseline, week 3) | "*Really tired. Struggling to do anything at all*" (Participant HC30, follow-up time 2, week 8) |
| "*My day was normal until the chemotherapy - this wiped me out and I was unable to do anything including filling diary in*" (Participant CT55, baseline, week 1) | "*During all of these weeks I have not felt able to do my card making it just feels too much bother - which is not like me at all. I also enjoy reading but just do not seem to be able to settle down - most unusual of me. Not sleeping well - apart from having very hot flushes also have been having bad dreams*" (Participant RT45, baseline, week 4) | |

Between baseline and follow-up time 2, a cyclical experience linking fatigue and treatment administration was documented in the chemotherapy group: "*At the moment it*

*is less than one week since my 5ᵗʰ chemo session which accounts for my extreme tiredness and lack of energy. Within the next week I anticipate feeling somewhat more energetic and should begin to sleep better at night"* (Participant CT10, questionnaire at follow-up time 2). This was echoed by another participant who described: *"Tiredness came after say 5-7 days after treatment but I soon felt back to normal after 3-4 days. The last treatment proved more tiring directly after the treatment lasting about 10 days but again I was then able to resume normal duties"* (Participant CT29, questionnaire at follow-up time 1). *"During treatment I have 1 week off work following each session. Mum came to stay for 5 days each time. She did all cooking and cleaning in that time. At least a couple of days where I do little but sleep. Normally OK again after a week"* (Participant CT66, questionnaire at follow-up time 1). Radiotherapy patients most frequently reported fatigue between baseline and follow-up time 1, which coincided with receiving radiotherapy treatment.

Table 9.15

*Factors Participants Perceived to be the Causes of Fatigue*

| Causes of anxiety | Chemotherapy group | Radiotherapy group | Healthy control group |
|---|---|---|---|
| Age-related | | *"I do get tired more but think this is probably due to getting older and working still. I never seem to stop and when I do feel very tired. Do think it is old age!!!" (*Participant RT55, questionnaire at follow-up time 2) | |
| Anxiety | | | *"Haven't slept well last couple of days - I'm sure it's simple stress - have sold [house] and nowhere to go"* (Participant HC104, baseline, week 12) |
| Treatment-related | *"Thursday 18ᵗʰ March. Umm just I noticed on a few occasions today when I was reading I was having to re-read a few lines or you know a short paragraph to take in what was happening in my book. I took that down to the fact that I had my final chemo at the end of last week and I am still incredibly tired because of that"* (Participant CT10, audio diary, follow-up time 1 to time 2) | *"Do not sleep well but this is mostly due to the very hot flushes which are the side effects of the Amidrex tablets I am taking"* (Participant RT45, baseline, week 2)<br><br>*"Developed tiredness mid-week, concentration not affected but feel a little forgetful. I am informed that tiredness is related to my body healing itself after the radiotherapy"* (Participant RT33, baseline, week 5) | |

| Causes of anxiety | Chemotherapy group | Radiotherapy group | Healthy control group |
|---|---|---|---|
| Pain | *"My main problem has been lymphoedema which started after finishing chemo. This has been very painful particularly at night time, hence lack of sleep"* (Participant CT16, questionnaire at follow-up time 3) | *"I get tired because of arthritis. Because of the pain in my hands, knee joints and feet it can be very tiring. It is not the cancer and the treatment I have been given that makes me tired, thought I should explain"* (Participant RT01, questionnaire at follow-up time 1) | |
| Looking after others | | | *"I have a busy lifestyle, which I find very fulfilling but the present illness of my 86yrs blind mother- who is now living with me- is causing strain on the time I am able to give to the rest of my family. This is causing emotional tensions all round and leaves me physically tired with no spare time for myself"* (Participant HC95, questionnaire at follow-up time 1) |

Participants across all groups reported feeling fatigued and took naps to compensate. However, several chemotherapy patients acknowledged that *"normally this is something I would never do"* (Participant CT16, questionnaire at follow-up time 2). In order to cope with the fatigue, chemotherapy patients reduced the number of daily tasks to complete: *"I was able to pace myself during the day, especially after I was advised to perhaps complete one task per day rather than say three"* (Participant CT29, questionnaire at baseline). Another breast cancer patient described a number of methods she used to help cope with fatigue:

> *"When I get tired I go home and get in bed. This is the only way I can overcome the fog. Kept a routine. Make sure others keep to it too. Make lists - do jobs as soon as you think of them. Recognise the symptoms of tiredness and listen to them. Ask for help. Accept help is given"* (Participant CT60, baseline, week 2).

### *Quality of life*

The subtheme 'quality of life' relates to participants' experiences of their psychological well-being and outlook on life. A number of chemotherapy patients reported experiencing a negative impact on quality of life associated with chemotherapy, as described by the following 33-year-old breast cancer patient:

> *"Day 2: Fell really ill, lost my anti-sickness pills, not sleeping 4 hours at the most at night. It's really getting to me now. I don't want to go back for more treatment. Went to the Doctor because I have been feeling very down, tired and in pain (my arm hurts, the vein that they use all the time is very sore all the time). Less chest pains now I'm not taking anti-sickness pills. Went to the consultant and I had to wait 2 hours, when I explained it really wasn't good enough he told me I should be grateful he had turned up"* (Participant CT57, baseline, week 2).

Another chemotherapy participant described her difficulty in remembering to take her Tamoxifen tablets and questioned if others experienced similar, suggested reassurance that this was a normal experience, because she was worried *"that I might be losing my marbles"* and described a *"constant "insane" feeling is playing heavily on my mind…. These hot flushes that these pills cause make me have sleepless nights my work 'mates' have fun at my expense and after they leave me drained. Doctors say I have to put up with it' (5 years I have to take these) yes I worry about concentrating on not losing it all round"* (Participant CT05, questionnaire at follow-up time 2). This extract also shows that colleagues could be more understanding and supportive.

Similarly, another chemotherapy patient discussed the negative impact of Herceptin treatment on her quality of life:

> "I was told that Herceptin was a breeze. I am allergic to it and it has caused no end of physical problems i.e. consistent pain, muscle fatigue etc. I have been positive and happy until about 4 weeks ago when I no longer wanted to carry on with treatment or life. I had a word with myself and I have now adjusted to the misery. I have now started back at Guides and the girls love my new hair. I do not rest because life is too short and I am constantly restless which increases the fatigue. However I am working full time, making wedding cakes, doing guides, helping my daughter set up home, helping other daughter pass her A Levels, look after my granddaughter and I am lucky that I am still alive to do all this" (Participant CT60, questionnaire at follow-up time 2).

Negative reports were also evident in the radiotherapy group:

> "I have a general feeling that my daily activities are meaningless and that my life is 'on hold' until the treatment I need is completed. The main effect on my activities is that I feel less confident and physically my hands shake and the more I try to prevent it happening the worse it gets" (Participant RT10, questionnaire at baseline).

In contrast, some reports were more positive. For example at the start of chemotherapy treatment, a 65-year-old chemotherapy patient commented (Participant CT16, questionnaire at baseline): *"At this moment I remain cheerful and positive about things, enjoying my life, and I am determined to remain this way, come what may"*. Similarly, the following chemotherapy patient described an optimistic approach to her management of daily tasks:

> "Just doing what I can and trying not to worry about what I can't. Rather independent and find it hard to accept I need help and most of all ask, even though I know my friends and family want to help me. I know I have to get over this!" (Participant CT62, questionnaire at baseline).

Another chemotherapy patient described that she was *"physically in pain in every joint all the time and do not sleep"*, however she did not let this impact her working life, as she would *"manage 160 staff and a £2.5 million budget to the best of my ability"*. She described her coping mechanisms being *"a no cry policy and never cry about cancer. I do struggle making difficult decisions but never pull the cancer card. I have discussed this strategy with my consultant and he says my mental health is more important than my physical health so do what I can. I will not let cancer spoil my life"* (Participant CT60, questionnaire at follow-up time 3).

Other reports from the final follow-up time-point described being back to a pre-diagnosis level of functioning: *"My life is 100% back to normal now and I'm looking forward to going on holiday in the Summer with my hubby! By Jan next year I'm hoping to have my reconstruction completed! All good! :)"* (Participant CT33, questionnaire at follow-up time 3). Other accounts suggested that normality was approaching: *"Having cancer and the on-going treatment is hard going but I know that there is light at the end of the tunnel and I will get there. I won't get to 100% but this year I am a lot better than I was in May 2010 when I first found out I had cancer. I am also going for extra tests to see if my cancer is genetic"* (Participant CT36, questionnaire at follow-up time 3).

In contrast, accounts from radiotherapy patients suggested a quicker resumption to normality: *"My health and my life seem to have returned very quickly to how things were before I was diagnosed with breast cancer. I am very actively involved on a number of committees and I feel my life is most interesting. My family also is most important and brings me a great deal of pleasure and happiness"* (Participant RT39, questionnaire at follow-up time 2).

**Managing physical ability at home**

The third key theme 'managing physical ability at home' refers to participants' experiences of physical difficulties whilst carrying out daily tasks. In particular, participants commented on pain and numbness, which are presented as separate subthemes below.

*Pain*

A number of participants reported experiencing pain during their daily life, which had a significant impact upon their ability to manage their everyday tasks. Therefore, 'pain' was identified as a subtheme and was particularly evident in the chemotherapy group. Due to the cytotoxic and systemic nature of chemotherapy, fast-dividing cells throughout the body are targeted, such as those located in the nail. Consequently, this can create pain and looseness of the nail (as described in Chapter Two). This can impact upon the ability to perform daily tasks, as documented by the following chemotherapy patient:

> *"Practical things (like pain in nails or nails falling off!) means you have to compensate when doing everyday "stuff" e.g. pulling up a zip, cutting veggies, changing gears,*

*opening ring pulls (on cans etc.) gets difficult and causes frustration!"* (Participant
CT19, questionnaire at follow-up time 1).

Another chemotherapy patient commented: *"I have had difficulty walking in the 2ⁿᵈ half of*
*my treatment the bottom of my feet got sore and my skin came off also lost most of my finger*
*nails"* (Participant CT22, questionnaire at follow-up time 1). In addition, several
chemotherapy patients expressed similar accounts as the following 65-year-old
chemotherapy patient: *"Main problem is still the lymphoedema which is still very painful"*
(Participant CT16,  follow-up time 2, week 3). In contrast, there was no reference to pain in
the diary extracts from the radiotherapy group or healthy control group.

The following extract comes from diary and questionnaire extracts from a 65-year-old
chemotherapy patient (Participant CT16), which documents the temporal changes
relating to her management of pain:

> *"I had mastectomy on the 29/1/2010 and arrived home on 1/1/2010. I was pleased that*
> *I could cope with my normal routine almost straight away, although the drain that was*
> *still attached to me slowed me down a bit. Oh! what a relief to get rid of it. Going out in*
> *the car was a bit more painful at first, as I was aware of vibrations on my chest wounds*
> *as we went over bumps and hollows on the roads, but after the first week or so this soon*
> *settled down. I am doing my arm exercises every day. I still can't get my arm up as high*
> *as my good left arm but I am working hard on this and it is starting to feel easier and*
> *not so numb…The main problem though this week has been my lymphoedema, although*
> *the compression sleeve and mitten have reduced the swelling in the hand and lower*
> *arm, the top arm and shoulder still swollen and very painful at times. This is another*
> *factor in being a bit clumsy"* (questionnaire at baseline).

> *"Main problem is still the lymphoedema which is still very painful. Loros lymphoedema*
> *clinic provided me with a compression sleeve and glove and this has helped to take the*
> *swelling down. The glove worked well and in just two days wearing, my swelling in my*
> *hand went right down to normal again, so was able to leave glove off and so far have*
> *not had to put it on again"* (follow-up time 2, week 3).

> *"Nothing really to report this week. Fourth week is usually a good week, when I feel*
> *more my normal self. Hair still growing back and finger nails looking much*
> *better…Lymphoedema still painful and arm still. Saw physiotherapist at Loros, who*
> *was very helpful and gave me some good advice on how to manage exercises. The staff*
> *at the Loros Lymphoedema Clinic are excellent and seem to take the subject very*

*seriously. I am lucky to live in Leicester and have such a good clinic available to me to help with this painful and sometimes disabilitating problem"* (follow-up time 2, week 4).

*"Lymphoedema getting a bit painful again and hard to do arm exercises. I saw my lovely sister [name removed] at Loros on Monday and she is sending away for a different compression sleeve for me to try to see if this helps the arm. Head wound from last month's fall is still sore, though it is healing, but frustrating slow…I feel a wreck and I don't like these hormone tablets that have put on, I get hot sweats two or three times a day. I'm too old to have the menopause all over again and now I'm turning into a moaning old woman. Oh dear! Oh dear! Oh dear!"* (follow-up time 2, week 10).

*"Arm still painful and underarm and right side of chest gets quite painful too. Energy levels not too bad even though I'm not sleeping well at the moment"* (follow-up time 2, week 11).

*"Nothing really to significant happened this week. Lymphoedema still a problem though, very painful, and have had to have my compression sleeve altered to another one again. Not sleeping very well because of the pain. Feet still very numb and can't get them warm at night in bed. Have started to wear bed socks, now I feel like a real granny"* (follow-up time 2, week 13).

*"Lymphoedema still painful. Compression sleeve fitting better now and I'm hoping this will help the arm. Energy levels back to normal now which is quite surprising considering lack of sleep. I am over half way through my Herceptin now and seem to be keeping OK with this treatment. My head wound has started to get a bit painful in the last couple of days"* (follow-up time 2, week 14).

*"Lymphoedema no better at the moment, getting twinges of pain in my elbow and sometimes get a real good stab of pain if I put any kind of pressure on the arm. Keep taking Paracetamol to kill pain in arm. Apart from pain I'm keeping well and very busy getting ready for Christmas"* (follow-up time 2, week 15).

*"…lymphoedema still painful, but it's not all bad news as finger nails are back to normal…and I've managed to get all my Christmas decoration up, and Christmas shopping done. Not bad eh for a one-armed, one breasted, wounded headed, suffering*

*lack of sleep woman. I'm not complaining, could be up there with the angels playing on a harp"* (follow-up time 2, week 16).

*"... having a stiff arm and shoulder has made mobility a bit more awkward, but I am learning to manage it and live with the pain"* (questionnaire at follow-up time 3).

In addition, breast cancer patients undergoing chemotherapy reported a number of physical side effects associated with chemotherapy treatment. Temporal changes linked to the onset of different chemotherapeutic agents were noted: *"With the first three chemotherapy I coped really well (FEC) but the last two sessions of chemotherapy the (T) has made me feel ill about three days later (I just ache and feel weak) it only last about four days then I feel fine again"* (Participant CT65, questionnaire at follow-up time 1).

Another chemotherapy patient aged 33 years described pain relating to blood tests she underwent as part of her chemotherapy treatment: *"They couldn't find a vein. My arm was hurting quite a bit. I feel sick, tired and I really don't want to go back, and I have chest pains they started within an hour of treatment"* (Participant CT57, baseline, week 1) and the following week she commented: *"Fell really ill, lost my anti-sickness pills, not sleeping 4 hours at the most at night. It's really getting to me now. I don't want to go back for more treatment. Went to the Doctor because I have been feeling very down, tired and in pain (my arm hurts, the vein that they use all the time is very sore all the time). Less chest pains now I'm not taking anti-sickness pills"* (Participant CT57, baseline, week 2).

### Numbness

The subtheme 'numbness' relates to participants' experiences of lack of feeling in their hands and feet (neuropathy), which impacted on their ability to complete daily tasks at home, and at times resulted in *"clumsiness"* and hazardous events. Neuropathy is a known side effect of chemotherapy (as described in Chapter Two) and was present in the chemotherapy group only. Chemotherapy patients associated increased clumsiness with treatment, as described by one participant: *"during treatment I found I became clumsy (dropping things) – now I have finished treatment they do seem to have become much, much, better and I feel I'm virtually back to normal"* (Participant CT24, questionnaire at follow-up time 2). The following extract comes from a 65-year-old chemotherapy patient (Participant CT16), towards the end of her chemotherapy treatment and describes how numbness in her fingers impacted her confidence:

*"Numbness in fingers has caused minor problems this week, more frustrating when you are trying to get jobs around the house done quickly…Things like putting on socks or tights is a bit of a struggle and takes me longer because of stiff arm and numb fingers"* (follow-up time 2 to time 3, week 1).

*"Still got numb fingers so am a bit clumsy. It was amazing how heavy things seem now I have lymphoedema, simple things like lifting saucepans, kettles, pails of water have become more difficult and I have to remember to try things with my other good arm"* (follow-up time 2 to time 3, week 2).

*"Fourth week is usually a good week, when I feel more my normal self. Still have a little numbness in tips of fingers but getting much better so it's easier to do more fiddly jobs. Feet however are still very numb and big toe nails are black and blue"* (follow-up time 2 to time 3, week 4).

*"Had a really nasty fall on the 25th. Tripped over the edge of mat in conservatory. Hit my head on the edge of a concrete step. My head had a nasty gash on it and it poured with blood. Luckily I keep a well-stocked first aid box so managed to pad and dress wound..Finger tips still improving only one of them a bit numb now"* (follow-up time 2, week 5).

*"Head still sore after last week's accident but it is healing up nicely now. Think I was very lucky not to have done more damage. Took a little while to get my confidence back though and I moving around a lot more slowly and carefully…Feet still very numb and toes nails still black"* (follow-up time 2, week 6).

*"Although numbness in fingers is much improved, still dropping things a lot. My feet are still completely numb. I am getting energy levels back now and although head is still a bit painful I am feeling more like my old self"* (follow-up time 2, week 7).

*"Still feeling all fingers and thumbs. Feet very numb still"* (follow-up time 2, week 10).

*"Have new compression sleeve fitted on. Arm feels a little more comfortable, hope it lasts. Numbness continuing so I'm still a bit clumsy, however feeling a lot stronger in myself this week"* (follow-up time 2, week 12).

In order to cope with numbness in the hands, Participant CT16 described using a compensatory aids to help manage her daily tasks, such as *"used magnet to pick pin up off floor…use gaject [gadget] to pull ring on cans, as cannot pull with fingers"* (Participant CT16, follow-up time 2, week 1).

**Managing working life**

The fourth key theme 'managing working life' refers to participants' experiences of the impact of cognitive, psychosocial and physical difficulties in the workplace, particularly relating to returning to work and whilst at work. Subsequently, two subthemes emerged, reflecting these aspects.

*The impact of treatment, cognitive, psychosocial, and physical difficulties on RTW intentions*

The subtheme 'the impact of treatment, cognitive, psychosocial, and physical difficulties on RTW intentions' refers to problems that participants' experienced while resuming employment, for example following sick leave. This subtheme was only present in the chemotherapy group. This reflects the severity of the invasive nature of chemotherapy treatment, resulting in many breast cancer patients taking sick leave whilst undergoing treatment. Some chemotherapy patients also commented on taking time off work following surgery. Since radiotherapy is a type of local therapy and therefore associated with fewer side effects, this may have impacted to a lesser extent upon daily functioning. In addition, it is important to note that radiotherapy patients tend to be older, and in the current sample, the majority of radiotherapy patients were retired, which may account for the lack of data from this sample linked to this subtheme. Finally, as shown in Chapter Eight, section 8.5, there were no accounts of sick leave in the healthy control group, which explains the lack of data associated with the current subtheme in this participant group. Despite the presence of this subtheme being prevalent in only the chemotherapy group, it was deemed important because of the impact that this experience had on the daily lives of several breast cancer patients.

As previously stated, the majority of chemotherapy patients were on sick leave during their treatment. One chemotherapy patient reported taking sick leave because of anticipated cognitive difficulties: *"I have stopped working as there is no way I would be able to juggle work demands. I need to be able to think on my feet when teaching and manage a lot*

*of paper work. I am sure I would rate far worse if I were doing this. My employer has cleared my teaching commitments and has been very supportive"* (Participant CT25, questionnaire at baseline).

On the other hand, the following extract from a 42-year-old chemotherapy patient (Participant CT34) reveals the emotional stress related to returning to work and after an unsuccessful attempt at returning to work she extended her sick leave:

> *"Emotional week - went to work to talk about return to work but had panic attack and got very tearful (Wed). Then had 'interview' with lovely ladies at Ingeus (D.W.P.) and there were lots more tears (Fri). Mon - went to see GP and got signed off work for bit longer"* (follow-up time 1, week 15).

> *"Since last questionnaire I have had some meetings with health counsellor and employment adviser to help me prepare for return to work. Had some emotional issues when contemplating return to workplace and experienced first ever "panic attack" style symptoms in meeting with line manager. Have since made full use of Breast Care Nurse, GP, Health Counsellor etc. to talk through all concerns and fears and it has helped hugely. Also helped my concentration because anxiety about work was beginning to dominate thoughts when pre-occupied. Talking to people other than family and friends has improved all aspects of my mental health which, in turn, has helped with coping with everyday tasks"* (questionnaire at follow-up time 2).

> *"I have had a phased return over 6 weeks, gradually increasing hours and teaching load until reached 4 full days/week (pre-diagnosis level). Finding it physically and mentally exhausting but confidence has improved noticeably since starting return. Find I can learn pupil names with some effort. One side effect I still struggle to deal with is having a hot flush and palpitations when feeling stressed or unexpected event occurs (often!) Workload has been reduced slightly as I don't have to do break duty/reports/parents evenings for this term"* (questionnaire at follow-up time 3).

In contrast, another chemotherapy patient commented that returning to work helped her cognitive function and she seemed to enjoy resuming her working life: *"Once returned to work my mind was much better. However this is the first time that I did not want to carry on with the chemo because I have been so disassociated from real life"* (Participant CT60, baseline, week 9).

***The impact of treatment, cognitive, psychosocial, and physical difficulties on work ability and adjustments***

The subtheme 'the impact of treatment, cognitive, psychosocial, and physical difficulties on WA and adjustments' refers to the problems participants' experienced relating to managing and completing tasks at work. There were far more accounts of difficulties with work ability in the healthy control group than in the chemotherapy group and radiotherapy group. An interesting difference was that the duration of poor work ability in the healthy control group was often minimal, as illustrated by the following diary extract: *"At work, in the middle of a job on pc - and just lost my place completely - for several seconds"* (Participant HC104, baseline, week10). In contrast, a 51-year-old chemotherapy patient commented that: *"Late afternoon meeting last 1/2 hours was a waste of time because couldn't concentrate"* (Participant CT60, baseline, w eek 3). The types of work ability issues experienced across participant groups are summarised in Table 9.16 below. Although the consequences of psychosocial and cognitive impairments were minor, they impacted upon work ability.

Table 9.16

*Typical Examples of Poor Work Ability Reported in the Chemotherapy Group, Radiotherapy Group and Healthy Control Group*

| Types of poor work ability | Chemotherapy group | Radiotherapy group | Healthy control group |
| --- | --- | --- | --- |
| Memory difficulties | *"Couldn't remember details at work of something 2 weeks ago"* (Participant CT01, follow-up time 2) | | *"Got to door of office having forgotten what I was going to do"* (Participant HC30, follow-up time 2, week 3) |
| Concentration difficulties | *"Late afternoon meeting last 1/2 hours was a waste of time because couldn't concentrate"* (Participant CT60, baseline, week 3) | *"Went to a meeting first time since I have been ill. After an hour I couldn't keep my concentration"* (Participant RT45, baseline, week 13) | *"Doing a repetitive job - boring and no brain power required. My mind starts to wander and then I forgot where I'm up to/how many I've done!"* (Participant HC104, baseline, week 6) |
| Multi-tasking difficulties | *"Work - couldn't multi-task - only one thing at a time"* (Participant CT01, follow-up time 2) | | *"Large workload. Kept starting one task and getting side tracked by another task"* (Participant HC90, follow-up time 1, week 12) |
| Language difficulties | | | *"Made a few errors in note writing at work"* (Participant HC60, follow-up time 2, week 5) |
| Psychomotor difficulties | *"Felt clumsy using computer system at work"* (Participant CT01, follow-up time 2) | | |

Temporal changes regarding work ability were documented by chemotherapy patients, as illustrated by the following extract:

> *"Memory and concentration issues have been much reduced since chemo finished: I do sometimes find I forget things at work…This tends to happen if I don't get time to make a note in my notebook – where I write my 'To do list' – or if I'm told something while concentrating on another thing. This is slightly more frequent than before chemo – and I need the calendar more than before too. Emotionally I am fine. I get a little worried when I get breast pain – this can also affect my concentration as I become preoccupied by it"* (Participant CT32, questionnaire at follow-up time 2).

One chemotherapy patient described how she struggled to complete a poem as part of her work and shared her poem:

> *"I edit a monthly newsletter for the care agency I work for and this has to be produced to a deadline. I've had moderate difficulty finding a topic for the main article ("editorial") and great difficulty producing an amusing poem – which I normally write with ease. Last month, with the printing date approaching I had to resort to one entitled "I haven't got a poem" (3 verses instead of the usual 5+), the first verse which went as follows:*

> <div align="center">

> *I've got to write a poem – but where's my inspiration?*
> *I need to write a poem – it's causing consternation!*
> *I want to write a poem – no-one could be keener*
> *But chemo takes your brain and in its place leaves semolina!"*

> </div>

(Participant CT28, questionnaire at follow-up time 1).


Chemotherapy patients frequently reported chemotherapy treatment affecting their work ability. There were also reports of anxiety impacting work ability. This was also evident in the healthy control group, however the prevalence was minimal, *"Felt stressed this morning - sudden burst of tasks and completely forgot what I was doing - honestly, seconds long!"* (Participant HC104, baseline, week 12). Fatigue was cited as having an impact on work ability in the radiotherapy group: *"The main thing which affects me generally and my work performance is fatigue, Whether getting good quality sleep/rest is affected by emotional or physical conditions I'm unsure? My feeling is it could well be"* (Participant RT19, questionnaire at follow-up time 2). In contrast, there were several reports in the healthy control group of unfavourable environmental conditions as the cause of their poor work ability: *"Struggling to get on at work - weather at office warm/stuffy which doesn't help"* (Participant HC30, follow-up time 2, week 10).

A 42-year-old chemotherapy patient explained that she coped with her forgetfulness at work by applying greater cognitive effort when completing her work tasks: *"Day 2 of this week felt more 'with it' than I have in ages and less tired despite getting up at 5:30 coz of hot flushes! Forgetting why/what I am doing is a daily occurrence 'the norm' for now. I really have to concentrate on what I am doing especially at work and I find myself constantly checking that I have done it right"* (Participant CT01, follow-up time 2, week 3). However, a 51-year-old chemotherapy patient reported that memory difficulties persisted despite using a memory aid: *"Missed the VC lunch - just forgot even though had a reminder"* (Participant CT60, baseline, week 3). Another chemotherapy patient commented how she maintained good work ability by changing her home life:

> *"I do 100% at work but go to bed at 4pm as soon as I get home. Not being told about treatment and hospital appointments at difficult time I find more stressful than the treatment. I cannot now write so secretary does most of hard writing for me"* (Participant CT60, questionnaire follow-up time 1).

Some chemotherapy patients managed their chemotherapy side effects and work by taking time off when they felt poorly: *"Alterations to work helpful. Took off one day per treatment cycle when felt unfit to work re side effects"* (Participant CT31, questionnaire at follow-up time 1). Similarly, the following radiotherapy reported taking sick leave due to treatment. Due to the physical impact of treatment, one radiotherapy patient commented: *"Have cut my working week from 28 hours to 18 as I feel I can no longer do the lifting"* (Participant RT03, questionnaire at follow-up time 1).

Table 9.17 summarises the aids and compensatory strategies reported by each participant group to facilitate good work ability. However, such strategies were not always effective in the chemotherapy group, as described by a 42-year-old occupational therapist: *"Boss pointed out made a mistake on a weekly absence form - even though I thought I'd checked it twice"* (Participant CT01, follow-up time 1).

Table 9.17

*Strategies and Adjustments Employed to Enable Good Work Ability*

| Chemotherapy group | Radiotherapy group | Healthy control group |
| --- | --- | --- |
| Lists (e.g. to do list) | None | Lists (e.g. to do list) |
| Change home life | | Tidy desk |
| Cut work hours | | Diary |
| Double checking tasks | | Calendar |
| | | Prioritise tasks |

Chemotherapy patients expressed more of an emotional reaction relating to work tasks, as illustrated by the following diary extracts from Participant CT60:

> *"At work when lots of people talking at once. Had to leave the situation. As a manager this was very stressful"* (baseline, week 2).

> *"Friday was a terrible day. I had deadlines to meet and a lot of pressure. I just went home in the end. By profession I am a cater so having a panic attack over a simple lunch was uncharacteristic and unfounded. Feeling guilty all the time is a negative emotion which needs dealing with as it is making me stressful and irritable"* (baseline, week 2).

> *"Recalled info from a meeting on Friday which I couldn't recall earlier in the week so really pleased with myself"* (baseline, week 3).

> *"Went back to work and did difficult sums!"* (baseline, week 4).

Further positive accounts of work ability are shown by the following extract:

> *"I started back work after Easter while I was having radiotherapy. I feel better being at work with staff and children. My boss at playgroup said they all thought I would get tired but it is as though I have never been away. Working in the kitchen at weekends I sometimes feel tired but I am usually working 7pm until 1am. The boss there said she has not noticed any difference in how fast I work"* (Participant CT65, questionnaire at follow-up time 2).

## 9.8    Chapter Summary

The diaries provided detailed descriptions of the experiences of chemotherapy patients undergoing chemotherapy. After comparing the diary entries from these participants with radiotherapy patients and healthy controls, it is clear that cognitive difficulties are ubiquitous and typically inconsequential. However, an interesting finding was that although chemotherapy patients reported using a greater number of compensatory strategies to manage cognitive difficulties, they did in fact experience more memory difficulties and the impact on daily life seemed more profound. In general, chemotherapy patients reported memory difficulties more frequently compared to radiotherapy patients and healthy controls, and also for an extended period of time. Cognitive difficulties in the chemotherapy group also fluctuated over time, which reflected the trajectory of their treatment. The difficulties reported by radiotherapy patients were often short-lived and coincided with the diagnosis of breast cancer, but improved following the commencement of radiotherapy treatment. Furthermore, the types of memory difficulties experienced by chemotherapy patients were more often linked to accidents and injuries. Healthy controls reported far more accounts of experiencing difficulty in making decisions. However, it is unclear whether this is because healthy controls experienced greater impairment in this cognitive function or because they were exposed to greater opportunities or contexts that required decisions to be made. The contextual information from one chemotherapy patient who revealed that she experienced difficulties with making decisions and so would do these on their "good days". In addition, healthy controls struggled to make decisions regarding what to do with their free time. However, it may be that chemotherapy patients focus on only one task or thought at a time and therefore this excludes the need to making decisions in some contexts. This is an important finding and neuropsychological measures might not reflect this temporal change. Despite having experienced a number of adverse physical and psychological side effects associated with chemotherapy, a number of participants valued the benefits of this treatment and looked to the future. Chemotherapy patients expressed a number of psychosocial and cognitive difficulties in the workplace. Although these were frequently subtle changes, they still impacted upon their work ability.

It is important to consider how reliable it is to use a tool such as a diary to record cognitive failures, particularly memory difficulties. One chemotherapy participant wrote in her diary: "*To be honest I have completely forgot to do this diary for the last few weeks. So will start again on the new one this week*" *(Participant CT18, follow-up time 1, week 5).* Healthy control participants also reported forgetting to write in the diary. This highlights the limitation of using this type of measure. However, considering the vast amount of data generated from the diaries, it is clear that this tool is able to provide detailed accounts of participants' lived experiences.

# Chapter Ten

## Discussion

## 10.1   Chapter Introduction

This thesis examined the impact of chemotherapy for breast cancer on patient's ability to manage their daily tasks. In particular, cognitive, psychosocial and safety-related outcomes in the home and workplace were considered using a longitudinal, mixed-methods design. The experiences of breast cancer patients undergoing chemotherapy were compared with a treatment control group and healthy control group. Data were collected using questionnaires and diaries. This chapter begins by integrating the quantitative and qualitative findings in relation to each objective, as outlined in Chapter Four (section 4.7). The strengths and limitations of the current research are then discussed. This is followed by a discussion of the implications of the findings and finally the chapter concludes with recommendations for future work.

## 10.2   Summary of Key Findings

In this section, the findings from the questionnaire phase and the diary phase are integrated and discussed in relation to the impact of chemotherapy for breast cancer on the following outcomes: psychosocial well-being, subjective cognitive function, safety-related incidences, quality of life, and work ability.

***Pre-chemotherapy psychosocial well-being and cognitive function***

Inconsistent findings in the psycho-oncology literature concerning chemotherapy-related cognitive impairment may relate to methodological limitations of previous research. For example, cross-sectional studies tend to report higher levels of cognitive impairment due to the lack of a pre-treatment measure that can be used to control for differences between participant groups. In this study, preliminary analyses of baseline data revealed no significant differences in subjective cognitive function between the chemotherapy group, radiotherapy group and healthy control group, which is in line with previous findings (e.g. Jenkins et al., 2006; Schagen, Muller, Boogerd, Mellenbergh, & van Dam, 2006; Stewart, Collins, Mackenzie, Tomiak, Verma, &

Bielajew, 2008). However, these findings are incongruent to other studies (e.g. Bender et al., 2006; Hermelink et al., 2007; Hurria et al., 2006; Ahles et al., 2008; Mar Fan et al., 2005; Paraska & Bender, 2003; Quesnel, Savard, & Ivers, 2009), and so this finding adds to the debate surrounding pre-chemotherapy cognitive function in the breast cancer population. In addition, there were no significant differences between any groups in baseline measures of depression and fatigue. In contrast, breast cancer patients about to undergo chemotherapy experienced significantly higher levels of anxiety compared to radiotherapy patients and healthy controls. Interestingly, breast cancer patients about to receive radiotherapy experienced the lowest levels of anxiety. There are several potential reasons that may explain this difference in levels of anxiety. Breast cancer patients in the chemotherapy group were more likely to be diagnosed with a more advanced stage of breast cancer, which could pose a greater risk to survival, and subsequently a more rigorous form of treatment was required (i.e. chemotherapy). Higher levels of anxiety in the chemotherapy group may have resulted from the impact of the diagnosis itself and/or the knowledge of the oncoming chemotherapy treatment and its associated (many) side effects. Alternatively, there may have been variation in the demographic characteristics of the samples. Healthy controls tended to be in full-time employment and so may have experienced relatively high levels of anxiety due to demanding workloads, whereas the radiotherapy group tended to be in retirement, which may give rise to a more sedentary lifestyle, as identified in Chapter Nine. In addition, older individuals may have greater exposure to, and experience of, breast cancer (since the incidence of breast cancer increases with age), such as attending mammogram screenings. Subsequently, the diagnosis and impending treatment may have had a reduced psychological impact in the radiotherapy group compared to those in the chemotherapy group who were generally younger and were more likely to be in full-time employment. However, it is important to note that there was no significant difference in levels of anxiety between the chemotherapy group and healthy control.

These findings highlight the importance of including a pre-treatment baseline measure so that between-groups differences can be controlled for in repeated measures analyses. In doing so, any temporal fluctuations can be accurately attributed to the onset of treatment instead of pre-existing differences between participant groups. This is highlighted by the diary findings, and also reported elsewhere (e.g. Cheung, Shwe, Tan,

Fan, Ng & Chan, 2012;  Hurria et al., 2006), where participants acknowledged that they experienced cognitive difficulties prior to the commencement of treatment.

### *The impact of chemotherapy for breast cancer on psychosocial well-being*

The quantitative findings suggest that chemotherapy may adversely impact upon depression and fatigue, although not anxiety, particularly at mid-chemotherapy (follow-up time 1). Chemotherapy patients self-reported significantly higher levels of depression and fatigue compared to radiotherapy patients and healthy controls at follow-up time 1. However, by follow-up time 2 (towards the end of chemotherapy treatment) both depression and fatigue scores reached similar levels to those reported by the radiotherapy group and healthy control group. The radiotherapy group and healthy control group exhibited similar levels of fatigue with minimal fluctuation over time This finding suggests that chemotherapy treatment may have an acute impact on the depression and fatigue, which alleviate as the administration of chemotherapy treated reduces.

The qualitative findings supported the quantitative findings. In relation to depression, the diaries revealed that chemotherapy patients became emotionally upset by relatively *"small things which are easily solved"* (Participant CT60), particularly earlier on in the treatment course. Some chemotherapy patients experienced lymphoedema, which persisted up to follow-up time 3, and often resulted in feeling depressed. In relation to fatigue, there were many more reports of feeling fatigued in the chemotherapy group than in the control groups and chemotherapy patients described a more severe type of fatigue. Participants from all groups commented on napping to help resolve feeling fatigued; however, for several chemotherapy patients, they had to take time off work and "do little but sleep" (Participant CT29). The qualitative findings also provided a more in-depth account of the subtle temporal fluctuations of participants' experiences. For example, a number of chemotherapy patients reported a cyclical experience of feeling fatigued that coincided with each administration of chemotherapy, as illustrated by the following extract: *"Tiredness came after say 5-7 days after treatment but I soon felt back to normal after 3-4 days"* (Participant CT29). Taken together, the findings from the questionnaires and diaries suggest that chemotherapy treatment can have a profound impact on breast cancer patients' daily lives, in particular resulting from fatigue. This

side effect inhibits patients from carrying out simple daily tasks and leaves patients needing to sleep excessively so that they are able to regain their energy.

Quantitative findings from the questionnaire survey demonstrated no impact of chemotherapy on anxiety, as participants in the chemotherapy group, radiotherapy group, and healthy control group reported relatively similar levels of anxiety across all follow-up time-points. Although chemotherapy patients experienced higher levels of anxiety at baseline, the qualitative findings also revealed that feelings of anxiety subsided over time, *"Starting chemotherapy first session I was rather anxious, but this soon diminished further into the treatment"* (Participant CT29). Furthermore, diary extracts showed that some chemotherapy patients used strategies to help them manage anxious feelings (related to cognitive difficulties), such as writing things down, pacing themselves, and taking sickness absence from work. It may be that anxiety is easier to manage than depression and fatigue. For example, cancer-related fatigue is thought to be severe in cancer patients and cannot always be alleviated by rest (Cella, Lai, Chang, Peterman, & Slavin, 2002). Alternatively, although anxiety levels were particularly high in the chemotherapy group at pre-treatment baseline, it may be that this was due to the thought of the oncoming course of chemotherapy and its associated, well-documented numerous side effects. Anxiety levels may then lessened due to familiarity with the treatment, as suggested by the excerpt above. Jacobsen, Bovbjerg and Redd (1993) described this as anticipatory anxiety reducing over time. Furthermore, breast cancer patients may have received further information from healthcare professionals about their prognosis and obtained support from cancer support groups and other patients, which again may have helped to alleviate anxiety.

### *The impact of chemotherapy for breast cancer on cognitive functioning*

The psycho-oncology literature provides evidence of subtle cognitive difficulties in breast cancer patients undergoing chemotherapy. Unexpectedly, the quantitative findings from the questionnaire phase revealed subtle but non-significant differences in subjective cognitive function scores between the chemotherapy group, radiotherapy group and healthy group, and over time. This contradicts the findings from a number of previous longitudinal studies (e.g. Bender et al., 2006; Hermelink et al., 2007; Jansen, Dodd, Miaskowski, Dowling, & Kramer, 2008). In the current study, significant between-groups difference were no longer significant after controlling for baseline

anxiety, depression and fatigue, which illustrates the importance of accounting for confounding variables.

Mean CFQ scores in the chemotherapy group were 37.98, 37.89 and 35.60 at follow-up time 1, time 2 and time 3, respectively. Wagle, Berrios, and Ho (1999) suggested that typical CFQ scores range from 25 to 35 in the general population, which was true for the mean score found in the radiotherapy group and healthy control group, and so suggests that chemotherapy patients may have experienced subtle cognitive impairment. Although this is a reassuring finding for breast cancer patients undergoing chemotherapy, it is important to recognise that even subtle cognitive changes can have a detrimental impact on daily functioning and quality of life (Meyers & Perry, 2008; Vardy & Tannock, 2007), as evidenced by the qualitative findings. Findings from the diary phase and responses to the open-ended questionnaire items revealed that all participant groups experienced cognitive difficulties, in particular memory difficulties, concentration difficulties, language difficulties, and psychomotor difficulties. However, excerpts revealed that chemotherapy patients experienced these cognitive difficulties more frequently, and most notably between baseline and follow-up time 2. Similar findings have been reported in previous qualitative work (e.g. Cheung, Shwe, Tan, Fan, Ng, & Chan, 2012; Downie, Mar Fan, Houede-Tchen, Yi, & Tannock, 2006; Munir, Burrows, Yarker, Kalawsky, & Bains, 2010; Myers, 2010). Furthermore, the impact of these cognitive difficulties on daily functioning included difficulty driving and returning to the workplace, which corroborates findings reported by Myers (2010) and Thielen (2008). Chemotherapy patients in the current study described difficulty reading a book and word finding ability, as well as using more compensatory strategies (e.g. 'to do' list, diary, calendar) than normal, which is congruent with findings by Boykoff, Moieni, and Subramanian (2009) and Cheung et al. (2012). The diary findings also suggested that family members were used as a source of support, particularly following the administration of each chemotherapy cycle when side effects were more acute, which has also been documented by other researchers (e.g. Mulrooney, 2007; Myers, 2010). In support of the quantitative findings, the qualitative findings also illustrated that cognitive function improved by follow-up time 3, as documented by one chemotherapy patient, *"Memory and concentration issues have been much reduced since chemo finished"* (Participant CT32), while others reported feeling *"back to normal"*.

As reported above, several chemotherapy patients noticed a decline in cognitive function while receiving chemotherapy, which is reflected by the CFQ scores reported above. The diary findings captured more subtle temporal fluctuations, revealing a cyclical pattern of cognitive impairment linked to the cycles of chemotherapy administration. Improvements in cognitive function were described by a number of breast cancer patients by follow-up time 2, although resumption to normality was not expressed by some patients until follow-up time 3. These findings suggest that chemotherapy can have an enduring impact on cognitive function in some individuals. This pattern is somewhat reflected in the questionnaire data, as shown in Figure 6.4 (see Chapter Six), which shows a subtle decrease in the number of cognitive failures experienced at follow-up time 1 to follow-up time 3.

The qualitative findings provide insightful contextual information relating to potential reasons why cognitive function improved over time. It may be that chemotherapy patients develop compensatory strategies to manage their cognitive difficulties (Calvio, Peugeot, Bruns, Todd, & Feuerstein, 2010). The qualitative findings suggested that chemotherapy patients used a greater range of memory aids compared to radiotherapy patients and healthy controls (see Chapter Nine, Table 9.8). Alternatively, the lack of a significant difference between the cognitive function scores in the chemotherapy group, radiotherapy group and healthy control group could be the result of participants in the radiotherapy group experiencing 'cognitive frailty' due to their older age (Hurria et al., 2006) and healthy controls experiencing higher cognitive loads (due to their full-time jobs), leading to both control groups experiencing relatively high levels of cognitive difficulties than would typically be reported in the general population. The radiotherapy group scored 34.83, 33.91, 34.16, and the healthy control group scored 33.53, 34.23, 33.69, at follow-up time 1, time 2 and time 3, respectively, which are on the upper end of Wagle's (1999) range for the general population.

Recently, Schagen, Das and van Dam (2009) demonstrated that priming or pre-existing knowledge regarding the concept of chemotherapy-related cognitive impairment significantly increases the reporting of cognitive complaints. However, for ethical reasons, it was necessary to inform participants of the purpose of research and so the association between chemotherapy and possible cognitive difficulties is evident in Information Sheets. In addition, breast cancer patients may have knowledge about

chemotherapy-related cognitive impairment through the media or cancer support groups (Schagen, Das, & van Dam, 2009). However, findings from the diaries suggested that this may not be an issue in this work because although some chemotherapy patients reported that they believed chemotherapy to be the cause of their cognitive difficulties, others dismissed this idea and described that these difficulties existed prior to chemotherapy and instead were age-related (see Chapter Nine, Tables 9.7 & 9.10).

Consistent with other longitudinal studies, subjective cognitive function was significantly related to anxiety and depression (Hermelink et al., 2007; Schagen, van Dam, Muller, Boogerd, Lindeboom, & Bruning, 1999) as well as fatigue. This suggests that as impairment in one of these variables increases, so does impairment in the others. It was anticipated that anxiety, depression and fatigue scores would predict subjective cognitive functioning scores. However, significant predictors of cognitive function in the chemotherapy included anxiety at follow-up time 1, age and anxiety at follow-up time 2, and depression at follow-up time 3. Based on these findings, it could be suggested that reducing levels of anxiety and depression may reduce the frequency of perceived cognitive difficulties.

### *The impact of chemotherapy for breast cancer on safety outcomes*

The findings from both the quantitative and qualitative data analyses have been integrated and incorporated into Figure 10.1 (see below). This figure demonstrates how the risk factors for safety-related outcomes change over time. Note that significant predictors identified following regression analyses are in bold. At baseline, findings from the questionnaire data analysis showed no difference in the distribution of accidents reported between participant groups in the home. Depression and cognitive difficulties were associated with safety-related outcomes, but neither were significant predictors. Findings from the thematic analysis support the link between cognitive difficulties and unsafe behaviour, as one chemotherapy patient frequently reported forgetting to turn off her cooker at baseline. The qualitative findings also provided a more in-depth understanding of the factors impacting upon safety between baseline and follow-up time 1. For example, detailed accounts provided by participants describing the context of accidents identified the specific types of cognitive difficulties that were involved, such as spatial awareness difficulties, *"Cut right thumb whilst in kitchen. Can't judge distances i.e. knife to thumb…Burnt elbow twice because not aware of pan on stove when*

*standing next to it"* (Participant CT60, baseline). Furthermore, the chemotherapy group commented on several factors that they thought were associated were hazardous events, including fatigue, neuropathy, weakness in legs, and lymphoedema. These findings suggest that there are both psychological and physical risk factors that contribute to potentially unsafe outcomes in the breast cancer population.

At follow-up time 1, the quantitative findings showed that chemotherapy patients encountered accidents more frequently compared to the two treatment groups. Fatigue and cognitive difficulties were associated with safety-related outcomes and results from the regression analyses revealed that cognitive function significantly predicted accident frequency. This could be explained by the previous finding that chemotherapy patients reported slightly more cognitive difficulties compared to the control groups, particularly at follow-up time 1. This association between cognitive difficulties and accidents has been reported in the safety literature (e.g. Larson, Alderton, Neideffer, & Underhill, 1997; Larson & Merritt, 1991). Findings from the qualitative data analysis revealed that chemotherapy patients identified fatigue, loss of balance and neuropathy as being associated with unsafe behaviour between follow-up time 1 and follow-up time 2. Similar physical treatment-related side effects have also been linked to accident proneness previous research (e.g. Myers, 2010). Chemotherapy patients reported difficulty performing daily tasks, such as putting on socks, dropping objects, and tripping over things due to numbness in the extremities.

Towards the end of chemotherapy treatment, chemotherapy patients reported fewer accidents and the quantitative findings demonstrated that there were no differences in the frequency of accidents reported between participant groups at follow-up time 2. Although fatigue, depression and cognitive difficulties were found to be significantly correlated with accidents, none of these variable significantly predicted accidents. However, this may have been due to collinearity amongst the predictor variables. Findings from the qualitative data analyses revealed that only fatigue and neuropathy were thought to have an impact on safety-related outcomes between follow-up time 2 and follow-up time 3. This may reflect enduring treatment-related side effects, and so it is important that patients are aware of these. One chemotherapy patient frequently described the impact of the neuropathy she experienced, including *"a really nasty*

*fall…Tripped over the edge of a mat in the conservatory. Hit my head on the edge of a concrete step…Feet very numb…Numbness continuing so I'm still a bit clumsy"* (Participant CT16).

At follow-up time 3, quantitative findings revealed that chemotherapy patients once again reported more accidents compared to the two controls groups. The significant difference in accident frequency between participant groups at follow-up time 3 may result from chemotherapy patients returning to employment or other activities (as suggested by the diary excerpts, *"My life is 100% back to normal now"* (Participant CT33), and therefore increasing the number of potentially hazardous events encountered.

With regards to accidents in the workplace, all participant groups reported similar levels of accidents in the workplace as measured by the questionnaire survey at each time-point. Since Salminen and Heiskanen (1997) found high correlations between accidents at work, traffic accidents and accidents during leisure activities, it was surprising to find no difference in the distribution of accidents in the workplace at each follow-up time-point in the current study. However, it is important to note that the sample size of the chemotherapy group in particular fluctuated for this analysis: 40.00%, 18.64%, and 8.77% of chemotherapy patients took sickness absence at follow-up time 1, follow-up time 2 and follow-up time 3, respectively. Therefore, it may be that those chemotherapy patients who were experiencing an increased number of accidents took sickness absence to avoid injury in the workplace. Some chemotherapy patients described using cognitive aids, such as a calendar, more frequently since undergoing chemotherapy. Since cognitive difficulty has been shown to predict accidents, the increased use of cognitive aids could reduce this risk. Furthermore, one chemotherapy patient described a change to her daily routine, which may reduce the impact of treatment-related side effects at work: *"I do 100% at work but go to bed at 4pm as soon as I get home"*.
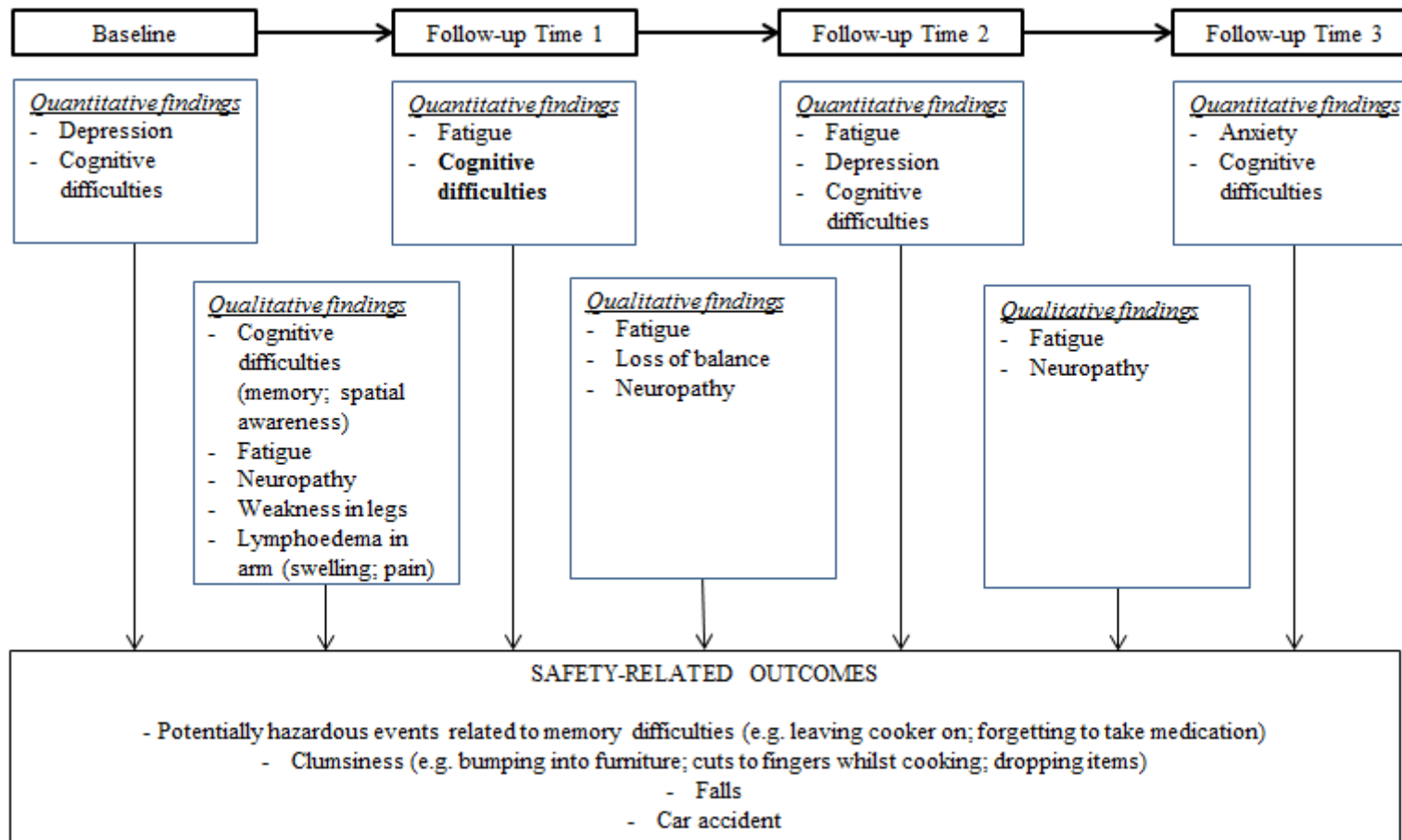
*Figure 10.1.* Accident theory model illustrating risk factors as reported by breast cancer patients undergoing chemotherapy (Lawrence Model 2)

*The impact of chemotherapy for breast cancer on quality of life*

The chemotherapy group reported significantly lower quality of life scores at follow-up time 1 compared to the control groups, however scores reached levels in line with the control groups by later time-points. As expected, anxiety, depression, fatigue, cognitive function, and accident frequency in the home were all significantly correlated with quality of life in the chemotherapy group. Ignoring accident frequency (as this has not previously been considered in the breast cancer population), this supports previous findings (Schagen, van Dam, Muller, Boogerd, Lindeboom, & Bruning, 1999). This relationship could explain the temporal fluctuation in quality of life scores as these factors were most prevalent at follow-up time 1. Furthermore, it was gleaned from the diary entries that chemotherapy patients implemented more compensatory strategies to help alleviate the negative effects of treatment on daily life, which may have improved quality of life over time.

In addition to practical changes, chemotherapy patients also underwent psychological changes over time, in the sense of an outlook on life. Between baseline and follow-up time 2, many diary extracts revealed accounts of poor quality of life; however, by follow-up time 3, reports on quality of life were more positive. For example, one woman undergoing chemotherapy reported feeling *"back to normal"* by follow-up time 3 and had a holiday and breast reconstruction to look forward to, whereas another woman described there being *"a light at the end of the tunnel"* to reflect her change to a more optimistic perspective regarding the cancer experience. While radiotherapy patients also underwent treatment, the experience was typically short-lived as radiotherapy lasts several weeks as opposed to months and has fewer associated physical and psychological side effects than chemotherapy. Similar to Mulrooney (2007), cognitive impairment affected self-esteem as participants described feeling *"stupid"*, *"silly"* and *"daft"*.

*The impact of chemotherapy for breast cancer on work ability*

Questionnaire data revealed temporal differences in work ability. Interestingly, at baseline, chemotherapy patients rated their mental work ability as being significantly poorer than healthy controls. This may reflect pre-occupation and high levels of anxiety following a recent diagnosis. At follow-up time 1, overall work ability was significantly poorer in the chemotherapy group compared to the control groups. This was expected

since, as previously stated, psychosocial and cognitive side effects were more pronounced at this time. Somewhat surprisingly, few variables were significantly related with work ability. However, this may reflect the fluctuation in sample size at each time-point due to chemotherapy patients taking sickness absence.

A number of chemotherapy patients involved in the diary phase described concentration difficulties impacting upon work ability. This finding is consisted with other research (Munir, Burrows, Yarker, Kalawsky, & Bains, 2010; Myers, 2010). While the majority of chemotherapy patients took sickness absence due to the inability to cope with work tasks related to cognitive difficulties, for one chemotherapy patient, returning to work was physically and mentally challenging, however it did improve her confidence.

### *Contribution to current knowledge*

Findings from this research contribute to several literatures. Firstly, further evidence is offered to the psycho-oncology literature regarding the impact of chemotherapy for breast cancer on patients' daily functioning. Secondly, findings broaden the current accident literature to include evidence on prevalence and severity of accident risk in breast cancer patients undergoing chemotherapy, as well as the predictors of accidents within this population.

This thesis could help (a) health professionals to provide clear information to breast cancer patients about potential treatment side effects; (b) enable breast cancer patients to make informed treatment decisions and evaluate the risk-benefit factors of treatment; (c) inform employers of potential treatment-related side effects that breast cancer survivors may experience in the workplace and identify what adjustments may be necessary to improve the successful transition of cancer survivors back into the workplace, and (d) identify appropriate interventions to support breast cancer patients to effectively manage their daily tasks. This research also exemplifies the value of employing a mixed-methods approach, which is currently under-utilised within psycho-oncology research, to provide a holistic understanding of treatment-related side effects among breast cancer patients that could be recommended for future research.

## 10.3   Methodological Considerations

As outlined in Chapter One, there have been recent recommendations in the psycho-oncology literature for research to adopt longitudinal designs (including pre-treatment baseline) with treatment and healthy control groups to address the limitations associated with previous work (Vardy et al., 2008). This study addressed these recommendations and as a result it was able to control the effect of covariates to allow for a realistic assessment of the impact of chemotherapy on important outcomes (Jenkins et al., 2006). Furthermore, the mixed-methods approach proved valuable. For example, several breast cancer patients noted a cyclical nature to their side effects, such as feeling particularly tired for several days following chemotherapy administration. However, the questionnaire survey did not capture these subtle temporal fluctuations due to the four months between questionnaires. This is important to recognise when interpreting findings from longitudinal research. In particular, this could have important implications for where interventions would be most effective and useful for the individual.

There are issues regarding the generalisability of the findings to the wider breast cancer population in the UK for several reasons. Firstly, male breast cancer patients were excluded from the current study since notable differences in the experiences of breast cancer in males and females have been documented (Ravandi-Kashani & Hayes, 1998). Unfortunately, due to the limited timeframe and resources inherent in a PhD project, it would not have been feasible to recruit a sufficient cohort of male breast cancer patients in order to provide generalisable findings to this subpopulation. Therefore, this thesis reviewed and documented the experiences of female breast cancer patients only. It is acknowledged that future studies with sufficient resources should consider the experiences of this subpopulation.

As outlined in Chapter Five, in addition to on-site recruitment at five NHS cancer clinics, efforts were made to recruit breast cancer patients from across the UK via support groups. Despite a number of advertisements displayed at support groups centres and on online forums, only three breast cancer patients expressed an interest in the study, and only one patient remained in the study. Potential reasons for this low recruitment rate may be the lack of direct researcher presence, meaning that participants

are required to be proactive and contact the researcher themselves, and it may be that few breast cancer patients access support groups prior to the commencement of their treatment. Whilst the recruitment from two NHS hospitals from different counties has its advantages, further multi-centre research spanning larger geographic areas is necessary in order to recruit larger samples and broaden the generalisability of the findings to the UK breast cancer population.

In addition, this study was limited by its relatively small sample size, which is a common limitation in psycho-oncology research (e.g. Jansen, Dodd, Miaskowski, Dowling, & Kramer, 2008). Although the sample sizes are higher compared to recent longitudinal studies examining cognitive difficulties in breast cancer patients (Bender et al., 2006; Collins, Mackenzie, Stewart, Bielajew, & Verma, 2009; Hurria et al., 2006; Quesnel, Savard, & Ivers, 2009), findings from the power calculations (see Chapter Five) suggest that larger samples sizes than obtained would have been able to detect a medium effect size for all analyses conducted. Therefore, the findings from the questionnaire phase should be interpreted with caution. However, a strength of this study is its relatively low attrition rate compared to other studies. This may reflect the less burdensome nature (e.g. time demands) of the questionnaire design compared to neuropsychological testing. With regards to the diary phase, the sample size was comparable to other qualitative work by Mulrooney (2007) ($n = 10$), Munir, Burrows, Yarker, Kalawsky, & Bains (2010) ($n = 13$), and Thielen (2008) ($n = 13$).

Another shortcoming is the use of convenience samples. Although a highly popular recruitment strategy (e.g. Jansen, Dodd, Miaskowski, Dowling, & Kramer, 2008), convenience samples may not always result in a representative sample and findings must therefore be interpreted with caution. In the current study, age, family and work pressures may have confounded results. Although the sample characteristics of the chemotherapy group were similar in age as previous studies (e.g. Jansen et al., 2008), and the chemotherapy group were closely matched on age with the healthy control group in the current study, the radiotherapy patients were significantly older. This may reflect the fact that older patients tend to be offered non-invasive treatment (such as radiotherapy), and so recruiting an age-matched sample of radiotherapy patients may have been out of the researcher's control. However, it is important to consider the impact of this potentially confounding factor. In particular, the literature reviewed in

Chapter Three suggested that older people are more likely to experience memory difficulties and in Chapter Four it was shown that older people tend to experience more accidents. Therefore, these age-related differences may mask any treatment-related differences when comparing the experiences of patients who have received radiotherapy treatment and those who received chemotherapy treatment. Subsequently, it was important to statistically control for age in the quantitative analyses when necessary.

Furthermore, the healthy control group had a disproportionately higher level of education compared to the chemotherapy group and radiotherapy group, which may reflect the interest of academics in the study following the University press release. In addition, participants in the radiotherapy group were more likely to be retired, whereas healthy control participants were more likely to be in full-time education. Consequently, the healthy control group may have experienced greater family and work pressures. Again, these differences may have masked any impact that chemotherapy may have had in the chemotherapy patient group. Although there were no significant differences in marital status between the participant groups, results from the diaries analyses showed that some participants were caring for young families or older relatives. These family pressures may have had an impact on the outcomes examined in the current study.

Finally, response bias may have been present in the diary study. All participants consenting to the questionnaire phase were invited to take part in the diary phase. The purpose of the diary study was briefly explained: to obtain a better understanding of the context surrounding any incidences of cognitive failures, near-misses and unintentional injuries participants may experience. Those participants believing to experience relatively few such incidences may have opted out of the study considering their experiences irrelevant to the study. Indeed, several participants decided to withdraw from the diary study after several weeks of keeping the diary as they found they had little incidences to report. Despite reassurances from the researcher that blank diaries were useful as it demonstrates they were experiencing fewer incidences, participants maintained their desire to withdraw from the study. Therefore, the diaries may be biased to those experiencing higher incidences of psychosocial difficulties, cognitive impairment and accidents. Participants may have thought they were wasting their own time by not having much to write about. Perhaps future diary studies could include a

tick box indicating that no or fewer difficulties were experienced so that participants still feel that they are contributing something to the study. In addition, some breast cancer patients withdrew from the study due to treatment-related side effects, such as feeling ill, tiredness and cognitive difficulties resulting in forgetting to make entries or being able to concentrate on making entries. This is linked to the Metamemory Paradox, which proposes that individuals experiencing cognitive impairment inherently have difficulty in remembering these incidences.

Some participants who kept a diary commented that they forgot what incident they wished to write about. Shilling and Jenkins (2007) found that when breast cancer patients were interviewed regarding their cognitive difficulties and asked to provide multiple examples of difficulties encountered, many were unable to do so. They concluded that this was because these accounts were not meaningful to the participants. However, an alternative interpretation is that subtle memory difficulties are frequent and as the diaries reveal can have an emotional impact, affect confidence and quality of life. Furthermore, several chemotherapy patients withdrew from the study or failed to return some questionnaire survey due to feeling unwell.

## 10.4   Implications of Findings

There are approximately 46,100 diagnoses of breast cancer in women annually in the UK (Office for National Statistics, 2011a). The survival rate is increasing and so women look to maintain a normal life during and beyond treatment. Due to the extension of working life in the UK, it is anticipated that there will be more cases of breast cancer in the workplace in the near future. Findings from this research suggest that chemotherapy treatment can have important implications for daily functioning in the home and workplace.

### *Implications of findings for health professionals*

This thesis has expanded the current knowledge of psychosocial and cognitive side effects associated with chemotherapy for breast cancer as well as providing novel information regarding the link between these psychological side effects and accident risk. Recent research has documented that health professional's lack information on chemotherapy-related cognitive impairment (Cheung, Shwe, Tan, Fan, Ng, & Chan,

2012; Munir, Kalawsky, Lawrence, Yarker, Haslam, & Ahmed, 2011; Myers & Teel, 2008). It is important that information regarding the potential safety implications of chemotherapy-related cognitive impairment is disseminated to health professionals so that future breast cancer patients can be educated and awareness is increased. Subsequently, this could improve informed consent for treatment options. However, since the aetiology of chemotherapy-related cognitive impairment is currently unclear, it is important that breast cancer patients are informed that psychosocial factors and other treatments for breast cancer may also contribute to cognitive changes. By providing this information, at an early stage, it could help to improve patients' management of these side effects. For example, they could implement coping strategies (Bender et al., 2008). Indeed, awareness alone could help to diffuse patient concern regarding whether these side effects are "*normal*" or whether they were "*losing [their] marbles*". It is important that further qualitative work is conducted on the lived experiences of breast cancer patients so that healthcare professionals can provide information on a profile of normal side effects following chemotherapy. Skalla, Bakitas, Furstenberg, Ahles, and Henderson (2004) found that cancer patients want information about specific side effects of treatment as well as the impact of treatment on their lives. Future work should consider which chemotherapeutic agents are associated with side effects so that healthcare professionals are better informed of the risks associated with chemotherapy regimens.

*Implications of findings for patients and relatives*

The finding that cognitive function did not significantly differ from control groups or over time is a reassuring finding for prospective chemotherapy patients, although qualitative findings suggested more subtle temporal changes can have a detrimental impact upon daily functioning. Recent qualitative research identified that breast cancer patients value receiving information regarding chemotherapy-related side effects, such as cognitive difficulties (Myers, 2010), and so it is likely that the potential impact of these side effects on safety outcomes would also be valued. It is vital that breast cancer patients are provided with comprehensive information regarding the potential side effects associated with their treatment options. A lack of awareness promotes issues relating to a lack of informed consent (Myers, 2010). Myers reported that 33% of participants were informed about chemotherapy-related cognitive changes and some wished to be involved in intervention to improve their cognitive function. This shows

that breast cancer patients want to reduce the impact of treatment-related side effects and manage their daily tasks effectively. The findings from the current study also highlight that it is important that breast cancer patients are able to perform their daily tasks safely.

An interesting finding from the diary phase was that despite employing cognitive aids, chemotherapy patients experienced more cognitive difficulties compared to the other two groups. It may also be that these types of aids are not effective in this group or that they are not being used to their best advantage. It may be that breast cancer patients need assistance and information regarding the most appropriate tools to help manage the impact of cognitive impairment on daily tasks.

*Implications of findings for employers*

It is important that employers recognise that chemotherapy-related side effects can impact upon work ability. Since many chemotherapy patients took sickness absence during treatment, little information was gleaned regarding the impact of treatment-related side effects on safety in the workplace. Work adjustments may be necessary for breast cancer patients undergoing chemotherapy and employers may need tailored evidence-based guidance on how best to minimise potential safety risks so that employees undergoing treatment for breast cancer can successfully manage their return to work and work ability within a safe and supportive environment.

*Future research directions*

These findings highlight the need for future research to consider both the physical and psychological side effects of chemotherapy for breast cancer in order to fully understand the impact of treatment on safety-related outcomes. Firstly, it is important that the findings from the current study are validated, which could be done through further triangulation of the study results by follow-up interviews with the current participants in order to provide an additional source of data collection to support the current findings. In addition, the findings could be presented at breast cancer survivor groups and the feedback from these individuals could be analysed to examine whether their experiences are congruent with those who took part in the current study. Further longitudinal work is also required to map temporal changes in different types of accidents during and following chemotherapy so that interventions can be applied at

their most effective stage. Assessment time-points should be relatively close together during chemotherapy to coincide with the cycles of administration when side effects are at their most profound, as identified by the qualitative findings. The more long-term side effects and their impact should also be a focus for future work, especially as subtle cognitive difficulties may become more pronounced once patients resume functional ability, such as social and work activities (Ferguson, McDonald, Saykin, & Ahles, 2007; Meyers & Perry, 2008; Vardy & Tannock, 2007).

Furthermore, more work is required to explore return to work and safety issues as there may be scope for utilising work as a form of rehabilitation. Evidence for this comes from findings reported in the diaries, as one chemotherapy patient described how returning to work improved her cognitive function and she seemed to enjoy resuming her working life: *"Once returning to work my mind was much better"* (Participant CT60). Another chemotherapy patient reported how returning to work improved her confidence: *"I have had a phased return over 6 weeks, gradually increasing hours and teaching load until reached 4 full days/week (pre-diagnosis level). Finding it physically and mentally exhausting but confidence has improved noticeably since starting return"* (Participant CT34). However, it is important to consider that there may be more opportunities for accidents to occur in the workplace as individuals may be potentially exposed to a greater number of hazards. Further intervention studies are required to help manage the impact of cognitive and psychosocial difficulties on safety outcomes. Although several interventions currently under investigation in the literature include exercise and cognitive retraining, more specialised approaches may be required to minimise accidents and injuries in the breast cancer population. A number of intervention studies to improve quality of life in cancer patients have been conducted. However, relatively few studies have specifically addressed cognitive side effects in cancer patients. Indeed, many studies exclude cancer patients with cognitive difficulties (Locke, Cerhan & Malec, 2008). In contrast, cognitive rehabilitation interventions are widely applied in patients with acquired brain injury (Locke, Cerhan, & Malec, 2008). As previously stated, since the cognitive side effects of cancer and its treatment tend to be subtle, compensatory strategies could be applied by the patients themselves, such as using memory aids (e.g. cue cards).

These findings may also facilitate the development of self-reports tools to quantify chemotherapy-related side effects. As recently acknowledged by Myers (2010), self-report measures of cognitive function designed for cancer patients, such as the Functional Assessment for Cancer Therapy-Cognition (FACT-COG), do not include items related to driving or reading ability. This suggests that further qualitative studies are required to develop a comprehensive in-depth understanding of the range of side effects associated with chemotherapy (including psychosocial, cognitive and physical). As found in the current study, diaries can be a valuable tool for capturing in-depth data, and findings could be used to develop standardised measures, such as questionnaires and neuropsychological tests. This will help to ensure that the complete experience of breast cancer patients undergoing chemotherapy is understood and examined accurately. Since many side effects are interactive, it is important to address as many as possible for intervention to reduce the impact of chemotherapy on daily functioning. This provides support for adopting a holistic approach to disease and healthcare, as suggested by the biopsychosocial model. This is in line with the national service frameworks (NSFs), previously discussed in Chapter One. Qualitative work can provide the opportunity to record the lived experiences from the 'expert patient' so that a comprehensive understanding of treatment on daily can inform interventions in a patient-focussed manner (Department of Health, 2009). There needs to be a balance between comprehensive measures that capture the range of side effects, but not excessively time-demanding as this may induce fatigue, which could invalidate results.

As previously discussed in Chapter Three, researchers examining chemotherapy-related cognitive impairment have employed a diverse range of methodological designs (Vardy et al., 2008). Subsequently, this can make it difficult to compare findings across studies. Despite the growing literature on the cognitive impact of chemotherapy in the breast cancer population, there is a need for greater collaborative efforts involving multi-centre recruitment sites to undertake large-scale standardised research (Hurria, Somlo, & Ahles, 2007). Future research needs to investigate these important outcomes in a larger and more representative sample to validate the current findings. In particular, further longitudinal studies are required to determine the nature of cognitive impairment in breast cancer patients undergoing chemotherapy (e.g. prevalence, onset, duration) as well as the implications on daily life. There is an obvious need for further work to consider the safety outcomes associated with chemotherapy treatment in the breast

cancer population. In turn, intervention strategies could be developed to facilitate effective management of daily tasks in the breast cancer population. Furthermore, although the majority of research examining the impact of chemotherapy-related side effects is conducted in breast cancer patients due to the relatively large incidence and high survival rate of this disease, it is important that further work is conducted in other cancer populations.

## 10.5   Conclusion

To summarise, the findings from the quantitative analysis of the questionnaire data and the qualitative analysis of the diary data provided a valuable insight into the impact of chemotherapy on psychosocial well-being, cognitive function, and safety outcomes. In particular, the diaries provided rich data on the lived experiences of breast cancer patient's management of their daily tasks during chemotherapy. This offered valuable supplementary data to the quantitative analyses. Breast cancer patients undergoing chemotherapy report some temporal changes to their psychosocial well-being, cognitive function, physical function, and experience of accidents, which reflect the course of their treatment. However, the aetiology of these experiences is unclear and further research is required to establish the exact causes. Meanwhile, the identification of safety outcomes related to cognitive, psychosocial and physical side effects needs to be taken seriously by health professionals, as clearly they can have a detrimental impact on patients' daily lives. In particular, as the survival rate of breast cancer is increasing and prognosis improves, many patients are now looking to resume pre-diagnosis levels of daily functioning following treatment or continuing typical activities throughout treatment. Therefore, it is important that they are aware of potential safety-related side effects so that they can minimise potential hazards.

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# Appendices

*Ref No: R09-P99*

**LOUGHBOROUGH UNIVERSITY**

*ETHICAL ADVISORY COMMITTEE*

**RESEARCH PROPOSAL
INVOLVING HUMAN PARTICIPANTS**

_____

Shower

Bio oil legs

| | |
|---|---|
| *Title:* | *The effect of chemotherapy for breast cancer on managing daily tasks* |
| *Applicant:* | *Dr H McDermott, Dr F Munir, C Lawrence* |
| *Department:* | *Human Sciences* |
| *Date of clearance:* | *17 June 2009* |

**Comments of the Sub-Committee:**
The Sub-Committee agreed to issue clearance to proceed.

Favourable opinion letter re-issued to correct version number of CF - 28 May 2009

**NHS**

## National Research Ethics Service
### Nottingham Research Ethics Committee 2

1 Standard Court
Park Row
Nottingham
NG1 6GN
Telephone: 01158839425
Facsimile: 01159123300

13 May 2009

Miss Catherine Lawrence
PhD Research Student
Wavy Top Building
Loughborough University
Leicestershire, LE11 3TU

Dear Miss Lawrence,

| | |
|---|---|
| **Full title of study:** | **The effects of chemotherapy for breast cancer on managing daily tasks.** |
| **REC reference number:** | **09/H0408/62** |

Thank you for your email of 12 May 2009, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Vice-Chair.

**Confirmation of ethical opinion**

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

**Ethical review of research sites**

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

**Conditions of the favourable opinion**

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

For NHS research sites only, management permission for research ("R&D approval") should be obtained from the relevant care organisation(s) in accordance with NHS research governance arrangements. Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk. Where the only involvement of the NHS organisation is as a Participant Identification Centre, management permission for research is not required but the R&D office should be notified of the study. Guidance should be sought from the R&D office where necessary.

Sponsors are not required to notify the Committee of approvals from host organisations.

This Research Ethics Committee is an advisory committee to East Midlands Strategic Health Authority.
*The National Research Ethics Service (NRES) represents the NRES Directorate within the*
*National Patient Safety Agency and Research Ethics Committees in England.*

Favourable opinion letter re-issued to correct version number of CF - 28 May 2009

**Approved documents**

The final list of documents reviewed and approved by the Committee is as follows:

| Document | Version | Date |
|---|---|---|
| Application, | 16073/34452/1/992 | 02 April 2009 |
| Peer Review | | |
| Protocol | 1 | 02 April 2009 |
| Investigator CV | | 02 April 2009 |
| Investigator CV | Supervisor | 27 March 2009 |
| Instructions for diary entries | 1 | 02 April 2009 |
| Advertisement : poster | 1 | 02 April 2009 |
| Questionnaire: treatment | 1 | 02 April 2009 |
| Compensation Arrangements | | 01 August 2008 |
| Letter from Sponsor | | 02 April 2009 |
| Summary/Synopsis | 1 | 02 April 2009 |
| Response to Request for Further Information | | 12 May 2009 |
| Participant Consent Form | 3 | 11 May 2009 |
| Participant Information Sheet | 2 | 11 May 2009 |
| GP/Consultant Information Sheets | 1 | 11 May 2009 |
| Questionnaire: battery | 2 | 11 May 2009 |
| Questionnaire: recruitment | 2 | 11 May 2009 |

**Statement of compliance**

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

**After ethical review**

Now that you have completed the application process please visit the National Research Ethics Website > After Review

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

The attached document "After ethical review –guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

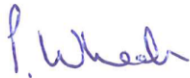Favourable opinion letter re-issued to correct version number of CF - 28 May 2009

We would also like to inform you that we consult regularly with stakeholders to improve our service. If you would like to join our Reference Group please email referencegroup@nres.npsa.nhs.uk.

| 09/H0408/62 | **Please quote this number on all correspondence** |
|---|---|

With the Committee's best wishes for the success of this project

Yours sincerely

Dr S Roe / Miss R Jibli
**Vice Chair / Coordinator**

Email: rinat.jibli@nottspct.nhs.uk

*Enclosures:*        "After ethical review – guidance for researchers"

Copy to:

Mr Peter Townsend
Director, Research office
Loughborough University
Leicestershire, LE11 3TU

R&D office for NHS care organisation at lead site - UHL

# Loughborough University research

*Are you interested in taking part in our cancer research project?*

*WE ARE RECRUITING BREAST CANCER PATIENTS ABOUT TO UNDERGO* **CHEMOTHERAPY** *OR* **RADIOTHERAPY** *TREATMENT*

• We are looking at how treatment for breast cancer affects thinking, memory and attention. This may have an influence on how breast cancer patients carry out their daily tasks.

• We are looking for adult women (of any age) to take part in our study. This involves answering a postal questionnaire on 4 occasions and also keeping a diary if you wish.

• We hope to increase knowledge on what is an important issue as more women are surviving breast cancer and continue their everyday activities during and after treatment.

If you would like to help with our research or have any questions then please contact us

Catherine Lawrence (Ph.D. student) Tel: 01509 228151 Email: C.L.Lawrence@lboro.ac.uk

27/05/2009; Version 1

# Loughborough University research

*Are you interested in taking part in our cancer research project?*

*WE ARE RECRUITING HEALTHY WOMEN TO JOIN OUR STUDY TO BE INVOLVED IN A COMPARISON GROUP*

*You need to be at least 18 years old and had <u>no</u> diagnosis of cancer*

• We are looking at how chemotherapy treatment for breast cancer affects thinking, memory and attention. This may have an influence on how breast cancer patients carry out their daily tasks.

• We are looking for healthy adult women (of any age) to take part in our study. This involves answering a questionnaire (postal or online) on 4 occasions.

• We hope to increase knowledge on what is an important issue as more women are surviving breast cancer and continue their daily activities. By comparing information from breast cancer patients and healthy women we can identify any changes over time more clearly.

If you would like to help with our research or have any questions then please contact us

Catherine Lawrence (Ph.D. student) Tel: 01509 228151 Email: C.L.Lawrence@lboro.ac.uk

# University Hospitals of Leicester **NHS**

**NHS Trust**

**Leicester Royal Infirmary**
Leicester
LE1 5WW

Tel: 0116 254 1414
Fax: 0116 258 5631
Minicom: 0116 258 6878

## THE EFFECT OF CHEMOTHERAPY FOR BREAST CANCER ON MANAGING DAILY TASKS

## PARTICIPANT INFORMATION SHEET

We would like to invite you to take part in our research project. The research team is based at Loughborough University.

Please read this information sheet carefully. It is important that you understand why the research is being done and what is involved should you wish to take part. If you have any questions or comments please contact the researcher – contact details are at the end of this sheet. You may also wish to talk to a member of the breast cancer team at the hospital, a family member or a friend about the study. Please take time to consider whether or not you wish to take part. If you do not wish to take part then please note that this decision has no impact whatsoever on your treatment or the standard of care you receive at the hospital.

- **What is the purpose of the study?**

We are interested in looking at the effect of **chemotherapy** and **radiotherapy** treatment on breast cancer patients' ability to think, concentrate and remember. Problems with these abilities may have an influence on oversights, lapses and absent-mindedness experienced during daily activities. This might include looking for your glasses then realising you're already wearing them, or injuring yourself during a fall. 'Human error' as a result of treatment may have an impact on typical activities at home, during leisure activities or at work. For some patients, maintaining or returning to their typical daily activities during and after treatment is an important step on the road to recovery. As more women are surviving cancer, understanding the impact of treatment is an important issue not only for patients, but also for healthcare professionals, employers, friends and family members who can offer support and guidance during and after treatment.

This study, which is part of a Ph.D. research project, will give the opportunity for breast cancer patients to provide valuable insight into the effects of cancer treatment. This information will be used to inform others so that the experiences of breast cancer patients are better understood. In time, we hope this will lead to intervention and

rehabilitation programmes that support cancer patients coping with the side effects of cancer and treatment. Improved guidance for employers could also be developed.

There are 2 parts to this study. Firstly, we would like to invite you to answer a questionnaire which will be posted to you. This will happen on 4 occasions throughout a 12-month period. Secondly, there is also the option to keep a diary during a period of your treatment. More information about each part follows.

- **Why have I been invited?**

You have been invited to take part in this study because you will be receiving breast cancer treatment at Leicester Royal Infirmary. We are interested in recruiting women who: have been diagnosed with breast cancer and will receive **chemotherapy** or **radiotherapy** treatment; have breast cancer as their primary cancer diagnosis; are able to read and write standard English.

- **Do I have to take part?**

It is your decision to volunteer to participate in the study. If you do not wish to take part then please note that this decision has no impact on the standard of care you receive. If you are interested and sign the Consent Form, you can still withdraw from the study at any time up to the point of publication. No reason is necessary.

- **What will happen to me if I take part?**

If you decide to take part then you will first need to contact the researcher to express your interest in the study – contact details are at the end of this sheet. Please take time to come to a decision and ask the researcher any questions you have. You will be asked to answer a brief recruitment questionnaire either by telephone or at the clinic with the researcher to make sure that you meet the criteria to take part. You will then be asked to sign the Consent Form if you are happy to do so. Three copies of the signed Consent Form will be made: one for you, one for the researcher and one for your medical records.

If you are happy to take part, then with your permission, the researcher will ask your breast cancer nurse or consultant about the type of cancer you have and your treatment. Please note that this information will be kept strictly confidential.

*Questionnaire*
The study involves answering a questionnaire which will be posted to your home address on four occasions (Time 1: before you start treatment; Time 2: four months later; Time 3: eight months later, and Time 4: twelve months later). The questionnaire asks about your general feelings, memory and concentration. It will take about 30 minutes to complete and you can return it in the pre-paid envelope within a week of receiving the questionnaire.

*Diary*
There is a second part to the study. It is up to you if you wish to keep a diary as well as answering the questionnaire. You will be asked to keep a diary for 4 months during your treatment and to record any incidences when you notice that you experience absent-mindedness. This might include forgetting to buy something from the supermarket, sending an email to the wrong person or a physical fall. Each entry need

only be a couple of minutes. We are interested in what errors you might make during typical activities, no matter how big or small.

- **What are the possible disadvantages and risks of taking part?**

The questionnaire should not cause you any discomfort or distress. You should only participate if you feel comfortable doing so. The researcher will meet with you at the start to outline the project and answer any questions you have. We will schedule meeting with you when you are attending the clinic to reduce any inconvenience to you. However, the researcher could visit you in your home if you prefer, or you could visit Loughborough University. Please note that we cannot reimburse travelling expenses.

Please be aware that the researcher is not a clinician or a breast cancer nurse. We advise that you contact your GP, a member of the cancer team at the hospital, or your local support groups should you feel distressed, for whatever reason, at any point.

- **What are the possible benefits of taking part?**

There will be no direct immediate benefit to you. Your participation will give an insight into the effects of cancer treatment which will provide valuable information about the experiences of breast cancer patients. This will enable better information to be available to cancer patients, healthcare professionals, employers and the general public. In time, we hope that intervention and rehabilitation programmes will be designed to support cancer patients coping with treatment side effects. Guidance could also be developed for employers and others. You will receive a summary of our findings, which will be available approximately one year after the end of the study.

- **Will my taking part in the study be kept confidential?**

If you decide to take part in the study then the researcher will require information about the type of cancer you have and your treatment. This information will be provided by a member of the breast cancer team by a questionnaire. Your identity will be protected by allocating a number to this information and your completed questionnaires. This will be stored with your contact details in a locked filing cabinet at Loughborough University. All information you provide will be kept strictly confidential and will only be accessible by the research team.

Electronic data will be stored securely on a computer at Loughborough University. This information will only be accessible by a password known only to the research team. The procedure for handling, processing, storage and destruction of your data will be compliant with the Data Protection Act 1998.

All reported data, that is anything written up about the study, will be made anonymous so that you cannot be identified. If you decide to take part in keeping an audio-diary, then your entries will be typed up and stored securely on a computer at Loughborough University. Again, your allocated number, instead of your name, will be used. Extracts from diary entries may be reported in publications, but all quotations will be made anonymous so that you cannot be identified.

- **What happens if I don't want to carry on with the study?**

You can withdraw from the study at any time and you don't need to give a reason for doing so. Once you have withdrawn you will not be asked to answer any more

questionnaires. If you are keeping an audio-diary then we will ask you to return the tape-recorder to a member of the breast cancer team or the researcher can collect it.

Withdrawing from the study does not affect your treatment or standard of care received. If you wish to withdraw you will be asked if you want any completed questionnaires or audio-diary entries to be discarded from the study. Previous information, although unfinished, may still benefit our research. We will shred questionnaires you have returned and delete any audio-tape recordings if you wish.

- **What if there is a problem?**

If you have any concerns about any aspect of the study then please contact the researcher. If you remain unhappy and wish to complain formally then please contact the Patient Advice and Liaison Service (PALS) at the hospital. You can contact PALS if you need advice or have concerns. Contact details are at the end of the sheet.

In the event that something goes wrong and you are harmed during the research and this is due to someone's negligence then you may have grounds for a legal action for compensation against Loughborough University. You may have to pay your legal costs. The Patient Advice and Liaison Service will be able to provide information.

- **What will happen to the results of the research study?**

This research is part of a Ph.D. project. We will summarise the data and anonymous data will be reported in academic journals and at conferences. This enables the sharing of information between researchers, filling the gap of knowledge and allows others to learn from the data. We will send you details of publications if you wish. You will be sent a summary of the findings once all results have been analysed.

- **Who has reviewed the study?**

This research has been reviewed by an independent group of people called the NHS Research Ethics Committee. They have given the research ethical approval to take place at Leicester Royal Infirmary. Loughborough University's Ethical Advisory Committee has also approved the study.

- **What if I have any questions or concerns?**

If you have any questions or comments, or wish to express your interest in taking part, please contact the researcher:

<div align="center">

Miss Catherine Lawrence, B.Sc. M.Sc.
School of Sport, Exercise and Health Sciences
Wavy Top Building
Loughborough University
Loughborough
Leicestershire
LE11 3TU
Tel: 01509 228151
Email: C.L.Lawrence@lboro.ac.uk

</div>

Other points of contact include your breast cancer team or the Patient Advice and Liaison Service (PALS) at Leicester Royal Infirmary. Please use this source if you need advice or have concerns:

PALS Office
Glenfield Hospital
Groby Road
Leicester, LE3 9QP
Tel: 0116 258 3100

**Thank you for taking the time to read this information sheet and for considering taking part in the study. Please retain this information sheet for future reference.**

**University Hospitals of Leicester** **NHS**

**NHS Trust**

**Leicester Royal Infirmary**
Leicester
LE1 5WW

Tel: 0116 254 1414
Fax: 0116 258 5631
Minicom: 0116 258 6878

**THE EFFECT OF CHEMOTHERAPY FOR BREAST CANCER ON MANAGING DAILY TASKS**

**CONSENT FORM**

*Please initial box*

- I have read the Participant Information Sheet dated **13/08/2009 (Version 3)** and have had the opportunity to consider the information. Any questions I had have been answered satisfactorily.

- I understand that my participation is voluntary and that I am free to withdraw from the study at any time and do not need to give a reason, without my medical care or legal rights being affected.

- I understand that a member of the breast care team will be asked questions relating to my cancer and treatment regime. If my treatment changes I understand that the researcher will ask a breast cancer nurse or consultant for an update of my treatment details.

- I agree to my GP being informed of my participation in the study.

- I agree to being contacted by the researcher if necessary.

- I understand that the researcher may contact a breast cancer nurse or consultant if she becomes concerned about my well-being.

- I understand that relevant sections of my medical notes and data collected during the study may be looked at by individuals from regulatory authorities or from the NHS Trust where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.

- I understand that the information I provide will be kept strictly confidential to the research team at Loughborough University, in accordance with the Data Protection Act.

☐

- I understand that only anonymous data may be published.

☐

- I agree to take part in the questionnaire study.

☐

- Do you wish to keep a diary?                    YES

☐

                                                    NO

☐

    If YES, I understand that anonymous quotations may be published.

☐

| | | |
|---|---|---|
| Name of patient | Date | Signature |

| | | |
|---|---|---|
| Name of researcher | Date | Signature |

*When completed 1 copy for patient, 1 original for researcher site file & 1 copy kept in medical notes*

**Loughborough University**

**THE EFFECT OF CHEMOTHERAPY FOR BREAST CANCER ON MANAGING DAILY TASKS**

**HEALTHY PARTICIPANTS / NON-CANCER GROUP**

**CONSENT FORM**

*Please initial box*

- I have read the Participant Information Sheet dated 27/05/2009 (Version 1) and have had the opportunity to consider the information. Any questions I had have been answered satisfactorily.

- I understand that my participation is voluntary and that I am free to withdraw from the study at any time and do not need to give a reason.

- I agree to being contacted by the researcher if necessary.

- I understand that the information I provide will be kept strictly confidential to the research team at Loughborough University, in accordance with the Data Protection Act.

- I understand that only anonymous data may be published.

- I agree to take part in the questionnaire study.

- Do you wish to keep a diary?                                   YES
                                                                 NO

  If YES, I understand that anonymous quotations may be published.

_____        _____        _____
Name of participant                    Date                     Signature

_____        _____        _____
Name of researcher                     Date                     Signature

*When completed 1 copy for participant & 1 original for researcher site file*

313

# University Hospitals of Leicester NHS

## NHS Trust

**Leicester Royal Infirmary**
Leicester
LE1 5WW

Tel: 0116 254 1414
Fax: 0116 258 5631
Minicom: 0116 258 6878

**THE EFFECT OF CHEMOTHERAPY FOR BREAST CANCER
ON MANAGING DAILY TASKS**

**RECRUITMENT QUESTIONNAIRE**

**Participant Number:** _____     **Date:** _____

*Please answer all questions. The information you provide will be kept strictly
confidential. The questionnaire will take approximately 10 minutes to complete.*

## PART A: *Questions about you*

1. **What is your date of birth?** (dd/mm/yy) ____/____/____

2. **What is your ethnic background?**

☐   White British
☐   White Irish
☐   Other White              (please state) _____
☐   Black African
☐   Black Caribbean
☐   Other Black              (please state) _____
☐   Bangladeshi
☐   Indian
☐   Pakistani
☐   Chinese
☐   Other Asian             (please state) _____
☐   Mixed ethnic origin   (please state) _____
☐   Other ethnic group    (please state) _____

**3.  What is your marital status?**

☐  Single                                    ☐  Married/living with partne

☐  Separated/divorced                        ☐  Widowed

☐  Other (please specify) _____

**4.  Is English your first language?**

☐  Yes                                       ☐  No (please specify)_____

**5.  Can you read and write standard English?**

☐  Yes                                       ☐  No

**6.  What is the highest academic qualification you have obtained?**

☐  None                                      ☐  GSCE (or equivalent)

☐  A Level (or equivalent)                   ☐  Degree (e.g. BSc, BA)

☐  Higher Degree (e.g. MSc, MA, PhD)         ☐  Other academic qualification
                                                (please state) _____

**7.  Please select the most appropriate menopausal stage you are at:**

☐  Pre-menopausal                            ☐  Post-menopausal
   (Not had menopausal symptoms)                (Have menopausal sympto

# PART B: *Questions about your employment status <u>just before the time of diagnosis</u>*

**8.  How would you describe your employment status just before diagnosis?**

☐  Working full-time                         ☐  Working part-time

☐  On sick leave                             ☐  Unemployed

☐  Retired                                   ☐  Other (please specify) ____
                                                _____

## *If you were <u>not working</u> just before you were diagnosed, go to PART C*

**9.  What was your occupation?**
_____

**10. On average, how many hours did you work per week?**_____ hours / week

## PART C: *Questions about cancer*

**11. When were you diagnosed with breast cancer?** ___/___/___ (dd/mm/yy)

**12. What treatment will you receive (e.g. surgery, chemotherapy, radiotherapy, hormone therapy)?**
_____
_____

**13. When is your first treatment appointment?** ___/___/___ (dd/mm/yy)

*Thank you for taking the time to complete this questionnaire*

*If you have any problems or require further information, please contact the researcher Catherine Lawrence*
*Email: C.L.Lawrence@lboro.ac.uk  Tel: 01509 228151*

**Loughborough University**

**THE EFFECT OF CHEMOTHERAPY FOR BREAST CANCER
ON MANAGING DAILY TASKS**

**RECRUITMENT & TREATMENT QUESTIONNAIRE**

**Participant Number:** _____          **Date:** _____

*Please answer all questions. The information you provide will be kept strictly confidential. The questionnaire will take approximately 10 minutes to complete.*

## PART A: *Questions about you*

1.  **What is your date of birth?** (dd/mm/yy) ____/____/____

2.  **What is your ethnic background?**

☐  White British
☐  White Irish
☐  Other White          (please state) _____
☐  Black African
☐  Black Caribbean
☐  Other Black          (please state) _____
☐  Bangladeshi
☐  Indian
☐  Pakistani
☐  Chinese
☐  Other Asian          (please state) _____
☐  Mixed ethnic origin   (please state) _____
☐  Other ethnic group    (please state) _____

3.  **What is your marital status?**

☐  Single                              ☐  Married/living with partner
☐  Separated/divorced                  ☐  Widowed
☐  Other (please specify) _____

4.  **Is English your first language?**

☐  Yes                                 ☐  No (please specify)_____

5.  **Can you read and write standard English?**

☐  Yes                                 ☐  No

**6. What is the highest academic qualification you have obtained?**

☐  None                    ☐  GSCE (or equivalent)
☐  A Level (or equivalent)  ☐  Degree (e.g. BSc, BA)
☐  Higher Degree (e.g. MSc, MA, PhD)  ☐  Other academic qualification
                                              (please state) _____

**7. Please select the most appropriate menopausal stage you are at:**

☐  Pre-menopausal          ☐  Post-menopausal
    (Not had menopausal symptoms)      (Have menopausal symptoms)

## PART B: *Questions about your employment status <u>just before the time of diagnosis</u>*

**8. How would you describe your employment status just before diagnosis?**

☐  Working full-time       ☐  Working part-time
☐  On sick leave           ☐  Unemployed
☐  Retired                 ☐  Other (please specify) _____
                                  _____

## *If you were <u>not working</u> just before you were diagnosed, go to PART C*

**9. What was your occupation?**
_____

**10. On average, how many hours did you work per week?**_____ hours / week

## PART C: *Questions about cancer*

**11. When were you diagnosed with breast cancer?** ___/___/___ (dd/mm/yy)

**12. What type of breast cancer do you have?**

☐      Ductal carcinoma in situ (DCIS)
☐      Lobular carcinoma in situ (LCIS)
☐      Invasive ductal breast cancer
☐      Invasive lobular breast cancer
☐      Inflammatory breast cancer
☐      Other (please specify) _____

**13. What is the stage of the breast cancer?** Stage _____

**14. What is the grade of the breast cancer?** Grade _____

**15. Do you have any other type of cancer?**

☐   Yes (please specify) _____          ☐    No

## PART D: *Questions about chemotherapy or radiotherapy treatment*

**16. Please outline the type of cancer treatment (e.g. chemotherapy, radiotherapy, hormone therapy) you will receive**
Try to include as much information as you can – please put *don't know* for any sections you cannot complete

| Treatment | Name of drugs | Dose | Start date | End date |
|-----------|---------------|------|------------|----------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**17. When is your first treatment appointment?**

Chemotherapy      ___/___/___ (dd/mm/yy)      I'm not having chemotherapy ☐

Radiotherapy      ___/___/___ (dd/mm/yy)      I'm not having radiotherapy ☐

**18. Are you currently receiving any treatment(s) for another condition?**

☐   Yes (please specify) _____        ☐    No

## PART E: *Questions about surgery*

**19. Have you received surgery for breast cancer?**

☐   Yes                     ☐    No
          *If you have ticked NO, please go to Question 27*

**20. Please state the type of surgery received and the date it was performed**

_____ Date: ____/____/____

**23. Will you receive surgery in the future?**

☐    Yes                          ☐    No

**24. Please state the type of surgery and the date it will be performed**

_____ Date: ____/____/____

*Thank you for taking the time to complete this questionnaire*

*If you have any problems or require further information, please contact the researcher Catherine Lawrence*
*Email: C.L.Lawrence@lboro.ac.uk  Tel: 01509 228151*

![Loughborough University logo]

# THE EFFECT OF CHEMOTHERAPY FOR BREAST CANCER ON MANAGING DAILY TASKS

## HEALTHY SAMPLE / NON-CANCER GROUP

## RECRUITMENT QUESTIONNAIRE

**Participant Number:** _____    **Date:** _____

*Please answer all questions. The information you provide will be kept strictly confidential. The questionnaire will take approximately 10 minutes to complete.*

## PART A: *Questions about you*

1. **What is your date of birth?** (dd/mm/yy) ____/____/____

2. **What is your ethnic background?**

☐ White British
☐ White Irish
☐ Other White          (please state) _____
☐ Black African
☐ Black Caribbean
☐ Other Black          (please state) _____
☐ Bangladeshi
☐ Indian
☐ Pakistani
☐ Chinese
☐ Other Asian          (please state) _____
☐ Mixed ethnic origin  (please state) _____
☐ Other ethnic group   (please state) _____

3. **What is your marital status?**

☐ Single                          ☐ Married/living with partner
☐ Separated/divorced              ☐ Widowed
☐ Other (please specify) _____

4. **Is English your first language?**

☐ Yes                             ☐ No (please specify)_____

**5. Can you read and write standard English?**

☐   Yes                                   ☐   No

**6. What is the highest academic qualification you have obtained?**

☐  None                                          ☐  GSCE (or equivalent)
☐  A Level (or equivalent)                   ☐  Degree (e.g. BSc, BA)
☐  Higher Degree (e.g. MSc, MA, PhD)      ☐  Other academic qualification
                                                          (please state) _____

**7. Please select the most appropriate menopausal stage you are at:**

☐  Pre-menopausal                          ☐  Post-menopausal
      (Not had menopausal symptoms)            (Have menopausal sympto

## PART B: *Questions about your current employment status*

**8. How would you describe your current employment status?**

☐  Working full-time                        ☐  Working part-time
☐  On sick leave                             ☐  Unemployed
☐  Retired                                   ☐  Other (please specify) ____
                                                        _____

### *If you are <u>not working</u>, please go to PART C*

**9. What is your occupation?**
_____

**10. On average, how many hours do you work per week?**_____ hours / week

## PART C: *Questions about your health*

**11. Do you have any chronic illnesses?**

    ☐  Yes (please specify) _____        ☐  No

**12. Are you currently receiving any treatment(s) for a condition?**

☐  Yes (please specify) _____        ☐  No

*Thank you for taking the time to complete this questionnaire*

*If you have any problems or require further information, please contact the
researcher Catherine Lawrence
Email: C.L.Lawrence@lboro.ac.uk  Tel: 01509 228151*

# University Hospitals of Leicester NHS

## NHS Trust

### Leicester Royal Infirmary
Leicester
LE1 5WW

Tel: 0116 254 1414
Fax: 0116 258 5631
Minicom: 0116 258 6878

**THE EFFECT OF CHEMOTHERAPY FOR BREAST CANCER
ON MANAGING DAILY TASKS**

**TREATMENT QUESTIONNAIRE**

**Participant Number:** _____  **Date:** _____

*Please answer the following questions about the patient named on the attached
sheet, who has provided consent for this questionnaire to be completed by a breast
cancer nurse or consultant. All information will be kept strictly confidential. The
questionnaire will take approximately 10 minutes to complete. Please return the
questionnaire to the researcher in the pre-paid envelope provided.*

## PART A: *Questions about the cancer diagnosis*

1. **When was the patient diagnosed with breast cancer?** _____/_____/_____

2. **What type of breast cancer does the patient have?**

   ☐    Invasive ductal breast cancer
   ☐    Invasive lobular breast cancer
   ☐    Inflammatory breast cancer
   ☐    Other (please specify) _____

3. **At what stage is the patient's breast cancer?** Stage _____

4. **At what grade is the patient's breast cancer?** Grade _____

5. **Is breast cancer the patient's primary cancer diagnosis?**

   ☐    Yes                              ☐    No

## PART B: *Questions about surgery*

**6. Has the patient received surgery for her breast cancer?**

☐  Yes                                    ☐  No

*If you have ticked NO, please go to Question 8*

**7. Please state the type of surgery received and the date it was performed**
_____ Date: ____/____/____

*Please go to PART C*

**8. Will the patient receive surgery in the future?**

☐  Yes                                    ☐  No

**9. Please state the type of surgery and the date it will be performed**
_____ Date: ____/____/____

## PART C: *Questions about cancer treatment*

**10. Please outline the type of cancer treatment (e.g. chemotherapy, radiotherapy, hormone therapy, biological therapy) the patient will receive**

| Treatment | Name of drugs | Dose | Start date | End date |
|-----------|---------------|------|------------|----------|
| ………………………………………………………………………………………… |
| ………………………………………………………………………………………… |
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| ………………………………………………………………………………………… |

**12.** Has the patient experienced chemotherapy-induced menopause?

☐  Yes                                    ☐  No
☐  Not sure

*Thank you for taking the time to complete the questionnaire*
*If you have any questions please contact the researcher Catherine Lawrence*
*Email: C.L.Lawrence@lboro.ac.uk  Tel: 01509 228151*

Date: 22/06/2010; Version: 2; Reference Number: 09/H0408/62

## University Hospitals of Leicester NHS

### NHS Trust

**Leicester Royal Infirmary**
Leicester
LE1 5WW

Tel: 0116 254 1414
Fax: 0116 258 5631
Minicom: 0116 258 6878

## THE EFFECTS OF CHEMOTHERAPY FOR BREAST CANCER ON MANAGING DAILY TASKS

## QUESTIONNAIRE: ASSESSMENT 1

**Participant Number:** _____          **Date:** _____

This questionnaire should take approximately 30 minutes to complete.

Please answer the questionnaire as honestly and accurately as possible. All responses will be kept strictly confidential and anonymous. There is a blank page at the end of the questionnaire should you wish to add anything about your experiences of managing daily activities.

Please complete and return the questionnaire in the pre-paid envelope within 1 week.

If you have questions or comments please contact the researcher
Catherine Lawrence at Loughborough University
Tel: 01509 228151 or Email: C.L.Lawrence@lboro.ac.uk

*Thank you for taking the time to complete the questionnaire*
*We value your thoughts and experiences*

## PART A: *Questions about your general feelings*

The following statements are concerned with general feelings about yourself. Please don't take too long to think about your replies; your immediate reaction to each item will probably be more accurate than a long thought-out response. Please circle the appropriate rating for each statement which best reflects how you have felt <u>during the past week</u>.

| | | | | | |
|---|---|---|---|---|---|
| 1) | **I feel tense or 'wound up'** | Most of the time | A lot of the time | From time to time, occasionally | Not at all |
| 2) | **I still enjoy the things I used to enjoy** | Definitely as much | Not quite so much | Only a little | Hardly at all |
| 3) | **I get a sort of frightened feeling as if something awful is about to happen** | Very definitely and quite badly | Yes, but not too badly | A little, but it doesn't worry me | Not at all |
| 4) | **I can laugh and see the funny side of things** | As much as I always could | Not quite so much now | Definitely not so much now | Not at all |
| 5) | **Worrying thoughts go through my mind** | A great deal of the time | A lot of the time | From time to time but not too often | Only occasionally |
| 6) | **I feel cheerful** | Not at all | Not often | Sometimes | Most of the time |
| 7) | **I can sit at ease and feel relaxed** | Definitely | Usually | Not often | Not at all |
| 8) | **I feel as if I am slowed down** | Nearly all the time | Very often | Sometimes | Not at all |
| 9) | **I get a sort of frightened feeling like 'butterflies' in the stomach** | Not at all | Occasionally | Quite often | Very often |
| 10) | **I have lost interest in my appearance** | Definitely | I don't take as much care as I should | I may not take quite as much care | I take just as much care as ever |
| 11) | **I feel restless as if I have to be on the move** | Very much indeed | Quite a lot | Not very much | Not at all |
| 12) | **I look forward with enjoyment to things** | As much as I ever did | Rather less than I used to | Definitely less than I used to | Hardly at all |
| 13) | **I get sudden feelings of panic** | Very often indeed | Quite often | Not very often | Not at all |
| 14) | **I can enjoy a good book or radio or TV programme** | Often | Sometimes | Not often | Very seldom |

## PART B: *Questions about your energy levels*

| | | Not at all | A little bit | Somewhat | Quite a bit | Very much |
|---|---|---|---|---|---|---|
| 1) | I feel fatigued | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2) | I feel weak all over | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3) | I feel listless ("washed out") | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4) | I feel tired | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5) | I have trouble starting things because I am tired | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6) | I have trouble finishing things because I am tired | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7) | I have energy | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8) | I am able to do my usual activities | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9) | I need to sleep during the day | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10) | I am too tired to eat | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11) | I need help doing my usual activities | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12) | I am frustrated by being too tired to do the things I want to do | ☐ | ☐ | ☐ | ☐ | ☐ |
| 13) | I have to limit my social activity because I am tired | ☐ | ☐ | ☐ | ☐ | ☐ |

## PART C: *Questions about your general well-being*

Below is a list of statements that other people with your illness have said are important. By ticking the most appropriate box per line, please indicate how true each statement has been for you <u>during the past week</u>.

| | | Not at all | A little bit | Some-what | Quite a bit | Very much |
|---|---|---|---|---|---|---|
| 1) | I have a lack of energy | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2) | I have nausea | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3) | Because of my physical condition, I have trouble meeting the needs of my family | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4) | I have pain | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5) | I am bothered by the side effects of treatment | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6) | I feel ill | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7) | I am forced to spend time in bed | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8) | I feel close to my friends | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9) | I get emotional support from my family | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10) | I get support from my friends | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11) | My family has accepted my illness | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12) | I am satisfied with family communication about my illness | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | Not at all | A little bit | Some-what | Quite a bit | Very much |
|---|---|---|---|---|---|---|
| 13) | **I feel close to my partner (or the person who is my main support)** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 14) | *Regardless of your current level of sexual activity, please answer the following question. If you prefer not to answer it, please check this box* ☐ *and go on to the next item.* **I am satisfied with my sex life** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 15) | **I feel sad** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 16) | **I am satisfied with how I am coping with my illness** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 17) | **I am losing hope in the fight against my illness** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18) | **I feel nervous** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19) | **I worry about dying** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20) | **I worry that my condition will get worse** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21) | **I am able to work (include work at home)** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 22) | **My work (include work at home) is fulfilling** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 23) | **I am able to enjoy life** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 24) | **I have accepted my illness** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 25) | **I am sleeping well** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 26) | **I am enjoying the things I usually do for fun** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 27) | **I am content with the quality of my life right now** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 28) | **I have been short of breath** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 29) | **I am self-conscious about the way I dress** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 30) | **One or both of my arms are swollen or tender** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 31) | **I feel sexually attractive** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 32) | **I am bothered by hair loss** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 33) | **I worry that other members of my family might someday get the same illness I have** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 34) | **I worry about the effect of stress on my illness** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 35) | **I am bothered by a change in weight** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 36) | **I am able to feel like a woman** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 37) | **I have certain parts of my body where I experience significant pain** | ☐ | ☐ | ☐ | ☐ | ☐ |

## PART D: *Questions about making mistakes*

The following questions are about minor mistakes which everyone makes from time to time, but some of which happen more often than others. We want to know how often these things have happened to you in the past week.  Please tick the most appropriate box for each question.

| | | Very Often | Quite Often | Occasionally | Very Rarely | Never |
|---|---|---|---|---|---|---|
| 1) | **Do you read something and find you haven't been thinking about it and must read it again?** | □ | □ | □ | □ | □ |
| 2) | **Do you find you forget why you went from one part of the house to the other?** | □ | □ | □ | □ | □ |
| 3) | **Do you fail to notice signposts on the road?** | □ | □ | □ | □ | □ |
| 4) | **Do you find you confuse right and left when giving directions?** | □ | □ | □ | □ | □ |
| 5) | **Do you bump into people?** | □ | □ | □ | □ | □ |
| 6) | **Do you find you forget whether you've turned off a light or a fire or locked the door?** | □ | □ | □ | □ | □ |
| 7) | **Do you fail to listen to people's names when you are meeting them?** | □ | □ | □ | □ | □ |
| 8) | **Do you say something and realise afterwards that it might be taken as insulting?** | □ | □ | □ | □ | □ |
| 9) | **Do you fail to hear people speaking to you when you are doing something else?** | □ | □ | □ | □ | □ |
| 10) | **Do you lose your temper and regret it?** | □ | □ | □ | □ | □ |
| 11) | **Do you leave important letters unanswered for days?** | □ | □ | □ | □ | □ |
| 12) | **Do you find you forget which way to turn on a road you know well but rarely use?** | □ | □ | □ | □ | □ |
| 13) | **Do you fail to see what you want in a supermarket (although it's there)?** | □ | □ | □ | □ | □ |
| 14) | **Do you find yourself suddenly wondering whether you've used a word correctly?** | □ | □ | □ | □ | □ |
| 15) | **Do you have trouble making up your mind?** | □ | □ | □ | □ | □ |
| 16) | **Do you find you forget appointments?** | □ | □ | □ | □ | □ |

|  |  | Very Often | Quite Often | Occasionally | Very Rarely | Never |
|---|---|:---:|:---:|:---:|:---:|:---:|
| 17) | **Do you forget where you put something like a newspaper or a book?** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18) | **Do you find you accidentally throw away the thing you want and keep what you meant to throw away - as in the example of throwing away the matchbox and putting the used match in your pocket?** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19) | **Do you daydream when you ought to be listening to something?** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20) | **Do you find you forget people's names?** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21) | **Do you start doing one thing at home and get distracted into doing something else (unintentionally)?** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 22) | **Do you find you can't quite remember something although it's "on the tip of your tongue"?** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 23) | **Do you find you forget what you came to the shops to buy?** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 24) | **Do you drop things?** | ☐ | ☐ | ☐ | ☐ | ☐ |
| 25) | **Do you find you can't think of anything to say?** | ☐ | ☐ | ☐ | ☐ | ☐ |

## PART E: *Questions about your experiences while at home and in the workplace*

1. **How often have <u>accidents</u> occurred, while you were at home, during the past week? (E.g. dropped something; fallen over; injured yourself)**

| All the time | Often | Occasionally | Rarely | Never |
|:---:|:---:|:---:|:---:|:---:|
| ☐ | ☐ | ☐ | ☐ | ☐ |

2. **Please list the types of accidents that have occurred during the past week (if any)**

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_____
_____

## AT WORK
### *If you are not currently working, please go to PART F - Question 1*

3. **How often have accidents occurred, while at work, during the past week? (E.g. dropped something; fallen over; injured yourself)**

| All the time | Often | Occasionally | Rarely | Never |
|:---:|:---:|:---:|:---:|:---:|
| ☐ | ☐ | ☐ | ☐ | ☐ |

4. **Please list the types of accidents that have occurred during the past week (if any)**

_____
_____
_____

## PART F: *Questions about your current employment status*

Please answer the following questions in relation to your <u>current employment status</u>

1. **How would you describe your current employment status?**

☐ Working full-time        ☐ Working part-time
☐ On sick leave        ☐ Unemployed
☐ Retired        ☐ Other (please specify) _____

### *\* If you <u>are not</u> currently working, please go PART H \**

**What is your current occupation?**
_____

2. **On average, how many hours do you currently work per week?**_____ hours / week

3. **Have you experienced any changes, e.g. adjustments, in your work since you were diagnosed?**

☐ Yes                ☐ No

**If yes, please tick the changes that have been made:**

| | Yes | No | Change currently in place |
|---|:---:|:---:|:---:|
| Offered support services (e.g. counselling) | ☐ | ☐ | ☐ |
| Working fewer hours | ☐ | ☐ | ☐ |
| Flexible working hours | ☐ | ☐ | ☐ |
| Frequent breaks | ☐ | ☐ | ☐ |
| Slower work pace | ☐ | ☐ | ☐ |
| Shared responsibility for tasks | ☐ | ☐ | ☐ |
| Reduced physical demands (e.g. lifting) | ☐ | ☐ | ☐ |
| Reduced mental demands (e.g. work-load) | ☐ | ☐ | ☐ |
| Allocated space to rest / lie down | ☐ | ☐ | ☐ |
| Other (please specify) _____ | ☐ | ☐ | ☐ |
| Other (please specify) _____ | ☐ | ☐ | ☐ |
| Other (please specify) _____ | ☐ | ☐ | ☐ |

1. **Are the demands of your work primarily:**

   ☐ Mental            ☐ Physical            ☐ Both mental and physical

2. **Assume that your work ability at its best has a value of 10 points. How many points would you give your current work ability? Please circle the most appropriate number (0 = cannot currently work at all; 10 = current work ability is at its best).**

   | Completely unable to work | 0   1   2   3   4   5   6   7   8   9   10 | Work ability at its best |

3. **How do you rate your current work ability with respect to the physical demands of your work?**

   | Very good | Rather good | Moderate | Rather poor | Very poor |
   |:---:|:---:|:---:|:---:|:---:|
   | ☐ | ☐ | ☐ | ☐ | ☐ |

4. **How do you rate your current work ability with respect to the mental demands of your work?**

   | Very good | Rather good | Moderate | Rather poor | Very poor |
   |:---:|:---:|:---:|:---:|:---:|
   | ☐ | ☐ | ☐ | ☐ | ☐ |

## PART G – *Questions about the questionnaire*

**1. Have you experienced any problems completing this questionnaire?**

☐  Yes (please explain)                    ☐  No

_____
_____
_____

**2. Have you experienced any problems remembering things which the questions ask about?**

☐  Yes (please explain)                    ☐  No

_____
_____
_____

*Thank you for taking the time to complete the questionnaire.*

*Please use the blank page on the next page if you would like to share anything else about your experiences of managing your daily activities.*

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University Hospitals of Leicester **NHS**

NHS Trust

**Leicester Royal Infirmary**
Leicester
LE1 5WW

Tel: 0116 254 1414
Fax: 0116 258 5631
Minicom: 0116 258 6878

## Instructions for making diary entries

Thank you for agreeing to take part in this research project. We are interested in hearing about your experiences of managing daily activities while undergoing cancer treatment.

**Cassette recorder**
The researcher has given you a compact digital recorder and spare batteries. Your diary will be recorded onto the digital recorder. If you are not sure how to use the recorder, please ask the researcher. If you need more batteries, or have a problem making a recording, please contact the researcher.

**When should I make an entry?**
Please try to make an entry in the diary every day, no matter how long or short. You do not have to make an entry in one sitting – you can make several entries per day if you wish.

Please do not rewind the tape. You can record entries one after another. You will be given a start date and an end date indicating the period you should keep the diary. We ask that you keep the diary for 4 months.

**Making an entry**
Whenever you make an entry in the diary, please first state the date and time. You can then use your own words to describe any problems you have experienced during your daily activities, e.g. incidences of absent-mindedness. These may be while you were at home, at work or during leisure activities. Please be as open as possible and remember that the information you provide will be kept strictly confidential and anonymous.

Here are some examples of the types of things we are interested in hearing about:

- Difficulty in remembering how to do something
- Difficulty in remembering what you have already done
- Difficulty in remembering people's names
- Difficulty in remembering a particular word that is on the 'tip of your tongue'
- Forgetting what you had intended to do (e.g. forgetting to post a letter; going shopping for milk but come home with items other than milk; going into a room and forgetting why)
- Any mistakes you have made in carrying out a task
- Any accidents or injuries (e.g. dropping a cup; falling over)

We are interested in **types of absent-mindedness, errors and accidents** you may experience while at **home** (e.g. during household chores or chatting to a friend on the phone), at **work** (e.g. in a meeting or at your desk) or during **leisure activities** (e.g. during a hobby or socialising). The above are just a few examples. We would like to hear about all the incidences you encounter during the day so that we can better understand your experiences.

We understand that some consequences of absent-mindedness may be upsetting or embarrassing. We encourage you to be as open about your experiences as possible, as this will provide a more complete and accurate picture of living with the effects of cancer treatment and managing daily activities. However, we do not want you to feel uncomfortable or distressed while keeping the diary, so please only record entries when you feel happy to do so.

If you have any questions or require further information, please do not hesitate to contact the researcher, Catherine Lawrence
Tel: 01509 22 8151    Email: C.L.Lawrence@lboro.ac.uk

Thank you for your time!

**Checklist for every diary entry:**

- **Date** (e.g. Monday 22<sup>nd</sup> March).

- **Time** (e.g. 2:30pm).

- **Where** the incident occurred (e.g. kitchen, office, shopping centre, driving my car, at the gym).

- **What** happened (e.g. I was at home looking for my reading glasses in the living room, but forgot that they were around my neck; I was washing up but then dropped the plate).

- You could make an entry **as soon as** you realise that you have experienced absent-mindedness and make several short entries that day; or you could split up the day and list the incidences that have happened during that **morning** and then again later that **evening**; or some days you may find that it is better for you to list the incidences that have occurred **earlier that day**.

- Please try to make at least **one diary entry per day**.

- Please keep the diary for 4 months:


**START DATE: _____**                    **END DATE: _____**

University Hospitals of Leicester **NHS**
NHS Trust

## The effects of chemotherapy for breast cancer on managing daily tasks

## DAILY DIARY (paper only)

Thank you for agreeing to take part in the diary aspect of the research project. We are interested in hearing about your experiences of managing daily activities while undergoing cancer treatment. The information you provide in the diary, along with the questionnaire, will give us a clearer and more complete picture of your experiences.

**What do I need to do?**
When you turn over the page you will see 4 sets of tables – each double page represents a week. As soon as you receive this booklet please write the date at the top of the first table – your diary will start on this day. At the end of each day for the next 4 weeks, please jot down brief notes to each question. The diary should take about 10 minutes to complete each day. At the end of the 4 weeks, please return the booklet in the pre-paid envelope provided.

The researcher will send you another booklet for the next month just before you finish this one. We ask that you keep the diary for 4 months in total. We understand that this is quite a long time but the more information we can collect the better we can understand your experiences during this time. You may also find it useful and interesting to complete the diary and reflect upon your own experiences.

Use the spaces to make your own notes about any problems you have experienced during your daily activities. We are interested in types of absent-mindedness, mistakes and accidents you may experience while at home (e.g. during household chores or chatting to family), at work (e.g. in a meeting or at your desk), or during leisure activities (e.g. during a hobby or socialising).

You may withdraw from the study at any time with no reason necessary by contacting the researcher. Your responses will be kept strictly confidential to the research team. We will ensure that any reported information is anonymous so that your identity will not be known.

If you have any questions or require further information, please contact the researcher Catherine Lawrence
Tel: 01509 22 8151   Email: C.L.Lawrence@lboro.ac.uk

| Week 13: Start date<br>\_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_ | Day 1 | Day 2 | Day 3 | Day 4 |
|---|---|---|---|---|
| Difficulty in multi-tasking – when and what happened? | | | | |
| Difficulty in making decisions – when and what happened? | | | | |
| Made a mistake – when and what happened? | | | | |
| Lost concentration – when and what happened? | | | | |
| Forgot to do something or any memory problems – when and what happened? | | | | |
| Did something but you intended to/meant to do something else – when and what happened? | | | | |
| Felt clumsy – when and what happened? | | | | |
| Had an accident or injured yourself – when and what happened? | | | | |
| Used any aids/strategies to help manage your tasks, e.g. a calendar, shopping list? Please list. | | | | |

| Week 13 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|
| Difficulty in multi-tasking – when and what happened? | | | |
| Difficulty in making decisions – when and what happened? | | | |
| Made a mistake – when and what happened? | | | |
| Lost concentration – when and what happened? | | | |
| Forgot to do something or any memory problems – when and what happened? | | | |
| Did something but you intended to/meant to do something else – when and what happened? | | | |
| Felt clumsy – when and what happened? | | | |
| Had an accident or injured yourself – when and what happened? | | | |
| Used any aids/strategies to help manage your tasks, e.g. a calendar, shopping list? Please list. | | | |

Please use this space to write about some of your entries from the week in more detail:

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| Week 14: Start date _____/_____/_____ | Day 1 | Day 2 | Day 3 | Day 4 |
|---|---|---|---|---|
| Difficulty in multi-tasking – when and what happened? | | | | |
| Difficulty in making decisions – when and what happened? | | | | |
| Made a mistake – when and what happened? | | | | |
| Lost concentration – when and what happened? | | | | |
| Forgot to do something or any memory problems – when and what happened? | | | | |
| Did something but you intended to/meant to do something else – when and what happened? | | | | |
| Felt clumsy – when and what happened? | | | | |
| Had an accident or injured yourself – when and what happened? | | | | |
| Used any aids/strategies to help manage your tasks, e.g. a calendar, shopping list? Please list. | | | | |

| Week 14 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|
| Difficulty in multi-tasking – when and what happened? | | | |
| Difficulty in making decisions – when and what happened? | | | |
| Made a mistake – when and what happened? | | | |
| Lost concentration – when and what happened? | | | |
| Forgot to do something or any memory problems – when and what happened? | | | |
| Did something but you intended to/meant to do something else – when and what happened? | | | |
| Felt clumsy – when and what happened? | | | |
| Had an accident or injured yourself – when and what happened? | | | |
| Used any aids/strategies to help manage your tasks, e.g. a calendar, shopping list? Please list. | | | |

Please use this space to write about some of your entries from the week in more detail:

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| Week 15: Start date<br>_____/_____/_____ | Day 1 | Day 2 | Day 3 | Day 4 |
|---|---|---|---|---|
| Difficulty in multi-tasking – when and what happened? | | | | |
| Difficulty in making decisions – when and what happened? | | | | |
| Made a mistake – when and what happened? | | | | |
| Lost concentration – when and what happened? | | | | |
| Forgot to do something or any memory problems – when and what happened? | | | | |
| Did something but you intended to/meant to do something else – when and what happened? | | | | |
| Felt clumsy – when and what happened? | | | | |
| Had an accident or injured yourself – when and what happened? | | | | |
| Used any aids/strategies to help manage your tasks, e.g. a calendar, shopping list? Please list. | | | | |

| Week 15 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|
| Difficulty in multi-tasking – when and what happened? | | | |
| Difficulty in making decisions – when and what happened? | | | |
| Made a mistake – when and what happened? | | | |
| Lost concentration – when and what happened? | | | |
| Forgot to do something or any memory problems – when and what happened? | | | |
| Did something but you intended to/meant to do something else – when and what happened? | | | |
| Felt clumsy – when and what happened? | | | |
| Had an accident or injured yourself – when and what happened? | | | |
| Used any aids/strategies to help manage your tasks, e.g. a calendar, shopping list? Please list. | | | |

Please use this space to write about some of your entries from the week in more detail:
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| Week 16: Start date _____/_____/_____ | Day 1 | Day 2 | Day 3 | Day 4 |
|---|---|---|---|---|
| Difficulty in multi-tasking – when and what happened? | | | | |
| Difficulty in making decisions – when and what happened? | | | | |
| Made a mistake – when and what happened? | | | | |
| Lost concentration – when and what happened? | | | | |
| Forgot to do something or any memory problems – when and what happened? | | | | |
| Did something but you intended to/meant to do something else – when and what happened? | | | | |
| Felt clumsy – when and what happened? | | | | |
| Had an accident or injured yourself – when and what happened? | | | | |
| Used any aids/strategies to help manage your tasks, e.g. a calendar, shopping list? Please list. | | | | |

| Week 16 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|
| Difficulty in multi-tasking – when and what happened? | | | |
| Difficulty in making decisions – when and what happened? | | | |
| Made a mistake – when and what happened? | | | |
| Lost concentration – when and what happened? | | | |
| Forgot to do something or any memory problems – when and what happened? | | | |
| Did something but you intended to/meant to do something else – when and what happened? | | | |
| Felt clumsy – when and what happened? | | | |
| Had an accident or injured yourself – when and what happened? | | | |
| Used any aids/strategies to help manage your tasks, e.g. a calendar, shopping list? Please list. | | | |

Please use this space to write about some of your entries from the week in more detail:
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