The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic

Dissertation submitted in partial compliance with the requirements for the
Master's Degree in Technology: Chiropractic
at the Durban University of Technology.

I, Lynn Fillis, do declare that this dissertation is representative of my own work, both in conception and execution, except where specific assistance is sought and duly acknowledged.

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DEDICATION

"But as for you, be strong and do not give up for your work will be rewarded."
(2 Chronicles 15:7)

I dedicate this work:

To my heavenly Father, I am grateful to have been blessed with an opportunity to make something of my life. Thank you for never leaving my side and providing me with everything I needed to complete this chapter of my life.

To my parents Ivan and Marilyn Fillis, who have been my biggest supporters since I can remember. You have been the best example of what can be achieved through hard work, sacrifice, patience and love. I can't thank you enough for the sacrifices you have made to afford me this opportunity. You have been there for me through the most difficult times and celebrated with me through all the milestones along this journey. I would never be able to repay you or express my gratitude. I can only strive to make you proud and make a success of the life you have provided me with. I love you.

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ABSTRACT

Introduction: Cardiovascular disease (CVD) is a major contributor to death in South Africa. Literature suggests that patients with musculoskeletal complaints frequently present with co-morbid pathologies such as hypertension and angina. However, ambiguity exists in the literature as to whether a relationship between the presence of CVD and the presence of musculoskeletal complaints exists.

Methodology: This quantitative cross-sectional retrospective cohort analysis utilised a validated data sheet to collect demographic characteristics; morbidity and prevalence of cardiovascular disease and musculoskeletal complaints; and their associated risk factors from 1066 clinic files of new patients who presented to the Durban University of Technology Chiropractic Day Clinic in one year. The data were manually extracted, coded and were captured on an Excel spreadsheet and imported into IBM Statistical Package for the Social Sciences (SPSS) version 24 for analysis. A two-tailed 0.05 level of significance was used. Where associations were found, Pearson chi-square tests or Fisher exact test was used for categorical variables, and independent t-tests for quantitative variables was utilised to determine the significance of the association, indicating whether the association was greater than chance alone (i.e. a *p* value <0.05 being considered statistically significant) (Singh, 2014). If the data were not normally distributed a Mann-Whitney U test was utilised. Odds ratios were calculated to determine the risk of the exposure where possible (Singh 2017).

Results: The patients presenting between 9 June 2015 and 9 June 2016 were predominantly Indian males; mean age of 37.87 years (SD 16.53 years); range five weeks to 86 years of age; majority within the 20-29 year age group. Most patients sought treatment for a primary musculoskeletal complaint (25% reported a secondary musculoskeletal complaint), characterised by chronic, moderate lumbar spine/abdomen pain of sharp character, with no associated pain radiation. The prevalence of cardiovascular disease was 25.2%, with hypertension and peripheral vascular disease as the most frequent. Risk factors in both the cardiovascular and non-cardiovascular disease groups included non-modifiable risk factors (viz. advancing age; gender; race/ethnicity and family history of CVD); and modifiable risk factors (viz. overweight/obesity; physical inactivity; blood pressure abnormalities; tobacco use; alcohol use; high fat and carbohydrate diet; diabetes mellitus; connective tissue disease; hypercholesterolaemia; use of non-cardiac medication and mental wellness). About 25% of patients reported the use of medication (the majority having been prescribed multiple medications (including anti-diabetics, anti-hypertensives, cholesterol-lowering drugs and anti-coagulants). Nearly 100% of CVD patients reported

chronic medication use. Univariate logistic regression analysis revealed a number medications and common risk factors influenced the presentation of musculoskeletal complaints between CVD and non-CVD patients. With multivariable analysis, it was found that many of the medications lost significance after adjustment for confounders/influencing factors, although antihypertensive (OR 36.6; *p*=<0.001) and thyroid agents (OR 5.1; *p*=0.078) remained associated with CVD. Common/mutual risk factors for CVD and MSD including: increasing age (OR 1.1 *p*=<0.001), family history of CVD (OR 2.1; *p*=0.006), smoking (OR 1.9; *p*=0.054) and grade 1 HTN (OR 2.5; *p*=0.043) were significantly associated with having CVD. Furthermore, MSCs located in the SI joint/pelvis (OR 7.1; *p*=0.005) and head (OR 7.3; *p*=0.019), as well as the thoracic spine/chest/ribs (OR 4.9; *p*=0.015) and shoulder/brachium (OR 3.1; *p*=0.090) were shown to be significantly associated with CVD.

Conclusion: The results of this study suggest that patients who seek treatment at the DUT CDC may present with both MSDs and CVD. Moreover, this study suggests that there may be an association between CVD and the presenting MSC. It is evident that the presentation of MSDs in CVD patients is multifactorial involving the use of cardiac and non-cardiac medication, and the presence of common CVD and MSD risk factors. However this study cannot conclusively comment on these pathophysiological changes. The current study can only speculate on causality based on known mechanisms as described in literature, however reverse causality may exist (viz. a lack of exercise, presence of MSCs may actually predispose to the CVDs).

It is possible that CVD patients, who frequently sought treatment at chiropractic teaching clinics, may present with musculoskeletal side-effects associated with the use of cardiac and non-cardiac medications. This may result in the development of chronicity of musculoskeletal complaints, unresponsiveness to treatment and/or delayed recovery. It is important for chiropractic interns to be aware of this association as it affects how these patients are currently treated and managed thus affecting their prognosis. Caution needs to be applied as the outcomes of this study need to be investigated prospectively in larger sample sizes, different contexts and with some refinement of the data collection tool to confirm the outcomes of this study.

Key words: Chiropractic, cardiovascular disease, musculoskeletal

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LIST OF ABBREVIATIONS

ABRREVIATION	DESCRIPTION
ACE inhibitors	Angiotensin- converting enzyme
ADHD	Attention deficit hyperactivity disorder
AIDS	Acquired Immune Deficiency Syndrome
ApoB/ApoA1	Apolipoprotein B/apolipoprotein A1
ATH	Atherosclerosis
BJD	Bone and Joint Decade
BMI	Body mass index
BP	Blood pressure
CAD	Congenital artery disease
CAM	Complementary and Alternative Medicine
CASA	Chiropractic Association of South Africa
CCE	Council on Chiropractic Education
CCF	Congestive cardiac failure
CCP	Cyclic citrullinated peptide
CDL	Chronic diseases of daily lifestyle
CI	Confidence interval.
CHD	Coronary heart disease
CK	Creatine kinase
CMCC	Canadian Memorial Chiropractic Clinic
CNS	Central nervous system
COX	Cyclooxygenase
CT	Computed Tomography
CVA	Cerebrovascular accident
CVD	Cardiovascular disease
CV	Cardiovascular
CWP	Chronic widespread pain
DBP	Diastolic blood pressure
DEXA	Dual-Energy X-Ray Absorptiometry
DM	Diabetes mellitus
DUT CDC	Durban University of Technology Chiropractic Day Clinic
DVT	Deep vein thrombosis
EC	Electronic cigarette
ECG	Echocardiography
ESR	Erythrocyte sedimentation rate
et al.	and others

FDA	Food and Drug Administration
GERD	Gastroesophageal reflux disease
HDL	High-density lipoprotein
HF	Heart failure
HFA	Hyogo Framework for Action
HIV	Human Immuno-Deficiency Syndrome
HRT	Hormone replacement therapy
HTN	Hypertension
ICD-10	10^{th} revision of the International Statistical Classification of Disease and Related Health Problems
IHD	Ischaemic heart disease
IREC	Institutional Research Ethics Committee
LBP	Low back pain
LDL	Low-density lipoprotein
LP	Local pain
MC	Maintenance care
MetS	Metabolic syndrome
MI	Myocardial infarction
MRFIT trial	The Multiple Risk Factor Intervention
MRI	Magnetic resonance imaging
MSC	Musculoskeletal complaint
MSD	Musculoskeletal disorder
MTrP	Myofascial trigger point
N	Refers to the subsample size.
N	Refers to the total sample size..
NCD	Non-communicable diseases
NCEP	National Cholesterol Education Program
NHIS	National Health Interview Survey
NNRTI	Non-nucleoside reverse transcriptase inhibitor
NRT	Nicotine replacement therapy
NSAID	Nonsteroidal anti-inflammatory
NUCCA	National Upper Cervical Chiropractic Association
NYHA	New York Heart Association
OA	Osteoarthritis
OB	Obese/obesity
OCP	Oral contraceptive pill
OLS	Ordinary least squares
OP	Osteoporosis

OR	Odds ratio
OTC	Over-the –counter medication
OW	Overweight
P	*p*-value
PAD	Peripheral artery disease
PE	Pulmonary embolism
PHC	Primary healthcare
PI	Protease inhibitor
PNS	Peripheral nervous system
PUFAs	Polyunsaturated fatty acids
PVD	Peripheral vascular disease
QoL	Quality-of life
RA	Rheumatoid arthritis
RCT	Randomized controlled trial
RF	Rheumatoid factor
RHD	Rheumatic heart disease
RP	Regional pain
SA	South Africa
SADoH	South African Department of Health
SBP	Systolic blood pressure
SD	Standard deviation
SGA	Second-generation antipsychotic
Sig	Significance value or *p* value
SLE	Systemic lupus erythematosus
SMT	Soft tissue manipulation
SOAPE	Subjective, Objective, Assessment, Plan, Evaluation
SPSS	Statistical Package for the Social Sciences
SSA	sub- Saharan Africa
STI	Sexually transmitted infection
TIA	Transient ischaemic attack
TNF-α	Tumour necrosis factor-alpha
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus
UK	United Kingdom
US	Ultrasonography
VO2	Volume of oxygen
VSD	Ventricular septal defect
WHO	World Health Organisation

WSP	Widespread pain
%	Percentage
=	Signifies “equals to”.
<	Refers to a number “less than” the number reported.
>	Refers to a number “greater than” the number reported.

DEFINITION OF TERMS

Term	Definition
Acute	Referring to a disease of sudden onset and brief duration. For the purpose of this study, it was considered a duration of less than three months (Stedman, 2005).
Apolipoprotein (Apo)	Proteins that bind lipids to form lipoproteins.
Atherosclerosis	The progressive build up of fatty deposits, called atheromatous plaques, within blood vessels resulting in thickening and stiffening of the inner walls of the arteries. These atheromas can cause a blockage that prevents blood from flowing to the heart or brain (World Heart Federation, 2017).
Blood pressure (BP)	The Heart and Stroke foundation of South Africa (Steyn, 2007) defines blood pressure as the force that blood exerts on the walls of the arteries.
Body mass index	This index reflects a individual's weight in terms of his/her height. This is defined as the weight in kilogram divided by height in meters squared (kg/m^2) (Steyn, 2007).
Cardiovascular disease	Defined as any disease of the heart and/or blood vessels (Steyn, 2007).
Chiropractic-teaching clinics	Chiropractic-teaching clinics function as educational facilities for final year students and interns, where students gain experience by providing chiropractic services to the general public (Bryant *et al.,* 2003).
Chronic	Term used to describe persistent disease or a long term illness. For the purpose of this study, it was considered as a time period of 6 months or more (Stedman, 2005).
Complementary and Alternative Medicine (CAM)	The National Center of Complementary and Alternative Medicine (2012), defines CAM as "a group of diverse medical and healthcare systems, practices, and products that are not generally considered part of conventional medicine".
Co-morbidities	A concomitant but unrelated pathological or disease process (Stedman, 2005).
Confounder/confounding	Any variable that when added to the regression model,

variable/influencing factor	alters the estimate of the association between the main independent variable (exposure) and the dependent variable (outcome) by 10% or greater (Beukelman *et al.,* 2016).
Cost effective treatment	A treatment that is not only effective in healing or controlling a disease/condition but also costs less to society than the cost of the disease if it is left untreated (Steyn, 2007).
Depression	Depression refers to feeling sad, blue or down and is associated with losing interest in things, feeling tired all the time, gaining or losing weight, trouble falling asleep, difficulty concentrating, and thinking of death or feeling worthless (Steyn, 2007).
Diabetes mellitus	A clinical syndrome characterised by hyperglycaemia resulting from a lack of or diminished effectiveness of endogenous insulin (Bloomfield *et al.,* 2006; Longmore *et al.,* 2007).
Disease prevention	According to the World Health Organisation (WHO), disease prevention refers to the measures taken to prevent the occurrence of disease, halt existing disease and reduce complications of established disease (World Health Organization Health Promotion Glossary, 1998).
Dysphasia	Impairment of language as a result of brain damage (Longmore *et al.,* 2007).
Dyspnoea	The subjective sensation of shortness of breath which is often exacerbated by exertion (Longmore *et al.,* 2007).
Endogenous	Refers to substances (e.g. hormones) which are produced or synthesized within an organism or system (Merriam-Webster online Medical Dictionary, 2017).
Epidemiological studies	According to the Concise Oxford English Dictionary (2003), these refer to the investigation of the prevalence, allotment and management of infectious and non-infectious diseases in populations.
Familial hypercholesterolaemia	A rare genetic disorder characterised by very high blood cholesterol levels and early onset of cardiovascular disease, which runs in families (Steyn, 2007).
Health promotion	Defined at the Ottawa Charter 1986 as the “process of enabling people to increase control over, and improve their

	health".
Hypercholesterolaemia	This refers to high total blood cholesterol which includes high levels of triglycerides and low-density lipoprotein (LDL) or low levels of high-density lipoprotein (HDL) cholesterol. Individuals who have a total blood cholesterol level of 5 mmol/L or higher are said to have hypercholesterolaemia NCEP, 2001; World Heart Federation, 2016).
Hyperglycaemia	Refers to high blood glucose levels (Steyn, 2007).
Hypertension	Also known as a high blood pressure, refers to a blood pressure reading of 140/90 mmHg or higher. An individual is diagnosed with hypertension if either of the values are above the cut-off point (Steyn, 2007).
Incidence	A measure of the frequency with which new cases of illness, injury, or other health conditions occurs among a population during a specific period (Centers for Disease Control and Prevention Glossary, 2017).
Local pain	Pain restricted to one specific body part or region (Grimsby-Ekman *et al.,* 2015).
Low back pain	Pain which is experienced between the area of the last ribs superiorly and the gluteal fold inferiorly (Walker *et al.,* 2004).
Metabolic syndrome	This syndrome which has been described as a cluster of physical examination and laboratory findings which include: excess visceral adipose tissue (Waist circumference ≥36 inches for women; ≥40 inches for men; insulin resistance (Impaired fasting glucose >100 mg/dL); dyslipidemia (Triglycerides >150 mg/Dl and HDL cholesterol <50 for women; <40 for men) and HTN (Blood pressure >130/85mmHg) (American Heart Association, 2014 and Kaur, 2014).
Modifiable risk factors	Risk factors which can be altered or treated by making certain lifestyle changes (Buttar *et al.,* 2005).
Morbidity	Refers to individuals who have a disease or condition but have not yet died of it (Steyn, 2007).
Mortality	Death (Centers for Disease Control and Prevention, 2017).
Musculoskeletal disorders	Affect the tissues of the musculoskeletal system which consists of muscles, tendons, ligaments, cartilage and

	bones which are located in different parts of the body, with muscles being the most common site of pain (Riihimäki, 1998).
Non-communicable disease	Diseases such as cancers, cardiovascular diseases and obstructive lung diseases, that are predominantly caused by preventable and modifiable risk factors (i.e. tobacco use, poor diets, hypercholesterolaemia, physical inactivity, alcohol abuse, high blood pressure etc), thus not transferable by direct contact from one individual to another (Puoane *et al.*, 2008).
Non-modifiable risk factors	Risk factors which cannot be altered (Buttar *et al.,* 2005).
Obesity	Obesity is defined as an excess accumulation of fat mass (WHO, 2000). An individual is considered obese when his/her BMI is 30 kg/m^2 or higher (Steyn, 2007).
Overweight	An individual is considered overweight when his/her BMI is above 25 kg/m^2 and below 30 kg/m^2 (Steyn, 2007).
Passive smoking	Involves the inhaling of tobacco smoke where other individuals are smoking, usually in an enclosed space (Steyn, 2007).
Prevalence	The proportion of a population that has a specific disease, injury, other health condition, or attribute at a specific point in time (point prevalence) or during a specific period (period prevalence) (Centers for Disease Control and Prevention Glossary, 2017).
Primary prevention	According to the Oxford Handbook of Clinical Medicine (2007), primary prevention refers to steps taken to prevent the occurrence of disease.
Risk factor	The risk factors are particular traits, conditions or habits that may increase an individual's risk for developing a specific condition (WHO, 2013a).
Secondary prevention	Secondary prevention involves screening individuals for the first stages of disease and arrest existing disease (Longmore *et al.,* 2007).
Smokeless tobacco	These are tobacco products that are not smoked but used in any other form, such as chewing tobacco or snuff (Steyn,

	2007).
Socioeconomic	Relates to the combination or interaction of social and economic factors (Merriam-Webster, 2017). Socioeconomic status (SES) denotes an individual's or group's position within a hierarchical social organisation and depends on a combination of variables, including occupation, education, income, wealth, and place of residence.
Stress	The Merriam-Webster online medical dictionary (2017) defines stress as physical, chemical or emotional factors that tend to alter an existent equilibrium, resulting in bodily or mental tension. Stress may be a factor in disease causation.
Sub acute	Refers to the course of a disease of a moderate severity and duration between three to six months (Stedman, 2005).
Type I diabetes mellitus	A type of diabetes mellitus that occurs as a result of selective destruction of insulin-secreting pancreatic *beta* cells (Longmore *et al.,* 2007).
Type II diabetes mellitus	A type of diabetes mellitus that is associated with an unhealthy lifestyle. The decreased insulin secretion and increased insulin resistance associated with this condition is associated with obesity, physical inactivity and high calorie intake (Longmore *et al.,* 2007).
Widespread pain	Pain experienced in at least two body regions in two contralateral (opposite) limbs and the axial skeleton; and marked equally on the front and on the back of the body (Grimsby-Ekman *et al.,* 2015).

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION TO THE STUDY

Cardiovascular disease (CVD) refers to any disease affecting the heart or blood vessels (Steyn, 2007). It is a major contributor of mortality in South Africa (SA), with the most common causes of death occurring as a result of hypertension (HTN), ischaemic heart disease (IHD) and cerebrovascular disease (Statistics South Africa, 2013a). The Centers for Disease Control and Prevention (2001) indicated that arthritis was the leading cause of disability worldwide, followed by back pain and CVD (Ulwin *et al.,* 2006; Alwan *et al.*, 2009).

Studies conducted at the Durban University of Technology Chiropractic Day Clinic (DUT CDC), suggest that patients who present with cervical and lumbo-sacral complaints frequently presented with co-morbid pathologies such as HTN (63.9% and 81.5%, respectively) and angina (Jaman, 2007; Venketsamy, 2007). It is, therefore, possible to argue that there may be a relationship between the presence of CVD in patients among these patients who complain of musculoskeletal disorders (MSDs). This has been alluded to by specific examples cited in Kauppila and Tallroth (1993), Penttinen (1994) and Shiri *et al.* (2007). Therefore, identifying and quantifying these relationships between the co-existing pathologies is important. It would enable healthcare practitioners to employ the most appropriate disease prevention and health promotion strategies (Brown, 2009) in order to ensure that patients do not develop chronic disease of either system (Daar *et al.*, 2007). As a result of the above it becomes possible for the practitioner to be able to more effectively address both the MSDs and the CVDs through primary prevention strategies (Baird *et al.*, 2011), resulting in more effective and holistic treatment for the patient. It is imperative that these relationships are investigated; links determined and further studied (Kauppila, 2009).

1.2 AIMS AND OBJECTIVES

1.2.1 THE AIM OF THE STUDY

The aim of the study was to investigate the dual profiles of patients complaining of musculoskeletal disorders with underlying cardiovascular diseases, at the Durban University of Technology Chiropractic Day Clinic.

1.2.2 THE OBJECTIVES OF THE STUDY

Specific objectives were identified and these included:

1) To determine the nature of any musculoskeletal disorders that the patient has presented with.

2) To determine the dual prevalence of cardiovascular disease among the aforementioned patients presenting at the Durban University of Technology Chiropractic Day Clinic.

3) To identify any diagnosed cardiovascular diseases (e.g. cardiac, vascular).

4) To identify the selected risk factors predisposing the patients to cardiovascular disease.

5) To identify the medications that the patient has been prescribed for their cardiovascular disease and the length of time for which this medication has been taken.

6) To determine if an association exists between the presence of and risk factors for the cardiovascular disease, the prescribed medication and the presenting musculoskeletal complaints noted.

1.3. RESEARCH QUESTIONS

1.3.1 RESEARCH QUESTION 1

What is the prevalence of cardiovascular disease amongst patients who presented to the Durban University of Technology Chiropractic Day Clinic from 9th June 2015 –9th June 2016?

1.3.2 RESEARCH QUESTION 2

What are the risk factors for presenting with cardiovascular disease in patients attending Durban University of Technology Chiropractic Day Clinic from 9th June 2015 –9th June 2016?

1.4 SCOPE OF THE STUDY

CVD is a major contributor to mortality in SA, with most deaths occurring as a result of HTN, IHD and cerebrovascular disease (Statistics South Africa, 2013a). According to the Centers for Disease Control and Prevention (2001), arthritis and back pain are the first and second leading causes of disability followed by CVD (Ulwin *et al.*, 2006; Alwan *et al.*, 2009). CVD is underpinned by a variety of lifestyle causes that have been identified in the literature which include but are not limited to patient education, exercise, nutrition, patients habits (e.g. smoking, alcohol consumption) (World Health Organisation, 2013a) (WHO). With the roles of

the chiropractor being that of promoting health and preventing disease (Jamison, 2002; Ford, 2013), it would therefore stand to reason that managing the patient's lifestyle forms an integral part of the management of the patient in order to prevent or improve the effects of the lifestyle that the patient has on their long term health. Therefore, identifying and quantifying the relationships between the conditions in the cardiovascular system and their risk factors (lifestyle causes) is important; as it would enable healthcare practitioners (e.g. chiropractors) to employ the most appropriate disease prevention and health promotion strategies (Brown, 2009). This enables practitioners to ensure that patients do not develop chronic disease (Daar *et al.*, 2007).

However as patients presenting to chiropractors most commonly complain of MSDs, the presence of CVDs may be potentially overlooked or not addressed. This may be as a result of the fact that there is conflict in the literature as to the relationship between MSDs and CVDs, where some research suggests that there may be a relationship (Hagen *et al.,* 2005; Jaman, 2007; Kandhai, 2007; Venketsamy, 2007) and other research which indicates that there is no relationship (Penttinen, 1994; Conaghan *et al.*, 2005). This is further complicated by unclear evidence that suggests that there are specific examples cited in Kauppila and Tallroth (1993), Penttinen (1994) and Shiri *et al.* (2007).

As a result of the lack of congruence in the literature in defining the associations between MSDs and CVDs, it therefore becomes impossible for the practitioner to be able to more effectively address both the MSDs and the CVDs through primary prevention and health promotion strategies (Baird *et al.*, 2011), resulting in ineffective and less holistic treatment and management plans for the patient. It is imperative that these relationships are investigated, links determined and further studied (Kauppila, 2009), to effectively allow practitioners to manage health promotion and disease prevention in order to reduce the morbidity and mortality of patients as a result of CVDs and MSDs.

1.5 LIMITATIONS OF THE STUDY

This study utilised a cross-sectional retrospective cohort analysis design set in a quantitative paradigm in which data was collected from clinic files of patients who visited the DUT CDC. This required accurate record keeping which was not always possible, as it was influenced by the patient's ability to recall information at the history taking and the chiropractic intern's ability to document that information legibly and comprehensively.

1.6 CONCLUSION

Following this introduction into this study, Chapter Two highlights the literature review discussing the background of cardiovascular disease and musculoskeletal complaints, and the possible association between them. Chapter Three presents the methodology which consists of research design, sampling method and data collection. The statistical findings are represented in Chapter Four. Interpretation of the results of the study are covered in Chapter Five, while Chapter Six covers a discussion surrounding this research and the conclusion to this research.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

In reviewing literature relating to musculoskeletal disorders (MSDs) and cardiovascular disease (CVD), it is apparent that literature on the aetiology, prevalence, clinical features, risk factors and management of these conditions is abundant. Similarly, a great deal of literature exists on the chiropractic management of MSDs, yet little exists on the chiropractic management of CVD in patients who present with both CVD and MSD. Conflicting literature exists relating to the possible association between these conditions (Kaupilla and Tallroth, 1993; Penttinen, 1994; Conaghan *et al.*, 2005; Hagen *et al.*, 2005). Thus, this chapter discusses the lack of congruence in the literature in defining the associations between MSDs and CVD by means of examples and substantiates the urgent need for these relationships to be investigated.

2.2 INTRODUCTION TO EPIDEMIOLOGICAL STUDIES

Epidemiological studies, according to the Concise Oxford English Dictionary (Pearsall, 2003), are the investigation of the prevalence, allotment, and management of infectious and non-infectious diseases in populations. For the purpose of this study the investigation involved determining the prevalence of and associated risk factors for CVD in patients who presented with musculoskeletal complaints (MSCs) to the Durban University of Technology Chiropractic Day Clinic (DUT CDC).

Epidemiology is a scientific discipline based on irrefutable methods of scientific investigation and relies on a systematic and unbiased approach to the collection, analysis, and interpretation of data. Epidemiological methods are reliant on meticulous observation, in addition to the use of valid comparison groups. These methods are employed to determine whether the observed phenomenon, for instance the number of cases of disease in a specific area during a specific time period or the frequency of an exposure among individuals with disease, differs from what might be expected (Centers for Disease Control and Prevention, 2006).

2.2.1 CLASSIFICATION OF EPIDEMIOLOGICAL STUDIES

Epidemiological studies can be classified into two main study designs namely descriptive studies and analytical studies.

2.2.1.1 DESCRIPTIVE STUDIES

Descriptive studies describe the occurrence of disease by time, place and person (Centers for Disease Control and Prevention, 2006).

2.2.1.2 ANALYTICAL STUDIES

Analytical studies are concerned with the search for causes and effects, or the why and the how. It is employed to quantify the association between exposures and outcomes and to test hypotheses about causal relationships. Analytical studies are further categorised into: experimental, quasi-experimental and non-experimental/observational study designs (Centers for Disease Control and Prevention, 2006).

Clinical research aims to identify the causes of health outcomes both good and bad (Boyko, 2013). The current gold standard to accomplish this aim is a randomised controlled trial (RCT) (Sibinga *et al.,* 2010).

2.2.1.2.1 RANDOMISED CONTROLLED TRIALS

As previously mentioned, RCTs are regarded as the “gold standard” among research designs, and their results are regarded as the strongest form of research evidence (Sibinga *et al.,* 2010).

2.2.1.2.1.1 BENEFITS OF RANDOMISED CONTROLLED TRIALS

The vigour of this type of research is attributed to the random assignment of research participants to the study condition (experimental or control) and the presence of a control group, which is used to compare the effects observed in the experimental group against. RCTs are used to compare new treatments or approaches with current treatment (Sibinga *et al.,* 2010).

- Contrasting to other research designs, participants from a single subject pool are randomly assigned to their study condition, resulting in a balance of baseline confounders (known and unknown subject differences relevant to the outcome of interest) across the experimental and control groups.
- If randomisation is successful and the groups are balanced at baseline, the researcher is able to conclude that differences observed between the two groups at the end of the study are attributed to the experimental treatment itself.

2.2.1.2.1.2 LIMITATIONS OF RANDOMISED CONTROLLED TRIALS

Despite the high levels of rigour, it is important to consider the following when interpreting results from or designing RCTs (Sibinga *et al.,* 2010; Boyko, 2013):

- The performance of a RCT requires strict specification of study conditions related to all aspects of its conduct namely participant selection, treatment and control assignment arms, inclusion/exclusion criteria, randomisation method, outcome measurement, and many other considerations.
- It not possible to evaluate the efficacy of all possible treatment comparisons in all possible groups of interest, or identify adverse (or unexpected beneficial) outcomes requiring longer follow-up or greater sample size using RCTs.
- RCTs are difficult to produce due to the expense in terms of time and money.
- This frequently leads to results that may be difficult to apply to a real-world setting due to either the rigour or complexity of the intervention or the selection process for participants that yields a population dissimilar from that seen in general clinical practice.

Given these considerations, observational research is often used to address important clinical questions in the absence of randomised clinical trial data.

2.2.1.2.2 OBSERVATIONAL STUDIES

Observational study designs include case reports, case series, case-control studies, cohort studies and cross-sectional studies.

2.2.1.2.2.1 BENEFITS OF OBSERVATIONAL STUDIES

Observational studies may make important potential contributions even when RCTs have been conducted. According to Boyko (2013), observational research often also addresses other questions not suitable or applicable for RCTs such as:

- An exposure known to be harmful or in other ways unacceptable to research participants or whose administration is inconsistent with ethical principles.
- Other exposures that are not potentially under the control of the researcher, for example, eye colour, blood type, presence of a specific genetic marker, or elevations of blood pressure (BP) or plasma glucose concentration.
- May also provide preliminary data to justify the performance of a clinical trial, which may not have received sufficient funding support without the existence of such results (Boyko, 2013).

Therefore, observational study designs are often used to deal with issues unaddressed or not addressable by RCTs (Boyko, 2013).

2.2.1.2.2.2 LIMITATIONS OF OBSERVATIONAL STUDIES

While observational study designs may have many benefits, this study design also has various limitations which include:

- A higher potential for bias (confounding, information and selection), however, various design and analysis features of this study design may be used to address these concerns, albeit not completely eradicate them (Boyko, 2013).
- A very limited potential to establish causal effects (Noordzij *et al.,* 2009).

Confounding bias is present when an exposure of interest is strongly associated with another exposure that is also related to the outcome. Observational studies do not have the benefit of randomisation to allocate by chance risk factors for an outcome of interest. Exposures to risk factors may occur for many reasons which include but are not limited to self-selection, medical provider prescription or occupation. However, various methods can be used to obtain an unbiased estimated exposure-disease association provided the confounding factor is accurately identified and measured (Boyko, 2013).

Selection bias may produce factitious exposure-disease associations if the research population fails to mirror the target population of interest. Effective observational research must recognise the potential for bias and attempt to minimise it, both in the design and analysis. Furthermore, this study design must accurately describe limitations of this data and the implications for study validity in reports of the results (Boyko, 2013).

In addition to confounding and selection bias, observational studies can be prone to other types of bias such as information bias, which occurs when the outcome, exposure or potential confounding variables are inaccurately assessed (Boyko, 2013).

Causal associations will always involve correlation. However, the presence of a correlation does not imply causation. According to Boyko (2013), the challenge of observational research is to assess whether a correlation is present and then determine whether it may be due to a causal association. Insight into the limitations of observational research in assessing causal associations is provided by the examination of the features of an RCT. The randomisation process provides the opportunity for equal distribution of risk factors for the outcome among research participants assigned to the treatment and control. Therefore, any difference in the outcome between these two groups will unlikely be due to unequal distribution of risk factors by treatment assignment. The use of randomisation provides

means to approach the problem of not having complete knowledge about predictors of all clinically important outcomes (Boyko, 2013).

Despite the various limitations of observational study designs, many well-accepted causal associations in medicine are supported entirely or in part due to this type of study design (Boyko, 2013). Examples include the association between hyperglycaemia and diabetes mellitus (DM) complications including retinopathy, nephropathy, peripheral neuropathy, and IHD (Consumption of sweet beverages and type 2 diabetes incidence in European adults: results from EPIC-InterAct, 2013). Other well-known examples include HTN and cerebrovascular accidents (CVA) (Kannel *et al*., 1970); smoking and lung cancer (Pirie *et al.,* 2013); asbestosis and mesothelioma (Churg, 1988); and low-density lipoprotein (LDL) and high-density lipoproteins (HDL) cholesterol concentrations and risk of IHD (Gordon *et al.*, 1981). In the case of complications due to hyperglycaemia (UK PDS, 1998a; UK PDS,1998b), high LDL-cholesterol concentration (Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S), 1994), and HTN (Survey of Healthcare Experience of Patients (SHEP) Cooperative Research Group, 1991), clinical trials conducted to reduce these levels resulted in reductions in the rate of these outcomes, thus further supporting a causal association. Observational study designs may be the only avenue for direct testing of associations in humans, when associations that involve an exposure cannot be controlled by the researcher or should not be modified for ethical reasons.

2.2.1.2.3 CROSS-SECTIONAL STUDIES

This study design simultaneously measures a specific outcome and an exposure status in a specific population. It provides a 'snapshot' of the frequency and characteristics of an outcome at a particular point in time.

2.2.1.2.3.2 BENEFITS OF CROSS-SECTIONAL STUDIES

While cross-sectional study designs have significant limitations, they are frequently used for their strengths according to Noordzij *et al.* (2009):

- They are useful in describing the prevalence of disease.
- They are fast and inexpensive.
- They are hypothesis generating.

2.2.1.2.3.1 LIMITATIONS OF CROSS-SECTIONAL STUDIES

In view of the fact that the exposure and outcome are measured at the same point in time, it is frequently impossible to determine whether the exposure preceded or followed the outcome. Thus, cause and effect relationships are uncertain (Noordzij *et al.,* 2009).

Based on the above information this study was designed as a cross-sectional retrospective cohort analysis set in a quantitative paradigm, which is categorised as a combination of observational study designs. This study design was selected as it allows the researcher to investigate disease in a study population (Centers for Disease Control and Prevention, 2006).

2.3 INTRODUCTION TO CARDIOVASCULAR DISEASE

Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels that include but are not limited to: IHD, cerebrovascular disease, peripheral arterial disease (PAD), rheumatic heart disease (RHD), congenital heart disease (CHD), deep vein thrombosis (DVT) and pulmonary embolism (PE) (WHO, 2013a). Of these grouped conditions, the most frequently encountered conditions are cardiomyopathies, cerebrovascular accidents (CVA), myocardial infarction (MI), heart failure (HF) and HTN (Steyn, 2007).

2.3.1 PREVALENCE OF CARDIOVASCULAR DISEASE

The largest rates of mortality in the western world are attributed to CVD. While the incidence of IHD in developed countries has been declining for the last two or three decades, it has increased in developing countries. This has consequently led to the predictions that CVD will soon become the leading cause of mortality on all continents (Bloomfield *et al.,* 2006).

The 'Heart Disease in South Africa' report commissioned by the Heart and Stroke Foundation of South Africa (Steyn, 2007), revealed the following alarming statistics:

- Between 1997 and 2004, 195 South Africans died as a result of some form of CVD a day.
- Approximately 33 individuals die a day due to MIs.
- For every female who dies of a MI, two males die.
- Approximately 37 individuals a day die due to HF.
- Premature deaths in individuals of working age (35–64 years) due to CVD, are expected to increase by 41% between 2007 and 2030 which will have an enormous and negative impact on the economy.

Furthermore, more than 50% of deaths related to chronic illnesses, which include CVD, occur before the age of 65 years. Premature deaths affect the workforce and have a major impact on the economy of the country (Pestana *et al.,* 1996; Bradshaw *et al.,* 2003). According to Norman *et al*. (2006), the highest mortality rates for CVDs in SA are found in the Indian population, followed by the Coloured, White and Black African population. When the prevalences of HTN, hypercholesterolaemia and DM in the Indian population were compared to other population groups in SA, higher prevalences of the aforementioned conditions were noted, which may be attributed to dietary differences between cultures and families (Yusuf *et al.,* 2001; Stewart *et al*., 2010; Prakaschandra *et al.,* 2016).

While the White and Black African population have similar rates for CVD, their patterns differ considerably. MIs are the most cause of death in White individuals, while the Black African individuals frequently die as a result of CVAs, cardiomyopathies and HTN (Norman *et al.,* 2006).

The burden of CVD is growing in SA amongst all age groups and is predicted to become the leading contributor to overall morbidity and mortality in patients over 50 years of age (Maredza *et al.,* 2011)**.** This concurs with Mayosi *et al.* (2009) and Statistics South Africa (2013a), who documented that CVD was a major contributor to death with an estimated 84,407 deaths in 2009 (15,386 were due to HTN, 12,291 due to IHD and 24,835 due to cerebrovascular disease) (Statistics South Africa, 2013a).

2.3.2 AETIOLOGY OF CARDIOVASCULAR DISEASE

Of the numerous diseases that fall under the broad term CVD, MIs and CVAs are the most common and are generally acute events. They are predominantly caused by a blockage that prevents blood flow to the heart or brain. Atherosclerosis (ATH) is the most common cause of this blockage. In ATH the inner walls of the arteries to the heart or brain become thickened and stiff as a result of the build-up of fatty deposits referred to as atheromatous plaques. ATH is not confined to the heart and brain and can affect various arteries throughout the body. In the arteries of the heart it is known as coronary artery disease (CAD) and in the extremities, peripheral arterial disease (PAD). ATH occurs over a period of time and can have severe consequences which include MI and CVA (World Heart Federation, 2017). CVAs may also be induced by bleeding from a blood vessel in the brain (haemorrhagic CVA) or from blood clots (embolism) (WHO, 2013a).

2.3.3 CLINICAL FEATURES OF CARDIOVASCULAR DISEASE

CVD presents with a relatively limited range of symptoms, thus arriving at a differential diagnosis frequently depends on the following: a detailed examination of the factors that provoke the symptoms; subtle variations in how they are reported by the patient; the clinical findings and appropriate investigations (Bloomfield *et al.,* 2006).

The hallmark of CVD is the close relationship that exists between the symptoms of CVD and exercise. The New York Heart Association (NYHA) functional classification is often used to grade disability. This classification system consists of four classes (Bloomfield *et al.,* 2006).

- Class I: No limitation during ordinary activity
- Class II: Slight limitation during normal activity
- Class III: Marked limitation of normal activities without symptoms at rest
- Class IV: Unable to undertake physical activity without symptoms; symptoms may be present at rest.

The first warning of underlying CVD may be a MI or CVA. Symptoms of a MI include pain or discomfort in the centre of the chest; pain or discomfort radiating to the arms, the left shoulder, elbows, jaw, or back (Bloomfield *et al.,* 2006). Patients may also report dyspnoea (shortness of breath); nausea or vomiting; dizziness; breaking into a cold sweat; and becoming pale. Dyspnoea, nausea, vomiting, and back or jaw pain are commonly reported by females (WHO, 2013a).

Sudden weakness of the face, arm, or leg (most often unilaterally), is the most common presenting symptom of a CVA. Other symptoms include sudden onset of confusion, dysphasia; unilateral or bilateral blurred vision; difficulty walking, dizziness, loss of balance or coordination; severe headache of unknown origin; fainting or loss of consciousness (WHO, 2013a).

Timely identification of the development of CVD is limited by two vital factors. Firstly, it is generally latent as in the case of Coronary artery disease (CAD). CAD can progress to advanced stages before the patient perceives any symptoms. Secondly, the range of symptoms attributable to CVD is limited, and it is common for various pathologies to present through a common symptomatic pathway (Bloomfield *et al.,* 2006).

However, the consequences of an unhealthy diet and lack of physical activity may emerge in individuals as HTN, diabetes mellitus (DM), hypercholesterolaemia, and being overweight (OW) or obese (OB). These risks factors can be measured in primary care facilities and

indicate an increased risk of developing a MI, CVA, HF and other complications (WHO, 2013a).

CVDs can be diagnosed by means of various investigations which range from simple procedures which include chest radiology (X-ray) and echocardiography (ECG), to more complex procedures such as cardiac catheterisation, nuclear scanning, computed tomography (CT) and magnetic resonance imaging (MRI) (Bloomfield *et al.,* 2006). Each procedure is utilised to identify various structural and functional pathologies of the cardiovascular (CV) system:

- **Cardiac catheterisation:** Used to measure intracardiac pressure, obtain blood samples from individual heart chambers, and obtain angiograms by injecting a contrast medium into a heart chamber or blood vessel.
- **Chest X-ray:** Utilised to determine the size and shape of the heart, and the condition of the pulmonary vessels and lung fields.
- **Computed tomography (CT):** Used for imaging the cardiac chambers, great vessels, pericardium and surrounding structures. This is investigation is the most valuable for imaging the aorta in suspected aortic dissection.
- **Echocardiogram (ECG):** Utilised to assess cardiac rhythm and the state of the conducting tissues. Information concerning the heart chamber size, the presence of myocardial ischaemia and infarction, valve abnormalities and the effects of certain medication on the heart can also be gained.
- **Magnetic resonance imaging (MRI):** Useful for imaging the aorta and the relationship of the great vessels to the heart chambers in CHD, as well as detecting infiltrative conditions affecting the heart.
- **Nuclear scanning:** Utilised to study cardiac function non-invasively.

2.3.4 CLASSIFICATION OF CARDIOVACSULAR DISEASE

CVDs are a collection of disorders of the heart and blood vessels (WHO, 2013a). CVD typically refers to conditions where the narrowing or blocking of blood vessels due to the build-up of fat can lead to a MI, chest pain (angina) or CVA. CVD also includes infections and conditions affecting the heart's muscle, valves or beating rhythm. Thus, CVDs include the following: According to the WHO (2013a) and the World Heart Federation (2017):

- **Cardiomyopathies**- Disease of the heart muscle. Several cardiomyopathies are genetic, while others are secondary to infection or other conditions that are poorly understood. One of the most common types of cardiomyopathy is idiopathic dilated

cardiomyopathy, where the heart is enlarged. Other types include ischaemic, where there is a loss of heart muscle; dilated, where the heart is enlarged; and hypertrophic, where the heart muscle is thickened.

- **Cerebrovascular disease**- Disease of the blood vessels supplying blood to the brain. A CVA occurs as a result of obstructed blood flow to a part of the brain. Cerebrovascular disease is also caused by ATH which may interrupt blood flow to the brain leading to CVAs and transient ischaemic attacks (TIAs).
- **Congenital heart disease**- Malformations of heart structure existing at birth. This may be genetic or due to adverse exposure to certain elements in utero, for example infections, numerous medications or alcohol and drug abuse. Congenital heart disease is a broad term and examples include holes in the heart (atrial/ventricular septal defects), abnormal heart valves, and abnormal heart chambers or vessels.
- **Coronary artery disease (CAD)**- Disease of the blood vessels supplying the cardiac muscle with blood, resulting in a decreased blood supply to the heart. This is also referred to as IHD. It is caused by ATH, during which the blood vessels that supply the heart are narrowed and/or blocked. CAD is the most prevalent type of CVD and the leading cause of MIs and angina (chest pain).
- **Hypertension (HTN)**- Refers to high BP. HTN may be referred to as primary hypertension if the origin of the high BP is unknown or secondary hypertension if the high BP is caused by diseases or infections which affect BP, for example adrenal gland tumours, kidney damage or disease, or damage to the blood vessels to the kidneys name a few. HTN increases the workload of the heart and overburdens the blood vessels thus resulting in aneurysms, CVA, HF, and renal disease.
- **Inflammatory heart disease**- Inflammation of the heart muscle, the myocardium (myocarditis); the membrane sac which surrounds the heart, the pericardium (pericarditis) or the inner lining of the heart, the endocardium (endocarditis). Inflammation may be induced by known toxins or infectious agents, or unknown sources.
- **Pericardial disease**- Disease of the fibrous sac enclosing the heart. The pericardium can be affected by a variety of conditions such as inflammation (pericarditis), fluid accumulation (pericardial effusion) and stiffness (constrictive pericarditis). The aetiology of these conditions varies.
- **Peripheral vascular disease (PVD)**- Disease of blood vessels outside of the heart and brain. PVD occurs as a result of ATH of the arteries and veins of the extremities and various organs. Two types of PVD have been identified: Functional PVDs where there is no structural damage to the blood vessel. Functional PVDs often have symptoms related to intermittent spasm of the blood vessels. The second type of

PVD is organic PVDs where inflammation or tissue damage may cause structural changes in the blood vessels. Peripheral artery disease (PAD) is a type of organic PVD. Initially, reduced lower limb circulation in PAD commonly manifests as intermittent claudication (American Heart Association, 2015). This is reported by the patient as cramping, fatigue, heaviness, and pain or discomfort in the legs and buttocks during activity, which is relieved by rest. Symptoms of poor kidney circulation include sudden HTN, or blood pressure that is difficult or impossible to control with the use of anti-hypertensive drugs. Significant obstruction of the kidney blood vessels may result in loss of kidney function or failure (American Heart Association, 2015). The presence of PAD increases the risk of developing gangrene in the lower extremities.

- **Valvular heart disease**- Disease of the heart valves. Numerous pathologies can result in damage to the heart valves. Valves may narrow (stenosis), leak (regurgitation or insufficiency) or not close properly (prolapse). Valvular disease may be congenital or may be secondary to pathologies such as rheumatic fever (damage to the cardiac muscle and heart valves caused by streptococcal bacteria), infections, connective tissue disorders, certain medications or radiation treatments for cancer which cause damage to heart valves.

2.3.5 RISK FACTORS FOR CARDIOVASCULAR DISEASE

Whilst most MIs, HF and other chronic diseases typically appear in the middle-aged and older population, the influence of CV risk factors can commence before birth and will have an effect throughout life. For that reason, it is imperative that the processes for prevention and management of CVD to be initiated early and continued throughout life (Steyn, 2007).

Risk factors are particular traits, conditions or habits that may increase an individual's risk for developing a specific condition. Numerous risk factors are recognized as causes of CVD. The majority of CVDs can be prevented by managing risk factors such as tobacco use, harmful use of alcohol, unhealthy diet and obesity, physical inactivity, HTN, DM and hypercholesterolaemia (WHO, 2013a).

Numerous risk factors associated with CAD and CVA exists. Certain risk factors cannot be altered and other risk factors can be altered or treated by modifying the individual's lifestyle (Buttar *et al.,* 2005). These are known as non-modifiable and modifiable risk factors, respectively (World Heart Federation, 2017).

2.3.5.1 NON-MODIFIABLE RISK FACTORS

- **Advancing age:** Merely growing older is a risk factor for CVD; the risk of CVA doubles with every decade after 55 years of age (World Heart Federation, 2017). Age is considered a risk factor for the majority of chronic diseases. This association is attributed to the wear and tear that the body experiences over time, making it susceptible to chronic disease. As an individual ages, the body is exposed to various strains and stressors, in addition to free radicals generated in the body, which accelerates the breakdown of cell and organ functions (Buttar *et al.,* 2005). Excess free radicals oxidize LDL cholesterol causing it to migrate across the endothelial membrane of arterial blood vessels. Oxidized LDL cholesterol then enters the blood vessel wall and initiates the formation of an atherosclerotic lesion. ATH results in blockage of blood vessels which interrupts blood flow to the heart causing severe pain, and may ultimately result in death of the cardiac tissue (Mimic-Oka *et al.,* 1999).

- **Family history of CVD:** CVD with either an inherited predisposition or origin is associated with HTN, congenital heart defects and with several rare inherited connective tissue disorders (Centre for Genetics Education, 2012). Certain individuals are at higher risk for CVD development due to their genetic makeup. This genetic predisposition places an individual at higher risk of disease despite environmental factors or lifestyle choices. This type of direct genetic risk normally involves a single gene (monogenic), examples of which include familial hypercholesterolaemia, familial hypertrophic cardiomyopathy or glucocorticoid suppressible HTN. In SA, familial hypercholesterolaemia is predominantly prevalent in the Afrikaans-speaking White community at a ratio of 1:72. This is attributed to the concentration of the specific gene in a small group of settlers in the country over many generations (Steyn *et al.,* 1996). Conversely, most CVDs are caused by multiple gene variants (polygenic) and, by chance and selection, some individuals and geoethnic groups have more of these variations and others less (WHO, 2013a). However, in the majority of cases where there is a family history of CVD, the genetic component appears to be a 'susceptibility' factor, rather than a direct cause, i.e., the disease is a multifactorial condition where both inherited genetic predisposition and environmental factors are involved (Centre for Genetics Education, 2012). Thus if a first-degree blood relative has been diagnosed with CAD or CVA before 55 years of age (for a male relative) or 65 years of age (for a female relative) the risk for CVD increases (World Heart Federation, 2017).

- **Gender:** While CVD remains the leading cause of mortality in both male and female genders in the United States (US), significant sex/gender dissimilarities in the

prevalence and burden of different CVDs exists. Similar patterns have been observed in SA as two males die for every female as a result of CVD (Steyn, 2007). CHD is the largest contributor to CVD morbidity and mortality for both male and female. The total CVD morbidity and mortality rates for females exceed those of males, as does the number of hospital discharges for HF and CVA. In addition, over 60% of US CVA deaths in 2007 occurred in females. However, more males are living with and dying of CHD than females and have more hospital discharges for CVD and CHD (Roger *et al.,* 2011). The prevalence of CHD is higher in males within each age stratum until after 75 years of age, which may contribute to the perception that CVD is more prevalent in males (Mosca *et al.,* 2011). This concurs with the findings of the World Heart Federation (2016), who suggested that males are at greater risk of developing CVD than pre-menopausal females. This is thought to be as a result of cardioprotective effect of endogenous oestrogen, that is to say that oestrogen protects the heart from disease. To date, the majority of literature has focused on the premise that endogenous oestrogen is cardioprotective in females (Mendelsohn *et al*., 1999). Increasing rates of CHD post-menopause, and post-oophorectomy, are amid the strands of evidence in humans that support this theory (Colditz *et al.,* 1987). However, upon careful examination this evidence is unconvincing, and is open to alternative explanations (Mosca *et al.,* 2001). Various clinical and laboratory studies have attributed the gender difference in the onset of CHD to a variety of mechanisms which include the use of hormone replacement therapy (HRT) for prevention of CHD, the effects of oral oestrogen versus non-oral oestrogen (e.g. transdermal) on blood vessels (Mosca *et al.,* 2001) and the biologic effects of the XX and XY chromosomes which are expressed through sex hormones (Rossouw, 2002). However, more research is required to further investigate these mechanisms underlying the gender difference in CHD.

Gender variations in CVD and CHD mortality reflect gender variations in the population demographics. Females are associated with a longer life expectancy than males, thus females represent a larger percentage of the elderly population in which the prevalence of CVD is highest. Even though traditional CVD risk factors are similar in both genders, the prevalence of these risk factors differs between genders (Mosca *et al.,* 2011).

- **Race*/* ethnicity:** Individuals who are of African or Asian origin are at higher risk of developing CVD than other racial groups (World Heart Federation, 2017). Previously, CHD in Africa was nearly absent in rural areas, and very uncommon in urban

centres, where many Africans are in an advanced stage of transition. Amongst town dwellers the consumption of food, particularly fat, has escalated and that of fibre-containing foods have descended. The increasing prevalence of the following major risk factors have also been attributed to the increasing prevalence of CHD in both in urban and rural settings in Africa: the mean blood cholesterol levels have doubled in rural populations living traditionally; OB in females has increased; the prevalence of HTN exceeds that in the White population and the prevalence of cigarette smoking in males has increased, but not in females. In addition to this, the level of physical activity has fallen (Walker *et al.,* 1997). Similarly in most urban and nearly all rural regions of sub-Saharan Africa (SSA), the prevalence of modifiable CVD risk factors among Black Africans were low. However, with urbanisation, an increase in traditional CVD risk factors and CHD rates was expected (Akinkugbe, 1985). In SA, the rapid migration of Black Africans to urban centres has led to increased poverty, OB, HTN, and hypercholesterolaemia. This trend of increasing risk factors with higher rates of urbanisation is expected to affect most of SSA. The national prevalence of HTN in SSA ranges from approximately 4% to 10%, with SA at the upper end of this range. The highest mortality rates for CVD in SA are found in Indian individuals, followed by the Coloured, White and Black African populations (Norman *et al.,* 2006).

The prevalence of HTN among males and females in one rural Mpumalanga district was 44% and 42% respectively, a higher figure than that reported for other rural areas in SSA (Thorogood *et al.,* 2007; Belue *et al,.* 2009). Data from the same sub-district show an emerging trend of OB and being OW among adolescent females, suggesting the emergence of a nutritional transition characterised by a shift towards a higher caloric content diet and/or decline in the level of physical activity (Kimani-Murage *et al.,* 2010). Dietary changes together with lifestyle and occupational changes among adults, reinforced by extensive labour migration to urban centres are fostering the epidemic not only of HTN and OB but also CVA (Conner *et al.,* 2005). However, this trend is not confined to rural areas. A Soweto hospital-based study demonstrated that 50% of all CVD patients presented with HTN, half of whom were OB (Sliwa *et al.,* 2004).

2.3.5.2 MODIFIABLE RISK FACTORS

While advancing age, gender and genetics are significant non-modifiable risk factors, the majority of the most recent cases of acute MIs, can be predicted by the prevalence of nine modifiable risk factors. These risk factors are consistent in nearly every geographic region, racial/ethnic group and gender worldwide (De Caterina *et al.,* 2006). These are also known

as behavioural/traditional risk factors are accountable for approximately 80% of CAD and CVA (WHO, 2011). This concurs with the findings of the INTERHEART study. This large scale case–control study of 25 countries revealed that more than 90% of the population attributable risk of acute MI was accounted for by these nine modifiable risk factors (Yusuf *et al.,* 2004; Joshi *et al.,* 2007; Anand *et al.,* 2008 and Teo *et al.,* 2009). These include cigarette smoking, DM, HTN, being OB, ApoB/ApoA1 ratio, a psychosocial index, low fruit and vegetable intake, lack of exercise, and regular alcohol consumption. Iqbal *et al.* (2008) identified that an unhealthy diet accounted for approximately 30% of the population attributable risk of acute MI globally, while Teo *et al.* (2006) observed all forms of tobacco use as one of the most dominant global risk factors. It is important to note that the distribution of risk factors may vary between various populations. For instance, in SA the prevalence of OB and HTN is higher than hypercholesterolaemia (De Caterina *et al.,* 2006).

- **Blood pressure abnormalities:** Steyn (2007) defines BP as the force that blood exerts on the walls of the arteries. BP is at its highest when the heart muscle contracts, pumping the blood throughout the body. This is referred to as the systolic blood pressure (SBP). The heart is at rest, between heart beats, causing the BP to drop. This lower pressure is referred to as the diastolic blood pressure (DBP). BP is expressed as these two values, the SBP and DBP, which are written as SBP/DBP e.g. 120/80 mmHg (measured in millimetres of mercury (mmHg). BP is measured with a variety of equipment, such as mercury Baumanometers or electronic BP monitors. High BP, known as HTN, is a BP reading of 140/90 mmHg or higher. An individual is diagnosed with HTN if either of the values are above the cut-off point (Steyn, 2007). HTN is known as a silent killer and is generally asymptomatic. Most individuals may be unaware that they have HTN until they experience heart, brain, or kidney problems. Untreated HTN may result in ischaemia as HTN may result in the following effects: weakening of the heart muscle resulting in HF; small bulges to form in the walls of arteries (these are referred to as aneurysms which commonly involves the aorta and the arteries of the brain, lower extremities, spleen and intestines); narrowing of renal arteries which may result in kidney failure; ATH or weakening of arteries throughout the body particularly those in the heart, brain, kidneys, and lower extremities which may result in a MI, CVA or kidney failure; rupture or haemorrhage of the blood vessels in the eyes, which may result in visual changes and blindness (Steyn, 2007). HTN is the leading risk factor for CVA and also plays a significant role in MIs. This risk factor can be prevented and successfully treated but only if it is detected early, the diagnosis is confirmed by a healthcare provider and the individual adheres to the recommended management plan (World Heart Federation, 2016).

HTN can be controlled by a healthy lifestyle and the use of appropriate medication (Steyn, 2007).

- **Hypercholesterolaemia:** This refers to high total blood cholesterol which includes high levels of triglycerides and LDL or low levels of HDL cholesterol. The incidence of the above increases the risk of CAD and CVA (World Heart Federation, 2016). HDL and LDL vary primarily in function and composition. LDL (also known as "bad cholesterol") has a higher triglyceride component than HDL (also known as "good cholesterol"). HDL has a higher density due to its higher protein content. LDL is deposited in arterial blood vessels and, when floating freely in the vascular system, it tends to have its highest atherogenicity. Atherogenesis is considered to be trigger by the oxidation of LDL within blood vessels. Conversely, HDL acts as a 'scavenger', collecting excess LDL that has been deposited in the blood vessels, which is then transported back to the liver for metabolic degradation (Thomson, 2004). Maintaining balanced blood lipid profiles is clinically important in minimising plaque and thrombus formation in arteries (Buttar *et al.,* 2005). Individuals who have a total blood cholesterol level of 5 mmol/L or higher are said to have hypercholesterolaemia. In most instances, hypercholesterolaemia is attributed to unhealthy lifestyle practices, which include the consumption of a diet high in fat or oily food (NCEP, 2001). This diet consist of saturated animal fats (i.e. hard fats like butter, fatty meat and greasy fast foods) or trans fatty acids in some hard margarines and some processed foods. Excessive consumption of cholesterol-rich food, such as eggs and red meat can also result in a rise in blood cholesterol. A diet low in fibre also contributes to high blood cholesterol (NCEP, 2001). Changing to a healthy diet, exercising and the use of lipid-lowering medication referred to as statins, can modify an individual's blood lipid profile (World Heart Federation, 2017).

- **Tobacco use:** Cigarette smoking or the use of any other tobacco products such as chewing tobacco or snuff, has been proven to be fatal to an individual's health. Tobacco users die of various diseases at an early age. However, most deaths are as a result of CVD (MI and CVA) followed by chronic lung diseases, such as chronic bronchitis and emphysema as well as lung cancer (Peto, 1994; Ezzati *et al.,* 2004). The smoking or chewing of tobacco increases the risks of CVD. The risk is particularly high if the individual started smoking at a young age, smokes heavily or is a female (World Heart Federation, 2017). No safe level of exposure to tobacco products exists. The use of smokeless tobacco products (e.g. chewing tobacco, snuff) or passive smoking exposes an individual to similar disease risks as those who

smoke tobacco (Peto *et al.,* 1992; Peto, 1994; Ezzati *et al.*, 2004). Thus, passive smoking is also considered a risk factor for CVD.

Cessation of tobacco use can significantly reduce the risk of CVD, irrespective of the duration of smoking (World Heart Federation, 2017). Refraining from cigarette smoking is the best outcome for smokers. However, the highly addictive properties of nicotine create a huge hurdle for individuals who have the desire to quit and until recently, smokers had merely two alternatives: either quit or suffer the harmful consequences of continued smoking (Farsalinos *et al.,* 2014). As a result, the smoking pandemic has increased, with approximately 6 million deaths annually and a predicted death toll of 1 billion within the 21st century (WHO, 2013b). However, a third choice, involving the use of alternative and safer nicotine sources with the goal to reduce smoking-related diseases is currently available. One such alternative is the invention of electronic cigarettes (ECs) also referred to as vaping, in 2003. With the increasing use and awareness of ECs over recent years various studies have been conducted to determine the safety and appropriateness of using these products. A systematic review on the safety evaluation and risk assessment of ECs as tobacco cigarette substitutes, suggests that EC use is undoubtedly a less harmful alternative to cigarette smoking as there is no tobacco and no combustion involved. Therefore, EC users may avoid numerous harmful toxic chemicals that are normally present in the smoke of tobacco cigarettes (Farsalinos *et al.,* 2014). However, in 2009, the Division of Pharmaceutical Analysis of the United States Food and Drug Administration (FDA) tested the contents of EC cartridges by two retailers. FDA findings suggested that ECs expose users to toxins and carcinogens similar to those associated with cigarette smoking. These toxic chemicals are released in the EC vapour, except their levels are substantially lower compared to that released in tobacco smoke (Farsalinos *et al.,* 2014). While ECs may have the potential to be a nicotine replacement therapy (NRT) device, exposure to toxic substances and the absence of sufficient scientific scrutiny is basis for the recommendation by the WHO study group (2009); that electronic nicotine delivery devices, including ECs, not be promoted as safe alternatives to cigarette smoking.

Other smoked forms of tobacco such as cigars, bidis, kreteks and water pipes have become highly popular and are often mistakenly perceived as less hazardous than cigarettes, when in truth their health burden is similar (O'Connor, 2011). The use of water pipes has become fashionable among young adults as a form of entertainment and leisure (Rastam *et al.,* 2004; Noonan *et al.,* 2009). The waterpipe also known as the hubbly bubbly, narghile, hookah, seesha or sisha; is an old recreational tobacco

smoking device commonly used in the Arab world but its origin dates back to several centuries ago in India, where it was utilised for smoking opium prior to the introduction of tobacco (Kandela *et al.,* 2000; American Lung Association, 2007). Literature on the effects of water pipes is less persuasive than that for cigarettes or smokeless tobacco (Study Group on Tobacco Product Regulation, 2005), but it indicates that its use is associated with cancer, CVD, lung function, infectious diseases and reproductive effects (Akl *et al.,* 2010; England *et al.,* 2010; Raad *et al.,* 2011).

- **Harmful use of alcohol:** Alcohol has been shown to have both beneficial and detrimental effects on the CV system. The chronic abuse of alcohol has been associated with negative effects, such as HTN, HF, bleeding disorders, atrial fibrillation, cardiomyopathies and haemorrhagic CVA (Hines *et al*., 2001; Watson *et al*., 2003). Other adverse effects of heavy alcohol consumption include but are not limited to: aerodigestive cancers; hepatic cirrhosis; foetal alcohol syndrome; fatal car crashes, and suicides (Hines *et al*., 2001). Concurrently, it has long been suspected that the moderate consumption of alcohol may be beneficial to CV health by protecting against morbidity and mortality associated with CHD and possibly thrombotic CVAs (Watson *et al*., 2003). A review of numerous studies on the moderate consumption of alcohol and CHD by Hines *et al.* (2001), demonstrated that the mechanisms by which alcohol affects the CV system, and many other organ systems, is complex. These mechanisms in include the effects of alcohol on HDL levels, genetics in addition to the alcoholic beverage type consumed. However, a more complete understanding of the aforementioned mechanisms are required to make recommendations at an individual level, which would be the most effective means for promoting overall health (Hines *et al.,* 2001).

- **Overweight and obesity:** Obesity (OB) refers to an excess build-up of fat mass. The gold standard for measuring body fat is under water weighing, referred hydrostatic weighing (Lustig *et al.,* 2003). Clinically, it can be difficult and expensive to accurately measure fat mass, as the aforementioned method is not readily available in private practice. For that reason, the body mass index (BMI) is widely used. BMI is expressed as weight (kg) divided by height (m^2), and allows for classification of individuals as underweight (<18.50), normal weight (18.50–24.99), overweight (25.00–29.99), OB (30.00–40.00) or morbidly OB (>40.00) (WHO, 2000). OB is a major risk for CVD and predisposes an individual to type 2 diabetes mellitus (T2DM) which is also a risk factor for CVD (World Heart Federation, 2016). OB has various

harmful effects on the heart which may be indirectly mediated through risk factors associated with metabolic syndrome such as dyslipidemia, HTN, and glucose intolerance, or effects from sleep disorders associated with OB (Shamsuzzaman *et al.,* 2002; Malik *et al.,* 2004). There are also numerous direct effects of OB on the heart and the CV system which include: increased blood volume, elevated cardiac output, left ventricular hypertrophy, and left ventricular diastolic dysfunction (Matthew *et al.,* 2008).

- **Physical inactivity:** The risk of CAD and CVA is enhanced by 50% when an individual does not engage in physical activity (World Heart Federation, 2016). An inverse relationship between physical activity and the incidence of CVDs has been repeatedly demonstrated i.e. an increase in physical activity results in a decrease in the relative risk of CVD (Buttar *et al.,* 2005). Exercise has been observed to positively influence blood coagulation (formation of blood clots) and fibrinolysis (breakdown of blood clots), vascular remodelling, BP and blood lipid profiles, all of which play an important role in the prevention of CVD (Buttar *et al.,* 2005).

  While physical activity or exercise forms a part of every individual's life, it is the degree of physical exertion that varies between individuals. In terms of defining physical activity, there are four areas of interest specifically intensity, duration, mode and frequency. According to Buttar *et al.* (2005), intensity is related to the degree or extent of exertion and is frequently presented as a percentage of target heart rate or lung volume (i.e. oxygen consumption [VO2]). Mode deals with the type of activity engaged in for example, walking; endurance activities such as running; or recreational activities such as gardening. Duration refers to the duration of a specific activity, while frequency refers to the number of times a specific activity is completed (Buttar *et al.,* 2005).

- **Diabetes Mellitus (DM):** Diabetes mellitus (DM) is a major risk factor for CVD. It is a clinical syndrome characterised by hyperglycaemia as a result of a lack of, deficiency, or ineffectiveness of insulin. This can arise in various ways but is most commonly due to the autoimmune destruction of pancreatic *beta* cells which secrete insulin (as in type I diabetes mellitus) or the resistance of body cells to the activity of insulin due to the effects of OB, physical inactivity and unhealthy diet (as in type 2 diabetes mellitus) (Bloomfield *et al.,* 2006). Insulin is responsible for transporting glucose from the blood into body cells where it is utilised for energy (Steyn, 2007). Thus a deficiency of insulin may affect the metabolism of carbohydrates, proteins,

and fats, and consequently disruption of water and electrolyte homeostasis. Untreated DM may result in functional and structural changes in body cells such as glucose intolerance and insulin resistance, with those of the vascular system being particularly susceptible (Bloomfield *et al.,* 2006: 580). Vascular disorders secondary to DM include retinopathy and nephropathy, PVD, CVA, and CAD. Furthermore, DM may induce both systolic and diastolic HF if the heart muscle is affected. The aetiology of the high rates of CVD morbidity and mortality in DM is unclear. Literature suggests that while hyperglycaemia, the hallmark of DM, plays a role in myocardial damage after myocardial ischaemia, it may not be the only factor, as both pre-DM and the presence of the metabolic syndrome, even in normoglycaemic individuals, increase the risk of most types of CVD (The DECODE Study Group, 1999; Muhlestein *et al.,* 2003; Thrainsdottir *et al.,* 2005). Type 2 DM (T2DM) increases the risk of CAD and CVA. T2DM increases an individual's risk of developing CVD two-fold compared to an individual who does not have CVD. Uncontrolled DM can result in the development of CVD at an earlier age than other individuals and its effects will be more devastating. DM in a pre-menopausal females negate the protective effect of oestrogen thus significantly increases the risk for CAD (World Heart Federation, 2017). Similarly type 1 (juvenile) DM (T1DM) increases the risk of CVD. T1DM compromises numerous aspects of body functions, with fat metabolism and glucose tolerance most affected. Metabolic disorders increase an individual's susceptibility to developing CVDs (Buttar *et al.,* 2005). Moreover, when individuals with DM develop clinical CVD, they incur a worse prognosis than non-DM individuals with CVD (American Heart Association, 1999).

- **Unhealthy diet:** A diet high in saturated fat increases the risk of CVD. Approximately 31% of CAD and 11% of CVAs worldwide is estimated to be caused by an unhealthy diet (World Heart Federation, 2017). In addition, excessive levels of dietary sodium (commonly consumed as salt, sodium chloride) are associated with increased BP and adverse CV health (Brown *et al.,* 2009). BP is regulated by two hemodynamic variables namely: peripheral vascular resistance and cardiac output. While peripheral vascular resistance is regulated by neural and hormonal inputs, cardiac output is affected by blood volume which is dependent on renal sodium homeostasis. High dietary intake of sodium increases blood sodium concentrations disrupting this balance by reducing the ability of the kidneys to reabsorb sodium from the blood stream. The decreased sodium excretion by the kidneys increases blood volume and cardiac output thereby elevating BP. The elevated BP will allow the kidneys to excrete sodium to achieve a new steady state of sodium excretion. However, the new

renal sodium homeostasis occurs at the expense of an elevated BP. Sustained high BP drives blood flow in excess of metabolic demands and may result in injury to blood vessel walls and end-organ damage. Damage to the walls of blood vessels may initiate ATH which is the origin of the majority of CVDs (Kumar *et al.,* 2007).

In SA, nutritional surveys by Ndaba *et al.* (1985); Steyn *et al.* (2001); Steyn (2006) and Sun *et al.* (2007) have revealed that individuals living in urban areas frequently consume a high fat diet, in addition to refined carbohydrates and added sugar. When compared to the traditional diet followed by individuals living in rural areas, it may be consider as less healthy. A poor intake of fruit and vegetables with resultant low fibre intake, high intake of plant and animal fat, including trans fatty acids, insufficient intake of milk and other dairy products, overall increases in the calorie/kilojoule intake, which lead to increasing weight or OB, and high and increasing alcohol intake were the unfavourable trends that have often been identified in urban diets (Ndaba *et al.*, 1985; Steyn *et al.*, 2001; Steyn, 2006; Sun *et al.*, 2007). The recommended daily allowance of salt is 5g/day, which is generally exceeded by the majority of SAs. The intake of high levels of sodium and low levels of potassium and calcium has also been associated with HTN. The overall low intake of fruits and vegetables has resulted in a potassium intake which is below the recommended daily intake (National High Blood Pressure Education Program, 1997; Charlton *et al.*, 2005a; Maseko *et al.*, 2006). There are many dietary sources of sodium in foods which are consumed daily. Processed foods have a high salt content attributed to flavour enhancers, bread and cereals. Bread which is a staple the diet of many SAs has continued to have a higher salt content than in various other countries. Important dietary sources of sodium and fat include meat products, soup powders and brick margarine. Adding flavour enhancers or soup powders to food during preparation is common and contributes to the high dietary sodium intake (Charlton *et al.,* 2005b). Efforts by SAs and the food industry to reduce the consumption of sodium rich foods and increase the consumption of potassium rich foods are not enough to reduce the risk of CVD in SA (Geleijnse, 2003; Cook *et al.,* 2007). Diet offers remarkable opportunities for the prevention of CVD as it can influence the majority of modifiable risk factors, most of which act by promoting ATH. Nutritional factors influence CVD by modulating vascular inflammation. Vascular inflammation is affected by high caloric intake (observed in OB and insulin resistance), alcohol consumption, numerous vitamins, dietary antioxidants, and n-3 polyunsaturated fatty acids (PUFAs). While diet modification has been shown to reduce the risk of CVD, it may be challenging to implement relevant and successful dietary changes. Dietary interventions

predominantly affect ATH by modulating, at the cellular level, pro-inflammatory processes that instigate and perpetuate endothelial dysfunction, plaque formation, and, ultimately, plaque rupture (De Caterina *et al.,* 2006).

- **Metabolic syndrome:** A collection of risk factors that have been correlated to an increased risk of CVD and T2DM, thus increasing the risk of CVA and MI (Seaman *et al.*, 2014). This syndrome which has been described as a cluster of physical examination and laboratory findings which includes excess visceral adipose tissue (Waist circumference ≥36 inches for women; ≥40 inches for men; insulin resistance (Impaired fasting glucose >100 mg/dL); dyslipidemia (Triglycerides >150 mg/Dl and HDL cholesterol <50 for women; <40 for men) and HTN (BP >130/85mmHg). Metabolic syndrome significantly contributes to the risk of CVD as the above mentioned conditions are united by a pathophysiological basis of low-grade chronic inflammation (American Heart Association, 2014; Kaur, 2014).

- **Medication:** A large number of medications, ranging from hormones to prescription and over-the-counter (OTC) medication, may increase the risk of/exacerbate pre-existing CVD. Hormones such as oral contraceptive pills (OCP) and HRT may increase the risk of CVD in healthy individuals (Buttar *et al,* 2005; World Heart Federation, 2016). The older high-dose OCP increases the risk of CVD by elevating LDL cholesterol levels and lowering HDL cholesterol levels thereby decreasing glucose tolerance, BP and promoting clotting mechanisms (Stadel, 1981). The composition of OCP has been significantly altered since they're first introduction. Presently oestrogen and progesterone levels have been decreased, thus their effect on lipoprotein levels is minor (Stampfer *et al.,* 1988). Thorogood (1993) found that OCP containing lower doses of steroids may carry a lower risk of CHD. The extensive evidence supporting the premise of a cardioprotective effect of oestrogen in females has been questioned by recent clinical trial data indicating that HRT is not cardioprotective as initially found. In females with existing CVD, it may initially increase CV risk. As a result of the increase in risk in secondary prevention trials, and the lack of published clinical trial data for primary prevention, HRT is no longer recommended for prevention of CHD (Mosca *et al.,* 2001). However, it remains probable that HRT prescribed for numerous years may be cardioprotective.

  Several prescription and OTC medications may induce HF in patients without concurrent CVD or may precipitate the occurrence HF in individuals with pre-existing left ventricular impairment (Feenstra *et al*., 1999). These medications are thought to

induce or exacerbate HF by causing direct myocardial toxicity or by exacerbating underlying myocardial dysfunction, leading to the precipitation or induction of HF (American Heart Association, 2016). Drug-induced HF may play a role in only a minority of individuals presenting with HF but, it should be regarded as a potentially preventable cause of this type of CVD. Table 2.1 demonstrates the various medications associated with an increased risk of/exacerbation of CVD.

Table 2.1 Prescription and over-the-counter medications that induce or exacerbate CVD

PRESCRIPTION MEDICATION				
DRUG CLASS		**INDUCE**	**EXACERBATE**	**REFERENCES**
Analgesics	COX, nonselective inhibitors (Nonsteroidal anti-inflammatories)	X	X	Feenstra *et al*., 1999; American Heart Association, 2016.
	COX-2 inhibitors		X	American Heart Association, 2016.
Antiarrhythmic	Class I- Flecainide; Disopyramide, and class 2- Sotalol		X	Podrid *et al*., 1980; Feenstra *et al*., 1999; American Heart Association, 2016.
Anticancer	Cytostatics	X	X	Appelbaum *et al*., 1976; de Forni *et al*., 1992; Feenstra *et al*., 1999; Barry *et al.,* 2007; Wadhwa *et al.,* 2009; Tarantini *et al.,* 2012; American Heart Association, 2016.
Antidepressants	Tricyclic antidepressants		X	Feenstra *et al*., 1999.
	Selective serotonin reuptake inhibitors- Citalopram		X	Feenstra *et al.,* 1999; US US Food and Drug Administration, 2011.
Anti-diabetics (Oral hypoglycaemics)	Biguanides- Metformin, thiazolidinediones		X	Delea *et al.,* 2003; American Diabetes Association, 2016.
	Dipeptidylpeptidase-4 inhibitors- Saxagliptin, Sitagliptin		X	Scirica *et al.,* 2013; Monami *et al.,* 2014.
Anti-epileptics	Carbamazepine, Pregabalin		X	Terrence *et al.,* 1980; Apfelbaum *et al.,* 1995.
Antifungal	Azole antifungal medications- Itraconazole, and other antifungal medications- Amphotericin B	X		Sharkey *et al.,* 1991; Nelson et al.,1993; Ahmad et al., 2001; Okamoto et al., 2007; Fung *et al.,* 2008; Hauben et al., 2013.
Anti-hypertensives	*Beta* blockers		X	Feenstra *et al*., 1999; American Heart Association, 2016.
	Calcium channel blockers- Diltiazem, Verapamil, Nifedipine		X	Packer *et al*., 1996; Feenstra *et al*., 1999; Parker *et al*., 2013; American Heart Association, 2016.
	Central alpha agonists- Moxonidine		X	Franciosa *et al.,* 1984.

	Alpha-1 blockers- Doxazosin		X	Collaborative Research Group, 2002.
	Peripheral vasodilators- Minoxidil		X	American Heart Association, 2016;
Antimalarials	Chloroquine, Hydroxychloroquine	X	X	Tönnesmann *et al.,* 2012; Tönnesmann *et al.,* 2013.
Antimigraine	Ergotamine, Methysergide, appetite suppressants	X		Misch, 1974; Mason *et al.,* 1977; Harbin *et al.,* 1984; Redfield *et al.,* 1992; Abenhaim *et al.,* 1996; Mark *et al.,* 1997; Sachdev *et al.,* 2002; Amabile *et al.,* 2004; Dodick *et al.,* 2004.
Antiparkinson	Dopamine agonist- Bromocriptine, and Pergolide- Pramipexole	X		Corvol *et al.,* 2007; Zanettini *et al.,* 2007; US Food and Drug Adminstration, 2012.
Antipsychotics	Clozapine	X		Allison *et al.,* 1999; Ray *et al.,* 2001; Hennessy *et al.,* 2002; American Diabetes Association, the American Psychiatric Association, the American Association of Clinical Endocrinologists, and the North American Association for the Study of Obesity, 2004; Merrill *et al.,* 2005; Mackin, 2008; American Heart Association, 2016.
Antiretroviral therapy	Protease inhibitor (PI) and/or non-nucleoside reverse transcriptase inhibitor (NNRTI)	X		Friis-Moller *et al*., 2003.
Corticosteroids		X	X	Stanbury *et al.,* 1998.
Disease-modifying antirheumatic agents	TNF-α inhibitors- All drugs within this class- infliximab, etanercept, and adalimumab)	X	X	Jain *et al.,* 2013; American Heart Association, 2016.
Haematological	Platelet reducing agents	X		American Heart Association, 2016.
	Anti-platelets		X	American Heart Association, 2016.
Ophthalmological medications	Topical beta-blockers and cholinergic agents		X	Munroe *et al.,*1985*;* Everitt *et al.,* 1990.
Pulmonary medications	Bronchodilators	X	X	American Heart Association, 2016.
	Endothelin receptor blocker- Bosentan		X	Karla *et al.,* 2002.
	Vasodilators- Epoprostenol		X	Califf *et al.,* 1997.
QT-prolonging medications	Antibiotics, antidepressants, antipsychotics and anti-emetics	X		Roden, 2004; Drew *et al.,* 2010.
Sodium-containing medications	Proton pump inhibitors	X		Medication insert.

Stimulants	All drugs within this class- racemic amphetamine, dextroamphetamine, methylphenidate, methamphetamine, pseudoephedrine	X		Smith *et al.,* 1976; Hong *et al.,* 1991; Wijetunga *et al.,* 2003; Yeo *et al.,* 2007; Marks, 2008; Vitiello, 2008; Westover *et al.,* 2008; Dadfarmay *et al.,* 2009; Ali *et al.,* 2011; Sylvester *et al.,* 2012; American Heart Association, 2016.
Urological medication	Alpha-1 antagonists- Doxazosin, Prazosin, Tamsulosin, Terazosin		X	American Heart Association, 2016.
Over-the-counter medications				
Analgesics	Non-prescription NSAIDs		X	Huerta *et* al., 2006.
Asthma medication	Non-selective sympathomimetic Amines		X	Medication insert.
Cough, cold; and allergy and sinus preparations	NSAIDs/vasoconstrictors		X	Medication insert.
Nasal and ocular decongestants	Vasoconstrictors		X	Glazener *et al.,* 1983; Cantu *et al.,* 2003; Corboz *et al.,* 2008; Fukushima *et al.,* 2008.

Clinician awareness of potential adverse effects on cardiac function by numerous classes of medications, particularly in individuals with pre-existing CVD, may contribute to timely diagnosis and prevention of drug-induced CVD particularly HF (Feenstra *et al*., 1999). It is important for clinicians to educate healthy patients on risks involved in the use seemingly harmless prescription and OTC medications. This should be emphasised particularly in patients with pre-existing CVD. As the information stated in Table 2.1 illustrates, a number of CV medications has also been demonstrated to exacerbate pre-existing CVDs. Thus, before clinicians recommend medication, they should ascertain whether the patient has underlying CVD; note whether the patient is using any other medication that may affect cardiac function and instruct the patient to report any new signs and symptoms of CVD experienced before commencement of drug therapy. Once the patient initiated the use of a new or more medication, it is imperative for the patient to monitor for any adverse effects associated with the medication (American Heart Association, 2016).

- **Socioeconomic status:** Poverty, regardless of the region in the world, increases the risk of CVD. This is in addition to a chronically stressful lifestyle, social isolation, anxiety and depression (World Heart Federation, 2017). More than 80% of CVD related mortality in the world occurs in low- and middle-income countries. The relationship between poverty and the development of CVD, in addition to other non-

communicable diseases (NCDs), is mediated by several factors. Firstly, individuals in low- and middle-income countries have a higher prevalence of risk factors such as tobacco use. Secondly, contrasting to high-income countries, these individuals generally do not have the advantage of prevention programmes, early detection services or access to effective and affordable healthcare services. As a result, numerous individuals die prematurely as a result of CVD, often during their most productive years, placing a heavy burden on the economies of low- and middle-income countries. Thus, the poorest individuals are mostly affected by CVD (WHO, 2011; WHO, 2013a). The high incidence of CVD in these populations may be as result of transitions in social structures, economics, politics, education, and home environments experienced by most countries in the worldwide, with a consequent shift from agricultural and rural societies to industrial and urban societies. These social and economic transitions have resulted in major alterations in population demographics, industrial structure, income levels, expenditure patterns, education levels, family structures, eating habits, and physical activity and in this manner markedly increased CVD risk factors and disease rates (Yusuf *et al.,* 2001). Conversely, CVDs and other NCDs have been demonstrated to contribute to poverty owing to catastrophic health spending and high out-of-pocket expenditure (WHO, 2011).

In SSA, the disease profile has been changing from infectious diseases and nutritional deficiencies to NCDs, mainly CVD (Velkoff *et al.*, 2006). It was suggested that, CVD will become the leading cause of mortality in low-income countries in Africa, by 2030. Furthermore, projections predict that in SSA, despite the excess mortality due to acquired immune deficiency syndrome (AIDS), the number of individuals at 60 years of age and older will double from 34 million in 2005 to more than 67 million in 2030. This growth rate is significantly higher than that in industrialised countries (Velkoff *et al.*, 2006). The older individuals of society compete with extremely stressful situations daily. The high HIV/AIDS related morbidity and mortality leaves them responsible for the care of their own sick children and grandchildren. These individuals are not only at risk of HIV/AIDS but also for CVA, DM, HTN, and related chronic disorders. Therefore, this transition in health has a direct and indirect impact on three generations, with the oldest individuals, who have an irreplaceable social role, susceptible to NCD (Tollman *et al.,* 2008). Additionally, CHD is anticipated to become the fifth most common the cause of disability-adjusted life-years lost in low-income countries by 2030 (Mensah, 2008). The growing prevalence of CHD in developing countries is attributed to sedentary lifestyles and

alterations in eating habits, with a shift from a traditional diet to a westernised diet high in saturated fats and sugar. Furthermore, cigarette smoking is significantly increasing in most African countries (Jha *et al.,* 2002). The prevalence of CVD risk factors in Africa was determined in the INTERHEART Africa study. This large scale case-control study recruited 578 cases of first-time MI and 785 controls from nine SSA countries (Steyn *et al.,* 2005). Approximately 75% of the participants were male. The study population consisted of 36.3% Black Africans, 46.7% coloured Africans, and 17% European and other African individuals. HTN and DM were particularly significant in the Black African population owing to its higher population attributable risk compared with that observed in the two other ethnic groups. Similar major CVD risk factors have been identified in both Africa and other regions of the world. However, paucity in the literature from Africa on the extent of the burden of CVD and CV risk factors, the strength of the associations amongst various risk factors, and the incidence of MI exist. The INTERHEART Africa study is currently the largest comprehensive research conducted in Africa. Even then, greater than 80% of the participants who enrolled in this study were SA. SA is considerably more developed than most of SSA. Thus, the findings of the INTERHEART Africa study should not be generalised to the African continent overall (Celermajer *et al*. 2012).

Increased risk of CVD has also been associated with a chronically stressful lifestyle, social isolation, anxiety and depression (World Heart Federation, 2016). Numerous prospective studies on healthy individuals have demonstrated the predictive role of depression or depressive symptoms in the development of CHD (Barth *et al.,* 2004). The results of two meta-analyses by Rugulies (2002) and Wulsin *et al.* (2003), support the premise that depression is a risk factor for the development of CHD. The risk of developing CHD was 60% higher in depressed individuals. According to these studies, clinical depression proved to be a substantially better predictor for the development of CHD in initially healthy individuals. According to Rozanski *et al.* (1999), depression is associated with poor health behaviour, maladaptive coping style, social isolation, and chronic life stress. Modifiable risk factors such as smoking tobacco, physical inactivity, an unhealthy diet, and the failure to adhere to medical recommendations mitigate the relationship of depressive disorders with CHD (DiMatteo *et al.,* 2000; Ziegelstein *et al.,* 2000). In addition, low levels of perceived emotional support and social isolation are related to both CHD and depression (Kaplan *et al.,* 1993; Segrin, 2000). Psychosocial stressors have been demonstrated to be predictors of depression in patients with CHD and are also known to be

predictors of CHD and the prognosis in CHD patients (Krishnan *et al.,* 1998; Hemmingway *et al.,* 1999).

Similarly, the relative risk of CVD mortality is significantly greater in individuals with psychiatric disorders than in the general population (American Diabetes Association, American Psychiatric Association, American Association of Clinical Endocrinologists, and North American Association for the Study of Obesity, 2004). This association may be attributed to the use of antipsychotic medication, particularly second-generation antipsychotics (SGAs). Although the SGAs have numerous significant benefits compared with first-generation antipsychotics (FGAs), their use has been correlated with dramatic weight gain, DM and hypercholesterolaemia. Because of the close associations between OB, DM, dyslipidaemia and CVD, there is substantial interest in the relationship between the SGAs and the development of these CVD risk factors. This relationship is of considerable clinical concern because OB and DM are also important risk factors for CVD. High rates of smoking and physical inactivity may also contribute to the excess mortality of individuals with psychiatric disorders as a result of CVD. (American Diabetes Association, American Psychiatric Association, American Association of Clinical Endocrinologists, and North American Association for the Study of Obesity, 2004).

It is important to note that an individual may not necessarily develop CVD if they have a risk factor. However, the greater the number of risk factors an individual has the greater the chance/probability of developing CVD, unless action is taken to modify risk factors to prevent them compromising cardiac health (World Heart Federation, 2017).

2.3.5.3 CARDIOVASCULAR DISEASE AND CONNECTIVE TISSUE DISORDERS

Particular factors that are associated with the future development of CVD in the general population exist. As mentioned previously in Section 2.3.5, those factors are referred to as non-modifiable and modifiable risk factors. CVD risk is enhanced in a number of connective tissue diseases, for example in systemic lupus erythematosus (SLE), rheumatoid arthritis (RA), systemic vasculitis and antiphospholipid syndrome. Traditional risk factors have been shown to be more prevalent in individuals with connective tissue disease compared to the general population (e.g. smoking in RA and hypertension in SLE). However, these factors do not completely clarify the susceptibility of these individuals to CVD development (Husain *et al.*, 2010).

Several factors have been attributed to the enhanced risk of CVD in connective disease. Firstly, connective tissue diseases are usually characterised by chronic inflammation as well as the use of immunosuppressive medication such as corticosteroids which can exacerbate traditional risk factor profiles thereby contributing to ATH. Secondly, previous studies have identified an increased correlation between connective tissue disorders and clinical CVD, predominantly in SLE. However, from a population impact, the small but significant correlation between RA and CHD is more relevant. It is probable that the basis for accelerated atherogenesis in these connective tissue disorders is mediated by inflammatory vascular damage. Many traditional risk factors for ATH are also altered in these conditions, for example, increased prevalence of HTN and DM in SLE and a higher prevalence of smoking in RA (Husain *et al.*, 2010). Furthermore, an increase in oxidised LDL, have also been reported in a number of these disorders. Lastly, a number of the autoantibodies present in these individuals may also be markers of risk. Certain antibodies may also directly influence AHT (Husain *et al.*, 2010).

Conclusively two main factors are responsible for the increased risk of CVD namely: the presence of chronic inflammation and a number of specific autoantibodies. However, the influence of these factors on CVD is debatable and should be further investigated. A greater understanding of the dissimilarities and similarities between the inflammatory state and therapy exposures that may account for the differences observed to date, are required. Awareness of these variations will assist in understanding the relationship between chronic inflammation and ATH (Husain *et al.*, 2010).

From a clinical perspective, healthcare providers who manage individuals affected by connective tissue disorders should be aware of the CV risk associated with these conditions; and screen and manage these individuals accordingly. For example, SLE is viewed as a CHD equivalent condition. Therefore, the objective is to strictly manage traditional risk factors which encompass modifying lifestyle including tobacco smoking cessation and weight reduction, and treating cholesterol and BP to strict targets with the use of appropriate medication (Wajed *et al.,* 2004).

2.3.6 MEDICAL MANAGEMENT OF CARDIOVASCULAR DISEASE

Numerous interventions are available for the medical management of CVD. Such interventions can be instigated by non-physician health workers in close-to-client facilities. These have been prioritised by the WHO and are very cost effective and high impact interventions.

2.3.6.1 PRIMARY INTERVENTION

These include medicinal, nutritional and educational interventions. Early detection of at risk patients in primary care is possible though the use of simple tools such as specific risk prediction charts. Early detection reduces the overall cost of treatment as inexpensive treatment options are available to prevent disease progression to MI, CVAs and other types of CVDs. Survivors of a MI or CVA are at high risk of recurrences and are at high risk of death as a result of them. The risk of a recurrence or death can be significantly reduced with a combination of medications to reduce cholesterol and BP (WHO, 2013a).

2.3.6.1.1 MEDICINAL INTERVENTIONS:

The risk of CVD can be decrease by treating HTN, DM and raised blood lipids (WHO, 2013a). Some of the major types of commonly prescribed CV medications used to improve and treat the symptoms of CVD include (American Heart Association, 2012): anticoagulants, antiplatelet agents, angiotensin-converting enzyme (ACE) inhibitors, angiotensin 2 receptor inhibitors, beta blockers, calcium channel blockers, diuretics, vasodilators and statins.

2.3.6.1.2 NUTRITIONAL AND EDUCATIONAL INTERVENTIONS:

The primary goal in the management of a patient with CVD is to prevent recurrence and progression of the condition. This can be achieved by educational and nutritional interventions. Patients are encouraged to modify their lifestyle by eating healthy (consuming a diet high in fruit and vegetables; and eliminating fat, sugar and sodium rich foods) and engaging in regular physical activity to maintain a healthy body weight. Patients are also advised to cease harmful use of alcohol and tobacco; and avoid second-hand tobacco smoke (WHO, 2013a).

2.3.6.2 SECONDARY CARE INTERVENTIONS

Surgical interventions are at times required for the treatment of CVDs. These include coronary artery bypass, balloon angioplasty, valve repair and replacement, heart transplantation, and artificial heart operations. In some cases medical devices are required to treat CVDs which include the insertion of pacemakers and prosthetic valves; and cardiac catheterisation to insert patches or plugs to repair permanent connections in the heart (this is done by means of open-heart surgery in certain types of atrial septal defects) (WHO, 2013a).

2.3.6.3 PREVENTION AND CONTROL OF CVDs

When addressing prevention of CVD, it is imperative to emphasise the following points: firstly, atherothrombotic CVD is highly prevalent worldwide and affects all ethnicities;

secondly, with urbanisation, the risk for CVD escalates; thirdly, efforts to prevent or reverse the adverse consequences of urbanisation should be implemented at a societal level (through changes in legislation or social policies) and at the individual level (through modification of risk factors and use of evidence-based treatments); fourthly, although differences in genetic susceptibility among ethnic groups have been observed, environmental factors and risk factors are a major contributor to the development of clinical disease in all ethnic groups. Thus, it is possible that prevention practices from one region or particular ethnicity may be applicable to another region or ethnic group. However, it is imperative that appropriate modifications take into consideration genetic susceptibility, social, economic, and cultural factors (Yusuf *et al.,* 2001).

2.3.6.3.1 PRIMARY PREVENTION

Two strategies are advocated for the primary prevention of CVD namely, the "population approach" and the "high-risk approach." The population approach employs community wide interventions to modify lifestyle behaviours which may have an impact on the distribution of risk factors in the population. The smallest risk modifications are expected to significantly reduce the cumulative population risk of CVD as a vast number of individuals are affected by this approach. Conversely, the high-risk strategy is designed to target only a few individuals. Firstly, this strategy identifies those who have a high risk of disease, which may have resulted from an increase of either a single or multiple risk factors. Once these individuals have been identified, targeted behavioural or pharmacological interventions are implemented. Thus, the population strategy seeks to decrease the incidence of disease in the entire population while offering small benefits to each individual. In contrast, the high-risk strategy offers large benefits to a small number of at risk individuals who represent only a small percentage of the total population. Consequently, the high-risk strategy offers relatively limited benefits to the community as a whole (Rose, 1992).

However, the objectives of the population approach has not been adequately achieved, as demonstrated by several community-based randomised intervention trials targeting multiple risk factors (WHO, 1986). Thus, the scientific-based development of community-based programs analogous to those completed during the 1970s and 1980s has been questioned (Thelle, 2000). This is contrasting to the reported success of the North Karelia program (Vartiainen *et al.,* 1994), the lifestyle program in Mauritius (Dowsen *et al.,* 1995), and the delayed benefits observed in the Multiple Risk Factor Intervention Trial (MRFIT trial) (The Multiple Risk Factor Intervention Trial Research Group, 1996). Studies assessing the benefits of the population approach are faced with various methodological drawbacks.

Firstly, although the number of individuals in the above mentioned studies is relatively large, the sampling units are communities and not individuals, thus, number of communities compared are small, which significantly reduces statistical validity. Secondly, simply a small impact of the intervention on risk factors is possible as a result of inefficient delivery of the intervention; "contamination" of the control population who have a tendency to partially adopt the intervention package; and declining disease rates overall, all of which reduce statistical power (Thelle, 2000). Therefore, it is imperative that the determinants of risk factors at a society level and how they can be modified more effectively through governmental or social policies are investigated (Yusuf *et al.,* 2001).

Data derived from individual level interventions and observations have indicated that a reduction in CHD is associated with a reduction in risk factors. The results from these studies promote policy changes and community level programs that control tobacco use, decrease OB, encourage exercise, and advocate a healthy diet. Conversely, the efficacy of the high-risk approach has been confirmed, whether for lifestyle interventions (Appel *et al., 199*7) or for pharmacological interventions e.g. trials of statins (Law, 1998), aspirin (Antiplatelet Trialists' Collaboration, 1994), or ACE inhibitors (The Heart Outcomes Prevention Evaluation Study Investigators, 2000).

However, it is imperative to recognise that the majority of CVDs are found in large portions of the populace who demonstrate average levels of risk factors and are, for that reason, at modest risk. As previously mentioned, the high-risk strategy reduces the risk of disease at an individual level thus only a small quantity of the population benefit from these interventions. Thus, high-risk strategies should be accompanied by more embracive risk reduction approaches which address larger population attributable risks (Yusuf *et al.,* 2001).

2.3.6.3.2 SECONDARY PREVENTION

The clinical trials for secondary prevention have also made a substantial contribution to the documentation of the value of risk factor modification, by demonstrating reductions in major cardiovascular events from interventions aimed at:

- Particular risk factors for example cholesterol (Law, 1998) and BP (Collins *et al.,* 1990);
- Mediators of thrombogenesis (Anand *et al.*, 1999);
- Dietary regimes for example fish (Ness *et al.,* 1999) or the Mediterranean diet (de Lorgeril *et al.,* 1999), they have strengthened the theory that risk factors and protective factors are critical to preventing CVD.

Progressive reduction of the thresholds for these clinical interventions, will allow clinical standards to come closer to prevention standards. Therefore, it is no longer astonishing to see clinical guidelines advocating LDL cholesterol target levels lower than 130 mg/dL (or below 100 mg/dL in individuals with clinical disease) or identifying the optimal BP as lower than 140/80 mmHg in otherwise healthy individuals or 120/80 mmHg in high risk individuals (e.g. diabetics). Hence, a significant overlap between a population approach and a high-risk approach to prevention exists (Yusuf *et al.,* 2001).

Risk factors have been demonstrated to begin from early childhood and continue into middle age and old age. In addition, children may also present with subclinical ATH due to the presence of elevated risk factors. Thus, it is imperative for preventive strategies to commence as early as possible. Considering that lifelong pharmacological treatment is unfavourable, with the exception of very high risk children, the requirement for community level prevention with particular focus on the family unit in a high-risk strategy is further emphasised. Thus, the prevention of CVD should begin with the control of the maternal risk factors and appropriate intra-uterine nutrition suggesting an intergenerational approach to prevention. This necessitates the need for both community wide population strategies and targeted high-risk individual strategies that would be applicable across the entire life span of individuals (Yusuf *et al.,* 2001).

CVD is a major global health burden occurring mostly in developing countries. However, the majority of knowledge regarding prevention and treatment of CVD is derived from studies conducted in developed countries and predominantly among White populations. For that reason, it is imperative to conduct appropriate research studies, raise awareness of CVD, and develop preventive strategies in developing countries. In the interim, as it is expected that the majority of risk factors will be of some importance in all ethnic populations in the world, prevention and treatment strategies that have been proven to be effective in developed countries, should be adapted for developing countries (Yusuf *et al.,* 2001).

These strategies should include approaches to prevent risk factor development in the entire population by modifying social and governmental policies in addition to approaches that can be applied to high risk individuals. Some approaches are relatively low cost and readily applicable (e.g. promoting physical activity, use of aspirin, or ACE inhibitors in high risk individuals and controlling BP with the use of thiazides or *beta*-blockers). Other approaches may only be applicable to relatively affluent regions of the world (e.g. statins or coronary artery bypass graft surgery). Therefore, both population-level and individual-level strategies should be customized to each country, community, and socioeconomic level. Translating

existing knowledge of CVD prevention into effective implementation might be expected to substantially blunt or even reverse the current and future global epidemic of CVD (Yusuf et al., 2001).

MI and CVAs can be prevented through healthy diet, regular physical activity, maintaining a healthy body weight and avoiding and/or ceasing tobacco smoke and alcohol consumption. In addition to lifestyle modification which reduces the risk of CVD, WHO (2013a), have identified various interventions which are very cost effective and feasible. These interventions can be implemented even in low income settings for the prevention and control of CVDs:

- Combining approaches that aim to decrease the risks of CVD throughout the entire population with strategies that target individuals that are at high risk or those with established disease.
- Examples of population-wide interventions that can be implemented to decrease CVD risk include:
    - Comprehensive tobacco control policies, such as the control of cigarette smoking by increasing the price of cigarettes and anti-tobacco campaigns (Yusuf *et al.,* 2001)
    - Taxation to reduce the intake of foods that are high in fat, sugar and sodium and promoting traditional dietary patterns (Yusuf *et al.,* 2001).
    - Promoting regular exercise, particularly among urban populations (Yusuf *et al.,* 2001) such as building walking and cycling paths to increase physical activity and providing healthy school meals to children.
    - Developing integrated approaches that focus on the main common risk factors for a range of chronic diseases such as CVD, DM and cancer: which include an unhealthy diet, physically inactivity and tobacco use.

WHO (2013a) suggest that the government invest more resources in the prevention and early detection of NCDs by introducing national programmes aimed at the prevention and control of NCDs including CVDs.

2.4 INTRODUCTION TO MUSCULOSKELETAL DISORDERS

Musculoskeletal disorders (MSDs) are associated with some of the poorest quality-of life (QoL) rankings as a result of body pain and reduced physical functioning or disability. These rankings for MSDs showed that for QoL, it ranked lower than those of gastrointestinal, respiratory, and cardiovascular disorders, respectively (Reginster, 2002). MSDs also have a

major effect on society as a result of their frequency, chronicity and consequent disability (Woolf *et al.,* 2003).

2.4.1 PREVALENCE OF MUSCULOSKELETAL DISORDERS

MSDs are very prevalent and impact us on a daily basis. They are the most common source of severe chronic pain and physical disability. Self-reported persistent pain associated with the musculoskeletal system has been used in numerous population based surveys to estimate the prevalence of MSDs as it affects up to 20% of the adult population (Woolf *et al.,* 2003).

MSDs affect hundreds of millions of individuals worldwide. Joint diseases, for example, constitute more than 50% of all chronic conditions in individuals of 60 years and older; while back pain is the second leading cause of sick leave (Lidgren, 2003). An estimated 2133 deaths from MSDs occurred in South Africa in 2009 alone (820 of these deaths were due to arthropathies, 379 systemic connective tissue disorders, 147 dorsopathies, and 628 were due to soft tissue disorders) (Statistics South Africa, 2013b). This concurs with the Centres for Disease Control and Prevention (2001), who indicated that arthritis the leading cause of disability in SA followed by back pain (Ulwin *et al.*, 2006 and Alwan *et al.*, 2009).

Despite the enormous impact of MSDs globally, MSDs receive insufficient attention and are inadequately funded (Delmas *et al.,* 2000; Weinstein, 2000; Woolf *et al.,* 2001). This lack of attention by the medical profession, policy-makers and the media is due to the misconception that MSDs are less serious, unlike CVD, AIDS and cancer; that they are largely chronic, non-fatal conditions; and tend to be perceived as an inevitable consequence of ageing. The extent of the dilemma will increase as ageing of the world's population will markedly increase the number of individuals affected by MSDs, thereby placing huge burdens on societies and health care systems, predominantly in less-developed countries (Lidgren, 2003; Woolf *et al.,* 2003). Changes in lifestyle factors, such as increased OB and lack of physical activity with the urbanisation and motorisation of the developing world, will result in a further increase the burden (Woolf *et al.,* 2003).

To assist in restoration of this imbalance on an international level, a group of health professionals, elected to create a global campaign, declaring the first 10 years of the 21st century the "Bone and Joint Decade" (BJD). The objective of the BJD is to improve the quality-of-life of individuals affected by bone and joint diseases and injuries globally thus improving awareness and understanding of the importance of MSDs, in addition to increasing research funding (Lidgren, 2003).

2.4.2 AETIOLOGY OF MUSCULOSKELETAL DISORDERS

The musculoskeletal system consists of muscles, tendons, ligaments, cartilage and bones which are located in different parts of the body. MSDs affect these tissues with muscles being the most common site of pain (Riihimäki, 1998). Effectively all MSDs are work-related, meaning that physical activity can aggravate or provoke symptoms even though the disorders were not a direct result of work. Generally, it is difficult to isolate one causal factor for MSDs. Conditions caused exclusively by accidental injuries are an exception; in most cases several factors play a role. For many of the MSDs, mechanical load at both work and leisure is a significant causal factor. Sudden overload; or repetitive or sustained loading can result injury to various tissues of the musculoskeletal system. In contrast, very low levels of activity can result in deterioration of the condition of muscles, tendons, ligaments, cartilage and even bones (Riihimäki, 1998).

Most MSDs are characterised by a local/regional ache or pain (Riihimäki, 1998) which may be referred to other regions of the body. The most prevalent musculoskeletal causes of local pain include (Wise, 2003):

- **Arthritis:** Occurs as a result of inflammatory, degenerative or crystal deposition conditions affecting joints. The most common types of arthritis including osteoarthritis (OA) and RA (Lidgren, 2003).
- **Bursitis:** Occurs as a result of mechanical or inflammatory changes in one of the bursae in the body. Bursae are synovial-lined sacs located around joints to minimize friction between tendons, ligaments, and bony structures.
- **Entrapment neuropathies:** Occur at sites where peripheral nerves are compressed as they cross joint areas that permit relatively little space for free movement of the affected nerves.
- **Low back pain:** The exact cause of low back pain may be difficult to determine as low back pain is mulitfactorial. It is usually attributed to a combination of chronic overuse and acute injury to muscles and ligaments (e.g. muscular or ligamentous strain), tendons, facet joints (e.g.arthritis), nerves, intervertebral discs, nerves or vertebrae of the lumbar spine (Chou *et al.,* 2007).
- **Myofascial pain:** Occur at sites within muscle groups and surrounding fascial tissues that become tender and painful due to localised injury or overuse.
- **Neck pain:** Occurs as a result of poor head and neck posture that causes a strain on the neck, zygapophyseal (facet) joint fixation, cervical disc herniation and overuse of neck musculature. Degenerative changes in cervical discs and facet joints as individuals age resulting in less neck mobility and thus making them more prone to injury may also be a cause of neck pain (Boodhoo, 2002). In addition, biomechanical

conditions, such as whiplash-associated disorder or any trauma, may results in neck pain and other symptoms (Venketsamy, 2007).

- **Tendinitis:** Generally occurs secondary to trauma or overuse of tissues near sites of insertion of tendons to bone or muscle (musculotendinous junction).
- **Tenosynovitis:** Occurs as a result of inflammation of a tendon and the fluid-filled sheath (synovium) which surrounds the tendon.

MSDs may also result in widespread/generalised pain. Myofascial pain is a common cause of regional pain, but it is also an important element of a widespread/generalised rheumatic syndrome known as fibromyalgia or fibrositis. This syndrome often results in symptoms of pain in the vicinity of several of the myofascial trigger points (Hardin, 1990: 759-760).

2.4.3 CLINICAL FEATURES OF MUSCULOSKELETAL DISORDERS

Greater than 150 types of MSDs exist, all of which present with a local ache or pain and/or inflammation (Lidgren, 2003; Riihimäki, 1998). Low back pain (LBP), which is the most common type of MSD, can range in character from a dull, constant ache to a sudden, sharp pain (National Institute of Neurological Disorders and Stroke, 2014). Pain as a result of MSDs may also be referred to various sites on the body. According to Waddell (2004), LBP always tends to radiate distally and 70% of patients with LBP may also have pain down one or both legs. Lumbar and sacro-iliac pain tends to be referred to the buttock and posterior leg (and sometimes to the lateral aspect of the leg) (Magee, 2002). MSDs may also involve restriction of motion that may hinder normal functioning at work or in other everyday activities (Riihimäki, 1998). Furthermore, the pain and physical disability produced by MSDs affect social functioning and mental health, diminishing the individual's QoL (Woolf *et al.*, 2003). Other common symptoms of MSDs include: tendon or joint swelling and/or stiffness, muscle weakness, muscle spasm, numbness and paraesthesia.

MSDs can be diagnosed based on the case history and the results of a physical examination. Laboratory tests, imaging tests, or other diagnostic investigations are sometimes required to assist in making or confirming a diagnosis (Villa-Forte, 2017). Each investigation is utilised to identify various structural and functional pathologies of the musculoskeletal system (Villa-Forte, 2017):

- **Arthrography:** Utilised for imaging ligaments and fragmented cartilage of a joint. It is an x-ray procedure during which a radio-opaque dye is injected into the joint space to outline the structures inside the joint. However, MRI is currently being employed in preference to arthrography.

- **Arthroscopy:** Used to identify inflammation of the synovial lining of the joint (synovitis); ligament, tendon, or cartilage tears; and loose bodies of bone or cartilage. During this procedure a very small skin incision is made and a small fiberoptic scope is inserted into the joint space, allowing the inside of the joint to be viewed, and projected as an image onto a video monitor. Local, spinal, or general anaesthesia or a combination is administered for this procedure. During arthroscopy, a sample of tissue (e.g. joint cartilage or joint capsule) can be extracted for analysis (biopsy), and, if necessary, corrective surgery may be performed.
- **Autoantibodies:** Rheumatoid factor (RF) and anti-cyclic citrullinated peptide (anti-CCP), these anti-bodies are helpful in confirming the diagnosis of RA.
- **Bone scanning:** An imaging procedure that is occasionally used to diagnose fractures, particularly if other investigations, for example plain x-rays and CT or MRI, are unable to demonstrate the fracture. Bone scanning utilises a radioactive substance (technetium-99m–labelled pyrophosphate) that is absorbed by any healing bone. The radioactive substance is injected intravenously and is detected by a bone-scanning device, which creates an image of the bone on a computer screen. The procedure can also be used to confirm a suspected bone infection or a tumour that has metastasised from a cancer elsewhere in the body. Although a bone scan may demonstrate a pathology in the bone, it unable to confirm whether it is a fracture, tumour, or infection.
- **Computed Tomography (CT):** CT and MRI provide a greater deal of detail than conventional x-rays and may be used to determine the extent and exact location of the injury or damage. These tests can also be utilised to detect fractures that are not visible on x-rays (e.g. small fractures of the hip and pelvis). CT is useful when MRI is not recommended or unavailable.
- **Creatine kinase (CK):** A normal muscle enzyme that is released into the bloodstream when muscle is damaged and is usually elevated when there is widespread ongoing destruction of muscle.
- **Dual-Energy X-Ray Absorptiometry (DEXA):** Utilised to assess bone density, which is essential when screening for, or diagnosing osteopenia or osteoporosis (OP). The most frequent cause of abnormal DEXA scan result is OP. In addition, it is also utilised to predict an individual's risk of fracture and to monitor the response to treatment. During this test, x-rays are used to examine bone density at the lumbar spine, hip, wrist, or entire body as

measurements of bone density are very accurate at these anatomical sites. Measurements of the lumbar spine and hip are preferred when screening for OP. In order to differentiate OP from other bone disorders, an individual's symptoms, medical history, drug use, and results of blood or urine tests may need to be considered in conjunction with the DEXA results.

- **Erythrocyte sedimentation rate (ESR):** Measures the rate at which red blood cells settle to the bottom of a test tube containing blood and is usually elevated in the presence of inflammation. However, ESR alone does not establish a diagnosis as inflammation occurs in numerous conditions.
- ***HLA-B27*-A:** A gene used to identify individuals who are at high risk of developing spondyloarthropathies. These are a group of disorders that result in inflammation of the spine and other joints as well as other symptoms, such as eye pain and redness and rashes.
- **Joint aspiration (arthrocentesis):** Utilised to diagnose specific joint pathologies. It is the most direct and accurate method of determining if an infection or crystal-related arthritis (e.g. gout or pseudo gout) is the cause of joint pain and swelling. For this procedure, an anaesthetic is injected to numb the area, and then a larger needle is inserted into the joint space to aspirate synovial fluid. The aspirated fluid is then examined microscopically to identify the presence of e.g. bacteria, uric acid crystals or calcium pyrophosphate dihydrate crystals thereby confirming the diagnosis of infection, gout or pseudo gout, respectively.
- **Magnetic Resonance Imaging (MRI):** Used for imaging muscles, ligaments, and tendons. MRI may be utilised if the cause of pain is thought to be severe soft-tissue injury (e.g. rupture of a major ligament or tendon or damage to vital structures inside the knee joint). MRI is preferred over CT for imaging bone. However, MRI is more expensive than CT and is often unavailable.
- **Nerve conduction studies and electromyography:** Are generally conducted simultaneously to determine whether the MSD is primarily in muscles (e.g. myositis or muscular dystrophy); the central nervous system, which supplies the muscles (e.g. CVA, spinal cord pathology, or polyneuropathy); or at the neuromuscular junction, which is the connection between nerves and muscles (e.g. myasthenia gravis). Nerve conduction studies are utilised to establish whether the nerves supplying the muscles are functioning normally and are particularly valuable for the diagnosis of peripheral nerve disorders, e.g. carpal tunnel syndrome and ulnar nerve

palsy. Electromyography is used to determine how well impulses from nerves are reaching the neuromuscular junction and, from there, the muscles, by recoding electrical impulses in the muscles.

- **Ultrasonography (US):** Utilised to identify inflammation in and around joints; and tears or inflammation of tendons. US is also used as a guide when a needle needs to be inserted into a joint for purposes such as: injecting drugs into a joint or aspirating joint fluid. As an alternative to CT and MRI, US is less expensive and, contrasting to CT, involves no exposure to radiation.
- **X-Rays/radiographs:** Plain x-rays are utilised for detecting bone abnormalities as they do not illustrate soft tissues such as muscles, bursae, ligaments, tendons, or nerves. X-rays can aid in the diagnosis of fractures, tumours, injuries, infections and deformities (e.g. congenital hip dysplasia). In addition, x-rays are utilised to demonstrate bone changes that confirm the diagnosis of a specific type of arthritis (e.g. rheumatoid arthritis or osteoarthritis). To assist in determining joint damage as a result of injury, a non-stress x-ray or one taken with the joint under stress (stress x-ray) may be used.

Although there are various diagnostic investigation tools available, in some cases the diagnosis of MSDs are frequently rooted mainly on the symptoms and limitations reported by the patient during the history taking. There is often little or no evidence of specific pathology or objective impairment, and any radiological findings may be incidental (Waddell, 2004).

2.4.4 CLASSIFICATION OF MUSCULOSKELETAL DISORDERS

MSDs are a diverse group of disorders with respect to pathophysiology. However, they are related anatomically and by their association with pain and impaired physical function. MSDs include a broad spectrum of conditions, ranging from acute onset and short duration to chronic lifelong disorders (Woolf, 2000).

The International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) as classified by the WHO (2016), is a coding system of diseases and signs, symptoms, abnormal findings, complaints, social conditions and external causes of injury or diseases. The classification of MSDs according to the WHO ICD-10 (2016) is shown in Table 2.2.

Table 2.2 Classification of MDSs according to the WHO IDC-10

CATEGORY	SUB CATEGORY
Arthropathies- any disease affecting joints.	Infectious arthropathies (e.g. Reiter's disease, pyogenic arthritis) Inflammatory polyarthropathies (e.g. RA, gout, psoriatic arthritis) Arthrosis (e.g. arthrosis of the first carpometacarpel joint) Other joint disorders (e.g. acquired deformities of the limbs or digits)
Systemic connective tissue disorders.	E.g. Systemic lupus erythematosus (SLE), Sjögren's syndrome
Dorsopathies- diseases affecting the spinal column.	Deforming dorsopathies (e.g. scoliosis, torticolis) Spondylopathies (e.g. ankylosing spondylitis, spinal stenosis) Other dorsopathies (e.g. low back pain, radiculopathy)
Soft tissue disorders- disorders related to use, overuse and pressure on soft tissues.	Disorders of muscles (e.g. compartment syndrome, muscle strain) Disorders of synovium and tendon (e.g. calcific tendonitis, trigger finger) Other soft tissue disorders (e.g. rotator cuff syndrome, plantar fasciitis)
Osteopathies-diseases affecting bone.	E.g. osteoporosis, Paget's disease
Chondropathies- diseases of cartilage.	E.g. Kohler disease, chondromalacia
Other disorders of the musculoskeletal system and connective tissue- other acquired deformities of musculoskeletal system and connective tissue.	E.g. pseudoarthosis, bone fractures

2.4.5 RISK FACTORS FOR MUSCULOSKELETAL DISORDERS

The prevalence of numerous MSDs increases with age, many of which are influenced by lifestyle factors, such as OB and lack of physical activity. The growing number of older individuals and the changes in lifestyle throughout the world is thought to result in a remarkable increase in the burden of MSDs on people and society (Woolf, 2000).

In reviewing literature relating to the risk factors associated with MSDs, it is apparent that this area has been comprehensively researched. Numerous risk factors have been attributed to various MSDs. For the purpose of this study major MSD risk factors have been summarised in the Table 2.3.

Table 2.3: Risk factors for MSDs

TYPE	EXAMPLES	REFERENCES
ERGONOMIC	Poor posture, prolonged sitting	Campo *et al.,* 2008; Roquelaure *et al.,* 2009; Tsigonia *et al.,* 2009.
BIOMECHANICAL	High repetition, application of force, static load, precision, visual demand and vibration	Sjogaard 1998; Devereux *et al.,* 2002.
WORK-RELATED	Inappropriate work/rest cycles	Sjogaard, 1998.
	Prolonged abnormal/awkward posture	Devereux *et al.,* 2002; Kumar *et al*., 2013.
	Sedentary work	Skov *et al.,* 1996.
	Lifting, bending and standing	Glover *et al.,* 2005; Dasappa, 2007.
LIFESTYLE	Lack of physical activity	Hoogendoorn *et al*., *2000*; Woolf, 2000; Mirtz *et al.,* 2005; Heneweer *et al.,* 2010; Roffey *et al.,* 2010a; Roffey et al., 2010b.
	Obesity, overweight / high Body mass index (BMI)	Roffey et al., 2010a; Roffey et al*.,* 2010b.
	Cigarette smoking	Kirkaldy-Willis and Burton, 1992; Roffey *et al.,* 2010a; Roffey *et al.,* 2010b*;* Frymoyer *et al.,* 2011*.*
	Alcohol consumption	Vallfors, 1985; Heliövaara *et al.,* 1991.
	Low dietary fruit and vegetable consumption	Wulan et al., 2010.
PSYCHOSOCIAL	Intensified workload, time pressure, low job control, monotonous work, and low support from management.	Devereux *et al.,* 2002.
	Stress, anxiety depression and mood.	Linton, 2000; Carroll *et al.,* 2004.
	Low support from co-workers.	Skov *et al.,* 1996; Devereux *et al.,* 2002.
SOCIOECONOMIC	High quantitative jobs and low socioeconomic status	Urwin, 1999; Ariëns *et al.,* 2001.
PERSONAL	Higher age	Roquelaure *et al.,* 2009; Larsson *et al.,* 2012.
	Gender	Larsson *et al.,* 2012.
	Prior history of MSDs	Roquelaure *et al.,* 2009.
	Family history of pain	Larsson *et al.,* 2012.

2.5 PATHOPHYSIOLOGY OF CARDIOVASCULAR DISEASE IN PATIENTS WITH MUSCULOSKELETAL COMPLAINTS

Recent studies conducted at the DUT CDC, suggest that patients who presented with cervical and lumbo-sacral complaints frequently presented with co-morbid pathologies such as HTN (63.9% and 81.5%, respectively) and angina (Jaman, 2007; Venketsamy, 2007). Cardiac conditions were the most frequent co-morbidity identified in extremity patients who presented to the CDC (9.2% in upper limb cases and 8.2% in lower limb cases) (Kandhai,

2007). It is, therefore, possible to argue that there may be a relationship between the presence of CVD in patients and the presence of MSDs complaints in the same patients.
There are various proposed pathophysiological mechanisms for this association described in literature. Kauppila and Tallroth (1993), reported an correlation between a history of back pain and atherosclerotic lesions in the lumbar arteries of cadavers. They hypothesised that back pain in some instances, may be an early manifestation of atherosclerosis. This has been alluded to by Penttinen (1994), who conducted two consecutive studies, over 13 years on 8816 Finnish farmers. He determined that males between 30-49 years of age, with a history of back pain, had an increased risk of death as a result of IHD. He concluded that "unspecific back pain" may often have a vascular basis however, very little is known about the character and mechanism of vascular pain. If vascular reasons are proven to be the usual causes of back pain, it will consequently change the diagnosis and care of chronic back pain (Penttinen, 1994).

Growing evidence from epidemiological studies supports the mechanism of vascular pain. It is suggested that OA is associated with atheromatous vascular disease (Conaghan *et al.,* 2005). ATH may result in narrowing of the blood vessels supplying bones (particularly the bone underlying the cartilaginous joint surface referred to as the subchondral bone, which is also responsible for providing nutrients to the joint cartilage) resulting in ischaemia. Ischaemia reduces the supply of nutrient rich blood to the subchondral bone and joint cartilage resulting in damage to these structures. The aforementioned process is thought to accelerate OA (Conaghan *et al.,* 2005). The current management of OA is aimed simply at decreasing pain and improving function, as disease prevention or modification are not yet realities. This vascular hypothesis suggests that the future treatments being developed for OA, most of which focus on altering cartilage degradation or repair, may fail as they are aimed at the wrong target (Conaghan *et al.,* 2005). Additionally, vascular conditions can mimic common musculoskeletal symptoms, such as leg pain, neurogenic claudication, and loss of function (Yochum and Rowe, 2005).

Hagen *et al.* (2005) suggested that there is a negative relationship between HTN and chronic MSCs. A higher blood pressure was associated with a 10-60% decrease in prevalence of chronic pain at various anatomical sites. However, limitations in their study included the fact that no descriptive data was collected on the type of musculoskeletal complaint, its severity, duration and associated risk factors for both the MSDs and CVDs, in order to be able to identify whether the relationship between the hypertension and the chronic pain was facilitated by a common factor (e.g. DM), an independent factor (e.g. person's weight or levels of activity) or whether in fact the relationship existed directly

between the hypertension and the chronic pain only. Hagen *et al.* (2005) study is further supported by specific examples cited in Kauppila and Tallroth (1993) and Shiri *et al.* (2007). Furthermore, a recent study conducted in Sweden (Grimsby-Ekman *et al.,* 2015), identified a relationship between increased spread of pain and the prevalence of CVD, HTN, and more severe pain characteristics. A postal questionnaire that addressed pain aspects (intensity, frequency, duration and anatomical spreading on a body manikin), co-morbidities and implications of pain (i.e., work situation, physical activity, consumption of health care and experience of hospitality and treatment of health care) was sent to 9000 Swedish adults. Of the 9000, 53% completed and returned the questionnaire. After nine weeks, a follow-up questionnaire (which included the same items as the first questionnaire) was sent to the 62% of 4774 participants who reported pain in the first questionnaire. Of these 2983, 65% completed and returned the questionnaire.

The most significant results of this study are listed below (Grimby-Ekman *et al.,* 2015):

- Participants with pain had lower educational levels, more co-morbidities, decreased general health, and decreased physical activities compared to the pain-free participants. The tendency of lower levels of education in pain groups has been previously demonstrated by Croft *et al.* (1993); Ramage-Morin *et al.* (2010); Azevedo *et al.* (2012) and Reitma *et al.* (2012), a result that may speak to the complexity of factors interacting with pain. Lower education levels may be associated with menial working situations associated with higher risks for developing pain conditions (Nachemson *et al.,* 2000; Larsson *et al.,* 2007). Individuals who were less educated tended to utilise less effective pain approaches (Cano *et al.,* 2006). That is to say, higher education levels may indicate better critical thinking skills that could assist in making better health decisions and more productive interactions with healthcare providers, all leading to better involvement in one's health (Shavers, 2007).
- Differences in co-morbidities, certain pain aspects, daily functioning, and health care seeking in the three pain categories (local pain, regional pain and widespread pain) based on spreading of pain were observed.
- Low levels of education, CVD, HTN, DM, decreased general health status, increased medical consultation, high impact on work, and intense, frequent, and chronic pain were more frequent in widespread pain (WSP) than in regional pain (RP) and local pain (LP). Heart diseases and HTN were reported to be most frequent in WSP, a finding previously reported in chronic widespread pain (CWP) by McBeth *et al,* (2009). Painful MSDs such as inflammatory arthritides, osteoarthritis and osteoporotic fractures, which are common in the general population, are associated with elevated levels of CVD (Sennerby *et al.,* 2009; Szabo *et al.,* 2011; Charles-

Schoeman, 2012; Jamnitski *et al.,* 2013) . The overall occurrence of these MSDs in the population might contribute to higher prevalence of CVD among individuals with pain.

- Regarding the impact of work and the frequency and intensity of pain; RP was the intermediate group and LP was the least affected group.
- No differences between LP and RP with regards to education, general health status, duration of pain, and health care consumption were found.
- The proportion of females differed between the three pain categories; as it was highest in WSP and lowest in LP. This difference was also noted for hospitality experience and good treatment from health care: WSP rated this lowest and LP highest.
- In the pain categories; proportions of married subjects, physical demanding activities, and complementary health care did not differ.
- For both LP and WSP, a substantial transition to RP had occurred by the 9-week follow-up.

Grimby-Ekman *et al.* (2015) have demonstrated an relationship between increased spreading of pain and prevalence of CVD, HTN, more severe pain characteristics (i.e., intensity, frequency and duration), problems with common daily activities, and increased health care seeking. The authors emphasise the importance of paying attention to co-morbidities when clinically examining a patient with WP, so as to adequately plan treatments and interventions for these patients.

The opposite is true for musculoskeletal complaints. Travell *et al.,* (1999) suggests that are three possible sources of musculoskeletal pain that are commonly overlooked: myofascial trigger points (MTrPs), fibromyalgia, and joint dysfunction. When pain of myofascial nature is overlooked, such as the pain caused by MTrPs in the pectoralis muscles that mimic cardiac pain, the symptoms are likely to be diagnosed as neurotic, psychogenic, or behavioural. This adds frustration and self-doubt to the patient's misery and hinders appropriate diagnosis and treatment of the complaint. MTrPs may become active as result of other existing MTrPs, visceral disease, arthritic joints, joint dysfunctions, and emotional distress. Satellite MTrPs are prone to develop in muscles that are located within the pain reference zone of key MTrPs, or within the referred pain zone from diseased viscera, for example the pain caused by MI, peptic ulcer, cholelithiasis, or renal colic (Travell *et al.,* 1999).

2.6 ASSOCIATION BETWEEN CARDIOVASCULAR DISEASE AND MUSCULOSKELETAL DISORDER RISK FACTORS

In the early 1980s, Kauppila and Tallroth (1993) found an association between cardiovascular risk factors and back pain, in particular smoking. In addition, a growing body of evidence identifies metabolic syndrome (MetS) as a biochemical promoter of MSDs such as neck pain, shoulder pain, patella tendinopathy, and general musculoskeletal pain (Dobretsov *et al.,* 2007; Malliaras *et al*., 2007; Mantyselka *et al*., 2008; Gaida *et al*., 2009; Mantyselka *et al*., 2009; Mantyselka *et al*., 2010).

A systematic review of cardiovascular and lifestyle factors in lumbar radicular pain or clinically defined sciatica, identified obesity, being overweight and smoking history as risk factors for lumbar radicular pain. However, the association between HTN and serum lipid levels were inconsistent (Shiri *et al.,* 2007). Therefore, further research is required to clarify these associations and mechanism.

In the SA context, Puoane *et al.* (2008) identifies the following major disease risk factors for chronic non-communicable diseases including HIV and AIDS, tuberculosis and DM (ranked from highest to lowest with related mortality rates in brackets). Those linked to CVD and MSD are highlighted:

- Unsafe sex / sexually transmitted infections (STI) (26.3%).
- Hypertension (9.0%) also related to MSDs (Hagen *et al.,* 2005) and CVD (World Heart Federation, 2016).
- Cigarette smoking (8.5%) also related to MSDs (Kirkaldy-Willis and Burton, 1992; Roffey *et al.,* 2010a; Roffey *et al., 2010b*; Frymoyer *et al.,* 2011) and CVD (Peto, 1994; Ezzati *et al.,* 2004; World Heart Federation, 2016).
- Alcohol (7.1%) also related to MSDs (Vallfors, 1985; Heliövaara *et al.,* 1991) and CVD (Hines *et al*., 2001; Watson *et al*., 2003)
- Overweight / high BMI (7.0%) also related to MSDs (Roffey *et al.,* 2010a; Roffey *et al.,* 2010b) and CVD (World Heart Federation, 2016).
- Hypercholesterolaemia (4.6%) also related to CVD (World Heart Federation, 2016).
- Diabetes Mellitus (4.3%) also related to CVD (World Heart Federation, 2016).
- Physical inactivity (3.3%) also related to MSDs (Hoogendoorn *et al.,* 2000; Mirtz *et al.,* 2005; Roffey *et al.,* 2010a; Roffey *et al.,* 2010b; Heneweer *et al.,* 2010) and CVD (World Heart Federation, 2016).
- Low dietary fruit and vegetable consumption (3.2%) also related to MSDs (Wulan *et al.,* 2010) and CVD (Ndaba, 1995; Steyn, 2001; Steyn, 2006; Sun, 2007).

2.7 ASSOCIATION BETWEEN MUSCULOSKELETAL DISORDERS AND CARDIAC MEDICATIONS, AND THEIR EFFECTS

A factor that may influence the relationship between CVD and MSDs may be the medication(s) which the CVD patients have been prescribed. According to Bannwarth (2007), MSDs including arthralgias, arthropathies, myopathies and bone diseases may be induced by these medications, particularly corticosteroids and statins. This was supported by Bruckert *et al*. (2005), who demonstrated that 10.5% of patients treated with high dose statins complained of muscle symptoms (pain, aches, stiffness, weakness, fatigue, cramping and tenderness), within one month after commencement of treatment. Additionally, Beattie *et al.* (2005) reported that statin use was associated with an increased risk of moderate grade radiographic hip OA development in elderly women. A possible interpretation of this would support the hypothesis that hypercholesterolaemia is a risk factor for the development OA (Conaghan *et al.,* 2005). Similarly, a lower blood pressure and current use of anti-hypertensive medication is associated with a higher prevalence of chronic MSDs (Hagen *et al.,* 2005). Therefore the knowledge of the relationship between MSDs and CVDs; and drugs for CVDs would allow for optimal management of patients (i.e. avoids unnecessary investigations), early discontinuation of the offending drug, adequate treatment monitoring and/or intervention with appropriate prevention measures (Bannwarth, 2007).

2.8 ALTERNATIVE MANAGEMENT OF CARDIOVASCULAR DISEASE

The management of common cardiovascular symptoms can be a challenging if they persist despite maximum medical treatment and CVD intervention. Complementary and Alternative Medicine (CAM) modalities may possibly complement the treatment of CVD symptoms that are stubborn to standard medical treatment or in cases in which drug side effects are intolerable (Prasad *et al.,* 2013*)*. A systematic review on the use of CAM by patients with CVD revealed several reasons for CAM use cited by patients (Grant *et al.,* 2012):

- CAM was considered to be of greater benefit than conventional medications (15%).
- Adverse drug reactions to conventional therapy (59%).
- Overall wellbeing and promotion of good health.

During the past few years CAM has become increasingly popular in the US. According to the Centers for Disease Control survey in 2007 involving more than 31,000 patients, approximately 40% of adults had used CAM therapies in the previous 12 months (Barnes *et al.,* 2004). The definition of complementary and alternative medicine (CAM) continues to develop. The National Centre of Complementary and Alternative Medicine (2012) defines CAM as “a group of diverse medical and healthcare systems, practices, and products that

are not generally considered part of conventional medicine". There are 5 categories or domains of CAM which are classified by the National Centre of Complementary and Alternative Medicine as whole medical systems (e.g. homeopathy, ayurvedic medicine), mind-body interventions (e.g., yoga, tai chi, meditation, qigong, biofeedback, hypnotherapy), biologically based therapies (e.g., herbal treatments, megadose vitamins), manipulative and body-based methods (e.g., chiropractic therapy), and energy therapies (e.g. Reiki, magnetic therapy).

Progressively more dietary supplements and other CAM treatments are marketed "over the counter" to decrease the risks and symptoms of CVD. The proportion of patients with CVD using these treatments has been reported in a number of studies (Wood *et al.,* 2003; Artz *et al.,* 2006; Saydah *et al.*, 2006; Yeh *et al.,* 2006; Decker *et al.,* 2007; Leung *et al.,* 2008). However, the data reported frequently only investigated a specific subset of patients (e.g., patients with acute coronary syndrome) (Barraco *et al.,* 2005; Dekker *et al.,* 2007 and Leung et al., 2008) or specific interventions (e.g. patients with coronary artery disease practicing mind-body interventions) (Leung *et al.,* 2008). This demonstrates the necessity to explore their efficacy for the management of chronic symptoms related to CVD (Prasad *et al.,* 2013).

Thus Prasad *et al.* (2013) investigated the use of CAM among patients with CVD. Data was collected with a prospective, anonymous, 17-question survey which addressed basic medical information and previous use and interest in the future use of dietary supplements and other CAM interventions among patients undergoing outpatient cardiology evaluation at a Midwestern tertiary care centre. The survey was completed by 1,055 patients (655 men, 351 women; mean age 63.5 years) of whom 98.1% were white. Of these, 36.8% had cardiac symptoms for more than 10 years, 48.2% had coronary artery disease, and 82.5% reported use of CAM therapies (Prasad *et al.*, 2013).

The most common cardiac symptoms for which patients reported using CAM treatments included dyspnoea, palpitations, angina, dizziness, and peripheral oedema. A perceived improvement was reported by approximately one in five patients for symptoms, including palpitations (22.2%), sleep disturbance (21.8%), angina (20.0%), and peripheral oedema (19.4%). The top four CAM modalities used for cardiac symptoms other than dietary supplements, were chiropractic (31.5%), massage (19.2%), relaxation techniques (12.6%), and stress management. Out of the 332 (31.5%) patients, 10 (0.9%) reported previous use of chiropractic for cardiac symptoms while 3 (0.3%) were currently using chiropractic for cardiac symptoms (Prasad *et al.*, 2013).

2.8.1 CHIROPRACTIC MANAGEMENT OF MUSCULOSKELETAL DISORDERS

Chiropractic is generally utilised for musculoskeletal complaints (MSCs) believed to be of mechanical nature (Riksman *et al.,* 2011). Leboeuf-Yde *et al.* (1997); Hurwitz *et al.* (1998); Rubinstein *et al.* 2000; Coulter *et al.* (2002); Hartvigsen *et al.* (2002) and Leboeuf-Yde *et al.* (2005), demonstrated that nearly all patients who present to chiropractors in private practice worldwide, seek chiropractic treatment for their MSCs. This was also demonstrated in various chiropractic teaching clinics abroad by Waalen et al. (1994); Bryant *et al.* (2003); Holt *et al.* (2005) and Lishchyna *et al.* (2012), where the majority of patients presented with MSCs.

Chiropractic training and literature have a similar approach to the clinical diagnosis of conditions, to that of all health care disciplines. Thus, a case history, physical and regional examination; and diagnostic investigations are routinely incorporated into patient work-ups (Haldeman, 1992).

Chiropractors manage a large variety of conditions in numerous ways. However, the core area of chiropractic practice is the musculoskeletal system, with particular focus on the spine. Studies have shown that spinal pain is the most common reason for seeking chiropractic care by chiropractic patients in different countries, with 64%-86% reporting spine-related symptoms (Leboeuf-Yde *et al.,* 1997; Rubinstein *et al.,* 2000; Coulter *et al.,* 2002; Hartvigsen *et al.,* 2002; Leboeuf-Yde *et al.,* 2005). LBP in particular was confirmed to be the most frequently reported complaint of patients who presented to chiropractors in private practice world-wide (Shekelle *et al.*, 1991; Waalen *et al.,* 1994; Hurwitz *et al.,* 1998; Mior *et al.,* 2008; Lishchyna *et al.*, 2012). LBP is also the most frequently reported by patients presenting to chiropractic teaching clinics. This was suggested by Nyiendo *et al.* (1989) who conducted a comparative study on patients and patient complaints at six chiropractic teaching clinics. The percentage of lumbar spine complains varied from 31% to 41% in all clinics and more patients reported low back pain than any other single complaint. Therefore, the therapeutic procedure most strongly associated with chiropractic, is spinal manipulation (Haldeman, 1992).

A variety of diagnostic methods are utilised by chiropractors to assess the patient's spine and to ascertain the need for spinal manipulations. These include palpation of vertebral prominences and soft tissues for pain, orthopaedic testing, motion palpation, neurological examination, and diagnostic investigations (e.g. x-rays, CT scan, and MRI) (Walker *et al.*, 1997).

Other MSDs are also relatively common among patients seeking chiropractic care (Leboeuf-Yde *et al.,* 1997; Rubinstein *et al.,* 2000; Coulter *et al.,* 2002; Hartvigsen *et al.,* 2002; Leboeuf-Yde *et al.,* 2005). Although joint manipulation is the core treatment for the chiropractic profession, chiropractic management also covers a range of non-surgical and non-medical treatments which include but are not limited to lifestyle counselling, dietary advice, ergonomic advice, physiotherapeutic modalities and rehabilitation (Haldeman, 1992; Pedersen *et al.,* 1994; Mootz *et al.,* 2005). Patients may also be referred for surgical intervention consult if indicated (e.g. in cases of cervical or lumbar disc disease or spinal stenosis with definite nerve entrapment or spinal cord compression, when timely decompression may be necessary to restore function or prevent further functional impairment) or when the response to conservative treatment proves to be less than optimal (Wise, 2003).

Various studies concerning the demographic and diagnostic profile of patients presenting to chiropractors and chiropractic teaching clinics have been conducted. The results of these studies reveal that the majority of patients presenting to chiropractors were female (Pedersen, 1994; Rubinstein *et al.,* 2000; Suleman, 2001; Hartvigsen *et al.,* 2002; Coulter *et al.*, 2005; Mootz *et al.,* 2005; Gaumer *et al.*, 2006; Mahomed, 2007); White (Coulter *et al.*, 2005; Mahomed, 2007; Mootz *et al.,* 2005; Gaumer *et al.*, 2006;), and presented with LBP.

The similarities and differences seen between the patients that present to chiropractic clinics may be attributed to the neighbourhood and location of the clinic (Hurwitz, 1998). This is suggested by the inconsistency of the results obtained by various studies. A study conducted at an Australian chiropractic teaching clinic by Bryant *et al*. (2003) found that 54% of the sample was males and 46% were female, as opposed to findings by Holt *et al.* (2005) who reported slightly more females (51.9%) than males (48.1%) at the New Zealand College of Chiropractic Teaching Clinic. A similar trend is noted form the result of previous studies conducted at the DUT CDC. Benjamin (2007) and Venketsamy (2007) showed that the majority of patients who presented with thoracic and cervical pain, were female. While Jaman (2007) and Kandhai (2007), reported the majority of lumbo-sacral- and extremity complaints at the DUT CDC to occur in males. Paucity in the literature regarding the race/ethnicity of chiropractic teaching clinics patients exists, as race was not documented in these studies. However, discrepancies in terms of age are also evident. Bryant *et al*. (2003), reported the average age of patients was 36.6 years; while Holt *et al.* (2005) found an average age of 32 years. Studies conducted at the DUT CDC over an eleven year period between 1995 and 2005, revealed that the mean age of patients who presented with cervical

pain (Venketsamy, 2007) and thoracic pain (Benjamin, 2007) was 36.89 and 33.3 years, respectively.

Despite the differences in the demographic characteristics between patients who present to chiropractors and chiropractic teaching clinics, there appears to be a consistency regarding the presenting MSC, namely LBP. LBP was identified as the most frequently reported complaint of patients who presented to private chiropractors in various countries world-wide (Shekelle *et al.*, 1991; Waalen *et al.,* 1994; Hurwitz *et al.,* 1998; Mior *et al.,* 2008; Lishchyna *et al.*, 2012) and in addition to chiropractic teaching clinics (Nyiendo *et al.*, 1989). However, these results are inconsistent with that of retrospective studies conducted at the DUT CDC in which the prevalence of various MSCs recorded over an eleven year period (1995-2005) was retrospectively analysed. Of the 7 487 patient files that were analysed, 1 342 (17.9%) had cervical pain (Venketsamy, 2007) and 1 296 (17.3%) had lumbo-sacral pain (Jaman, 2007). Nevertheless, these results were obtained from a sample of only 30% of 24 487 files recorded at the DUT CDC for the period 1995 to 2005, thus, it was not a true reflection of the population from which the sample was obtained.

2.8.2 CHIROPRACTIC TREATMENT AND MANAGEMENT OF CARDIOVASCULAR DISEASE

As previously mentioned most patients seek chiropractic treatment for MSCs (Riksman *et al.,* 2011). However, 2-6% of the complaints of patients seeking chiropractic care world-wide are non-MSCs (Leboeuf-Yde *et al.,* 1997; Rubinstein *et al.,* 2000; Coulter *et al.,* 2002; Hartvigsen *et al.,* 2002; Leboeuf-Yde *et al.,* 2005). Chiropractic treatments have been shown to benefit patients suffering from various “medical” conditions/non-MSDs which including HTN.

In 2007, Bakris published a study proving that one upper cervical chiropractic manipulation had the same effect as two anti-hypertensive drugs. In addition to this, the effects of a single manipulation were found to last more than six months. Compared to the placebo-treated patients, those who received the real procedure saw an average 14 mmHg reduction in systolic blood pressure and an average 8 mmHg reduction in diastolic blood pressure. However, Bronfort *et al.* (2010) found inconclusive but favourable evidence for upper cervical National Upper Cervical Chiropractic Association (NUCCA) manipulation for stage 1 HTN; inconclusive evidence for instrument assisted, Gonstead full spine or osteopathic soft tissue manipulation (SMT).

Other non-MSDs that have been shown to benefit from chiropractic treatment include:

- **Asthma, otitis media and nocturnal enuresis:** A systematic review by Ferrance *et al.*, (2010) found that the majority of published literature on these conditions were centred on case reports or series. The more scientifically rigorous studies showed that there was little data to suggest improvement of otitis media, asthma or nocturnal enuresis.
- **Attention deficit hyperactivity disorder (ADHD):** A systematic review (Karpouzis *et al*., 2010) states that the evidence is insufficient to support or refute the benefit of chiropractic treatment for ADHD in children.
- **Dysmenorhoea and irregularities in women:** A 2010 review found that SMT was not effective for the treatment of dysmenorrhea when compared to a sham manipulation, and that the evidence for premenstrual syndrome is inconclusive (Bronfort *et al.,* 2010).
- **Gastrointestinal conditions:** A 2015 narrative review by Angus *et al.,* (2015) reported mild to moderate improvements in presenting symptoms of gastrointestinal conditions and no adverse effects. Conditions included constipation, gastroesophageal reflux disease (GERD), irritable bowel disorder, infantile colic and colitis (in children only). The review suggests chiropractic care can be considered as an adjunctive therapy for such conditions if no co-morbidities are present.
- **Infantile colic:** A 2011 systematic review by Alcantra suggests that chiropractic care is safe and "a viable alternative" for infantile colic. A Cochrane database systematic review (2012) stated, "… it (is) impossible to arrive at a definitive conclusion about the effectiveness of manipulative therapies for infantile colic."

Although chiropractic care is not a specific form of treatment for a number of non-MSDs (such as those listed above) as the evidence supporting its use in the treatment of non-MSDs is insufficient. Despite this paucity in the literature, some practitioners use manipulation as an adjunctive treatment for non-MSDs (Muller *et al*., 2015).

Based on the above findings, the appropriateness of the use chiropractic in the treatment of CVD is inconclusive. However, it has been shown that patients with CVD frequently present to chiropractors (Prasad *et al*., 2013). Thus the role of the chiropractor should be to manage these patients by implementing health promotion and disease prevention strategies into their routine practice (Ndetan *et al.,* 2010). This speaks to the call on health care providers of all types, by the US Government, the Institute of Medicine, and other entities, to assist patients in setting and reaching goals regarding the prevention of the premature onset of morbidity

and mortality. This was also endorsed by the American Chiropractic Association and the Association of Chiropractic Colleges (Ndetan *et al.,* 2010).

The National Board of Chiropractic Examiners since 2005, have reported that chiropractors incorporate a variety of health promotion-oriented tasks as part of routine practice, however those vary in scope depending on the specific area of health promotion (Christensen *et al.,* 2005). For instance, the majority of chiropractors recommend general exercise to their patients, however, fewer discuss smoking cessation or safe sexual practices (Jamison, 2002; Christensen *et al.,* 2005). In a study on health information and promotion in chiropractic clinics, Jamison (2002) found that 97% of participants were willing to provide maintenance care (MC) to patients, with 85% believing adjustments / manipulation be included in MC as well as exercise (93%), dietary advice (81%), supplementation (48%) and tobacco, social drugs and alcohol adverse effect counselling and recommendations. Furthermore, 33% of the participants provided group education classes, 89% information brochures and 17% were prepared to provide patients with personalised health contracts. Additionally Ndetan and colleagues assessed the National Health Interview Survey (NHIS) data and established that patients who reported seeing a chiropractor as the only health care provider within the past 12 months were more likely to report being physically active and less obese. However those patients were no more or less likely to smoke or use alcohol than those having only seen a physician within the past 12 months (Ndetan *et al.,* 2010). A possible explanation is that while chiropractors offer lifestyle counselling and dietary advice, few discuss cessation of smoking or alcohol use with their patients (Jamison, 2002; Christensen *et al.,* 2005). Even fewer equip patients with information on cessation (Evans *et al.,* 2006).

The Council on Chiropractic Education (CCE) issued new standards in 2007 that set standards in the area of wellness, health promotion, and delivery of preventative medicine education for all students in the nation's chiropractic colleges. Those standards called for didactic information to modify the knowledge, attitudes, and beliefs of chiropractic interns regarding health promotion practices in addition to the demonstration of skills in the assessment and delivery of information and resources to patients (Stainsby, 2011). It is imperative for all practicing chiropractors as well as other clinicians, to take these standards from the CCE as a call to action to start assisting patients in addressing the removable causes of morbidity, disability and premature mortality where they exist, in addition to treating their painful spinal conditions (Evans *et al*., 2006). As primary healthcare physicians they play a crucial role in preventative healthcare issues by providing appropriate and timely lifestyle management strategies (Stainsby, 2011).

Teaching clinics refers to agencies providing primary care for individuals in addition to education for health professionals (Hoke *et al*. 2002). Chiropractic-teaching clinics function as educational facilities for final year students and interns, where students gain experience by providing chiropractic services to the general public (Bryant *et al.* 2003). These institutions of chiropractic education, whether university based or traditional chiropractic colleges, affects the beliefs of chiropractors regarding health promotion and disease prevention (Leboeuf –Yde, 2008). This is evident in the Hawk *et al.* (2004) study. They investigated the attitudes of students, public health faculty and practitioners on clinical preventive services and established an over-all positive attitude, in particular those related to physical activity and diet. Additionally, Ivie *et al.* (2011) found that 98% of Alabama chiropractors agreed that chiropractors should be advocates of disease prevention, with 90% willing to continue with further education in disease prevention if given the opportunity and 80% supporting an increase in prevention courses in chiropractic colleges.

Hawk and Evans (2005), assessed smoking cessation advice provided to patients in nine chiropractic teaching clinics and found approximately 40% of patients had been advised to quit smoking, however, fewer had been given specific information on how to do so successfully. One study asked graduating interns at a chiropractic teaching clinic about their intention to perform health promotion measures in practice and specifically asked about a number of health promotion behaviours. While the majority of interns (>85%) said they planned on using health promotion in practice, interns were more likely to say they would advise “all” patients on exercise, for example, rather than on stress or smoking (Evans *et al.,* 2009).

To evaluate the documented attempts to deliver health promotion messages to patients at two chiropractic teaching clinics in the United States, Ndetan *et al.* (2010) retrospectively reviewed 200 patient files (100 from each of the two clinics) to assess whether health promotion advice was given to patients when a file indicated a need for health promotion or a red-flag condition that could be helped with positive behavioural changes.
The authors found that out of 23 patients who were hypertensive (HTN) (12 from Campus 1 and 11 from campus 2), only five (21.7%) received health promotion advice. Eleven patients were found to have red-flag risk factors related to HTN, such as a personal medical history of HTN and a BP reading of >120/80mmhg, five (45.5%) of which received health promotion advice. Of those with a history of HTN but not were not diagnosed with HTN at the time, 5/14 (42.9%) received advice. Seven patients had a history of DM and of those; four were given advice on diet or nutrition (Ndetan *et al.,* 2010).

Among patients showing a family history of heart disease (67) and DM (46) in their files, 12 (18%) and 26 (57%) received health promotion advice on diet and nutrition, respectively. When the risks of heart disease, HTN, DM, and being currently OW or OB were combined to form a risk category for general CVD, 97 patients were observed to be at risk (43 from campus 1 and 54 from campus 2). Among them 17 (17.5%) received advice on health promotion. In general, those with increased CVD risk (97) were more likely to receive advice on health promotion when compared to those without CVD risk (Ndetan *et al.,* 2010).

Although the last mentioned study is limited to merely two teaching clinics, several of the indications raise serious concerns within the profession, should these findings in any way be representative of chiropractic teaching institutions as a whole. The researchers do not necessarily jump to that conclusion but consider it is only appropriate to communicate the seriousness of these findings when hardly 50% of the patients in a sample of 200 received any advice on how to live healthy. Every condition assessed had a component of prevention that could have been applied. Serious health risks for example patients who were at risk of CVD risk, but did not indicate a condition of CVD, yet only about 17% received any advice on health promotion that could be determined from their file. Some patients who were hypertensive at the visit yet received no advice (Ndetan *et al.,* 2010).

Chiropractors see patients more frequently than primary care physicians. Comorbid conditions associated with patients who develop chronic spinal conditions lead to premature morbidity and mortality. The relationship that chiropractors have with patients who choose them for routine care of spinal conditions puts them in a unique position to prompt patients to make behavioural changes towards better health (Ndetan *et al.,* 2010).

It is imperative for patients' habitual lifestyle changes to be encouraged by chiropractic teaching clinics as chiropractic interns are eager to incorporate health promotion into everyday practice. Thus, an opportunity to mould future chiropractors in order to for them to incorporate primary prevention into their management exists should the profession care to move in that direction. Therefore, it is imperative that chiropractic teaching clinics assess how they are assisting patients in achieving their health goals. Chiropractic patients deserve a higher level of preventive care and the profession should be rising to that occasion (Ndetan *et al.,* 2010).

The DUT CDC, formerly known as Technikon Natal, was officially opened in April 1994. Thousands of patients have been treated at DUT CDC over the past 22 years and many research studies have been conducted. However, no research of this nature has been

conducted at the DUT CDC. It is imperative that we identify and quantify the relationships between the conditions in the cardiovascular system and the musculoskeletal system not only to provide patients the best possible holistic care but to also determine whether the profession should place more emphasis on health promotion and preventative care in the management of patients with co morbid pathologies such as CVD.

2.9 IMPORTANCE OF MANAGING THESE CONDITIONS

Identifying and quantifying the relationships between the conditions in the cardiovascular system and the musculoskeletal system are important for many reasons and these include but are not limited to:

- Enabling healthcare practitioners to employ the most appropriate disease prevention and health promotion strategies (Brown, 2009) in order to ensure that patients do not develop chronic disease of either system (Daar *et al.*, 2007), particularly if it is found that common factors such as weight, level of activity, psychological disorders (Kessler *et al.,* 2003) and nutrition are found to be confounding factors for both disease processes.
- If it is found that MSDs occur prior to reported CVDs being diagnosed, then the intervention strategies from health care management organisations and medical aids should focus on promoting increased levels of activity, the provision of activity venues and ensuring that all obstacles for participating in activity are removed (Hawk *et al.,* 2004; Johnson *et al.*, 2008 and Fielding *et al.*, 2010).
- Conversely if it is found that CVDs are found to occur prior to MSDs, then it is important to consider that predisposing factors that enable CVDs in order to avoid the development of the thereupon following MSDs (Bannwarth, 2007).
- As a result of the above it therefore becomes possible for the practitioner to be able to more effectively address both the MSDs and the CVDs through primary prevention strategies (Baird, 2011), particularly if they are shown to be related to one another. This would result in more effective and holistic treatment for the patient with the result that there is an increase in the life span and the quality of life for patients suffering from one or both of the conditions; without the unnecessary expense of secondary and tertiary prevention measures (Omran, 2001; Ulwin *et al.*, 2006; Alwan *et al.*, 2009; Baird, 2011).

The above are particularly pertinent in SA, as little recognition has been given to the extent of the burden of chronic diseases of daily lifestyle (CDL). In addition, less priority has been placed on the prevention of unhealthy lifestyles, early diagnosis and cost-effective

management of CDL compared to other diseases (Tollman *et al.*, 2008; Chopra *et al.*, 2009; Samb *et al.*, 2010), through appropriate health promotion and disease prevention strategies (Daar *et al.*, 2007; Brown, 2009).

Tollman *et al.* (2008), Chopra *et al.* (2009) and Samb *et al.* (2010) indicate that the current lack of implementation of these strategies are astonishing as the national policy for health promotion in SA is based on the Ottawa Charter for Health, which advocate five major areas, namely (Coulson, 2000):

- establish public health policy,
- create supportive environments for health,
- develop personal skills,
- strengthen community action for health, and
- re-orient health services.

In addition, the South African Department of Health (SADoH) embraces the WHO's Hyogo Framework for Action (HFA) objectives and principles by promoting comprehensive public healthcare (PHC) to meet the healthcare needs of the SA population. Further to this, the SA Government's Reconstruction and Development Programme emphasize healthcare, the environment and nutrition as the most direct means of fighting poor health in SA (South Africa: The Department of Health's White Paper, 1997).

Therefore, it is imperative that relationships between the conditions in the cardiovascular system and the musculoskeletal system are investigated, links determined and further studied (Kauppila, 2009) particularly with the ever changing health and disease patterns (Omran, 2001). Therefore this research aims to investigate the profile of musculoskeletal conditions which are found in patients that suffer from cardiovascular diseases, at the DUT CDC; with the view to establishing the presence of any correlations or Odds Ratios defining the relationships between the presence of the cardiovascular disease, the prescribed medication and the presenting musculoskeletal complaints (type, severity and duration) noted.

2.10 CONCLUSION

Based on the all the examples and possible associations discussed between CVD and MSC, this necessitates the need for further investigation.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

The aim of this chapter is to outline the methodology, the data collection process and the process of statistical analysis utilised in this study.

3.2 RESEARCH DESIGN

This study was designed as a cross-sectional retrospective cohort analysis, set in a quantitative paradigm, which is a combination of observational study designs: Firstly, a cross-sectional study design as this research simultaneously measured the variations in the presentation of MSCs reported by CVD and non-CVD patients, and the presence of CVD risk factors, and use of cardiac or non-cardiac medication in patients who presented to the DUT CDC. It provides a 'snapshot' of the prevalence of CVD and risk factors in this population, and their possible effects on MSDs in the one year period from 9 June 2015 to 9 June 2016. Secondly, a retrospective study design as the files of patients who presented to the DUT CDC were reviewed after either/both CVD and MSD has occurred. Thirdly, a cohort study design as inclusion into the study sample was based on status of exposure to a certain factor i.e. all patients had to have sought treatment at the DUT CDC for MSCs. In addition, patient files were reviewed, and information related to diseases of the cardiovascular and musculoskeletal systems, and health-related outcomes were documented and compared. This design is also an analytic study design, as CVD and non-CVD groups were compared to identify and quantify associations between risk factors and the presence of CVD. The study design/s utilised in this study is set in a quantitative paradigm, as this study set out to collect quantitative data utilising a validated data collection tool. The data collected by this study was then used to identify relationships between variables (Centers for Disease Control and Prevention, 2006).

The research tool of choice in this study was a data sheet, as bias was kept to a minimum and there was a decreased chance of misinterpretation of the results (Mouton, 1996).

Variables were identified based on the review of literature. These variables were then documented on a pre-expert group data sheet (Appendix 1) by the researcher. The data sheet was then validated and tested by means of an expert group and pilot study. The final data sheet (Appendix 2) was then developed and used for data collection.

This study was approved on the 9th of June 2016 by the Durban University of Technology Institutional Research and Ethics Committee (REC 127/15) (Appendix 3).

3.3 CLINCAL SETTING

Data were collected from the patient files of patients who presented to the Durban University of Technology (DUT) Chiropractic Day Clinic (CDC).

3.4 ADVERTISING

No advertising was required. However, a notice (Appendix 4) was displayed at reception informing patients that research was being conducted at the DUT CDC. They were instructed to notify the reception staff if they wished to not have their flies included in the study.

3.5 CONFIDENTIALITY

The following steps were undertaken to maintain patient confidentiality throughout the process of this study:

- A written request (Appendix 5) was submitted to the DUT CDC Director to obtain permission for the use of patient files of patients who presented to the DUT CDC for research purposes.
- The DUT CDC Director was asked to provide written consent (Appendix 6) to the researcher to analyse the files of new patients who presented to the clinic.
- The researcher signed a statement of confidentiality (Appendix 7) and the research assistant signed a Letter of information and Consent (Appendix 8) that ensured patient confidentiality at all times.
- A notice (Appendix 4) was displayed at reception informing patients that research is being conducted at the DUT CDC. They were instructed to notify the reception staff if they wished to not have their files included in the study.
- Only the researcher, research assistant and the research supervisors had access to this information.
- Once the data had been captured, the spreadsheet containing the sampled file numbers was placed safe in storage, thus denying access by third parties.

To avoid reporter bias, the researcher and research assistant exchanged the files of patients that they had previously treated or were acquainted with.

3.6 SAMPLE

3.6.1 SAMPLING METHOD

The patient files of all new patients who presented to the DUT CDC from 9 June 2015 to 9 June 2016 (one year preceding IREC approval) were included in the study. Thus consecutive sampling was used, and the sample was considered to be representative of a larger population outside of the sampling dates. There was no reason to suspect sampling bias due to the dates of sampling chosen.

3.6.2 SAMPLE SIZE

A total sample of 1066 new patient files were used in this study as an average of 166 new patients presented to the DUT CDC per month. Two hundred and sixteen patient files failed to meet the inclusion and exclusion criteria and were excluded from the study. Permission for the use of this information in research conducted at the DUT CDC was given when the patient signed the Informed consent form (Appendix 9) at their initial visit.

3.5.3 SAMPLE CHARACTERISTICS

3.6.3.1 INCLUSION CRITERIA:

- All paperwork had to be present in the patient file (complete initial visit paperwork included a case history, physical examination, regional examination and SOAPE note).
- The patient must have sought treatment for any musculoskeletal complaint at the DUT CDC.

3.6.3.2 EXCLUSION CRITERIA:

- The files of patients who sought treatment at the DUT CDC for research purposes due to the possibility of those results being skewed either through participant or researcher bias.

3.7 RESEARCH PROCEDURE

3.7.1 EXPERT GROUP

The data sheet was validated by means of an expert group. This aimed to achieve face (Mouton, 1996; Morgan 1998a) and content (Mouton, 1996; Morgan, 1998a) validity by identifying any discrepancies, uncertainties, ambiguity and deficiencies (Bernard, 2000). Participants were encouraged to discuss their thoughts and ideas surrounding the topic of

the data sheet (Salant and Dillman, 1994) enhancing the validity of the data sheet (Bernard, 2000).

The expert group consisted of the researcher, the research assistant, the research supervisor, co-supervisor, two clinicians at the CDC, a qualified chiropractor and three chiropractic interns.
Each member of the expert group was asked to read, complete and sign the following documentation:

- Letter of Information and Consent (Appendix 10)
- Confidentiality Statement (Appendix 11)
- Code of Conduct form (Appendix 12)

Following reading and signing the relevant documentation, each participant of the expert group was handed an original copy of the pre- expert group data sheet (Appendix 1) and asked to read through it briefly. The researcher then read out aloud each point from the data sheet sequentially, allowing participants enough time for discussion and recommendations for each point.

The above procedure was voice recorded in order to enable accurate recording of the changes to the pre-expert data sheet (Appendix 1) as well as to provide evidence of those who participated in the expert group and the content discussed during the expert group meeting. As a result of the confidentiality statement signed by all participants of the expert group, including the researcher, the recording will only be available for purposes of examination and will be removed prior to the final publication of this dissertation.

All recommendations and suggested changes from the expert group as a whole were taken into account to develop the pre-pilot data sheet (Appendix 13).

3.7.1.1 EXPERT GROUP CHANGES TO THE DATA SHEET

3.7.1.1.1 The pre-expert group data sheet was divided into five sections namely demographics, presenting musculoskeletal complaint, cardiovascular disease (CVD) risk factors, cardiac medications and review of systems. However, these sections were not labelled as such. It was suggested that the above mentioned be labelled as such. The labels were then shaded to highlight the various sections of the data sheet.

3.7.1.1.2 It was suggested that each point on the data sheet be numbered for coding purposes during the main study.

3.7.1.1.3 The following changes were suggested for demographics:

a) Record of cardiovascular disease-the word “any” was removed from the first question regarding whether the file has a record of cardiovascular disease, as it implies that the researcher will have to assess all paperwork in the patient’s file. This was a concern particularly if more than one initial paperwork was present. This occurs when a patient’s last visit to the clinic was more than 6 months ago. Therefore, the question was reworded as: **Does this file have record of cardiovascular disease at the first visit to the Durban University of Technology Chiropractic Day Clinic?**
b) Race - Which was not included in the pre-expert group data sheet was added.
c) Weight and height - Were moved to this section as it falls under demographics.
d) Body mass index (BMI) - A section to calculate BMI was added.

3.7.1.1.4 The following changes were suggested for the presenting musculoskeletal complaint:

a) It was renamed as: **Presenting musculoskeletal complaint/s** as it did not account for a secondary complaint that the patient might have presented with at their first visit. Therefore it was divided into a primary and secondary musculoskeletal complaint.
b) Site/location of the complaint - Ribs were moved to thoracic spine/chest option.
c) Onset of the complaint - Timeframe for each option was removed as the acute, sub-acute and chronic period for various conditions vary.
d) Pain character - More options were added.
e) Radiation of complaint - The options did not read well thus it was broken up into: Radiation of complaint - YES and NO followed by site of radiation with eight options.
f) Severity of the complaint at the initial visit – The numerical pain rating scale was initially utilised to measure the severity of the presenting complaint at the initial visit. However, not all interns document this information. It was suggested that the severity be measured using MILD, MODERATE and SEVERE.
g) Changes c-f were applied to both the primary and secondary musculoskeletal complaints.
h) Associated signs and symptoms of the presenting musculoskeletal complaint/s - Was moved and blended into the review of symptoms (which aimed to identify possible side-effects of cardiac medications) as distinguishing between symptoms of cardiac medication side-effects, associated signs and symptoms of musculoskeletal complaints as well as those of other conditions is not possible.

3.7.1.1.5 <u>The following changes were suggested for cardiovascular disease risk factors:</u>

a. Presence of hypertension - This section did not include option for normotensive -, hypotensive- and pre-hypertensive blood pressure. These were added including the ranges for each category for clarity purposes.
b. History of CVD - The purpose for including this option was unclear as a presence of CVD would have been documented at the top of the data sheet. The aim of this option was to document any other conditions that the patient had been diagnosed with or had a history of, that could affect the cardiovascular system. Thus it was broken down into the following systems: Peripheral vascular (e.g. hypercholesterolaemia), Cardiac, Haematological, Endocrine and Other (e.g. congenital, collagen disorders).
c. The same options were added to family history of CVD.
d. History of other conditions - This option was added to document conditions that did not fit into the above mentioned categories.
e. Exercise type - Was aimed at documenting the intensity of exercise (i.e. mild, moderate). However, the researcher and research assistant may not had the same understanding as to what type of activities fall into which category. Therefore, it was changed to **exercise** with the following options: YES, NO, CARDIO and WEIGHT TRAINING.
f. Smoking - As information regarding the number of cigarettes smoked per year will not always be documented in patient files, this section was split into Currently smoking - YES and NO; and Previously smoked - YES and NO options.
g. Diet - Which was not included as a risk factor in the pre-expert group data sheet was added to this section with the following options: Vegan, vegetarian, high carbohydrate, high fibre, high protein, unspecified and missing. Provision was also made for diet supplementation (e.g. protein/meal replacement shakes).

3.7.1.1.5 No changes were suggested for the cardiac medications section.

3.7.1.1.6 <u>The following changes were suggested for review of systems:</u>

a) As previously mentioned, this section was merged with the associated signs and symptoms of the musculoskeletal complaint, thus the last mentioned options were moved to the review of systems.
b) As a result of the above changes to this section, the heading was changed to - **Review of systems: Identify signs and symptoms**

associated with musculoskeletal disorders, CVD and other conditions.

3.7.1.1.7 Every alternate system was shaded for ease of use by the researcher and research assistant.

3.7.2 PILOT STUDY

The pre-pilot data sheet (Appendix 13) was derived by changes made by participants during the expert group. The Ethics Committee then analysed the post-pilot data sheet after the pilot study was carried out. Thus the final data sheet (Appendix 2) was formulated and used in the main study of the data collection process.

A pilot study was conducted on seven files to determine if the data collection tool required amendments that allow for data collection tool refinement and ease of use of the data collection tool. The pilot study was conducted in a clinic room at the DUT CDC.

Both the researcher and the research assistant participated in the pilot study which also served as a training session to set a standard for the approach to data collection. In addition to identification of any further discrepancies or error, this piloting of the data collection tool also helped to determine the length of time required to collect data from one file. This allowed the researcher to determine the number of files that could be assessed in one day/week/month. It was assumed that it would take 15 minutes to complete one file. Therefore, four files could be completed in 1 hour which equates to 32 files per day times 2 (researcher and research assistant) equals 64 files per day in an eight hour day. Thus, 31 days were required to complete 2000 files. This was refuted by the pilot study as it took approximately 10 min to complete one file which equates to 48 files per day times 2 (researcher and research assistant) equals 96 files per day in an eight hour day.

3.7.2.1 PILOT STUDY CHANGES TO THE DATA SHEET

3.7.2.1.1 Seven dormant files were randomly extracted from the archives of the DUT CDC.

3.7.2.1.2 The pre-expert group data sheet was tested on four dormant files of patients who presented to the DUT CDC as three of the files were excluded.

3.7.2.1.3 The following changes were made to demographics:

a) Weight and height - a MISSING option was added as values for one/both options were not always documented.

b) Body mass index (BMI) - an UNABLE TO CALCULATE option was added as the patient's height and/or weight might not have been documented. BMI was also numbered for coding purposes.

c) Race – an UNKNOWN option was added as this demographic was not documented in the majority of the pilot study sample.

3.7.2.1.4 No changes were made to the presenting musculoskeletal complaint.

3.7.2.1.5 The following changes were made to cardiovascular disease risk factors:

a) Presence of hypertension - The BP ranges indicated from hypotensive to pre-hypertensive categories were too narrow, as a normotensive patient would also fall under the hypotensive BP category. Thus a range for normotensive BP was changed from <120/<80mmHg to >90-<120/>60-<80mmHg and hypotensive BP from <90/<60mmHg to 70-90/40- 60mmHg.

b) A section to document blood pressure was added for future reference.

3.7.2.1.6 No changes were made to cardiac medications section.

3.7.2.1.7 The following changes were made to review of systems:

a) CNS/PNS - numbness was added as an additional option.

b) Skin - was added as an additional system.

3.7.3 FINAL DATA SHEET DISCUSSION

The final data sheet (Appendix 2) was developed following amendments made to the pre-expert group data sheet as recommended by the expert group and the outcome of the pilot study. The final data sheet was approved by the DUT IREC on the 9th of June 2016.

3.7.4 MAIN STUDY:

The study took place over three phases on each day of the main study.

3.7.4.1 PHASE 1

The researcher booked a clinic room for data collection prior to commencement of the main study. On each day of data collection, both the researcher and the research assistant reported to the DUT CDC reception staff to collect the files. The researcher and research assistant manually extracted 50-100 files from the archives of DUT CDC on each day of the main study. The number of files assessed per day was confirmed by the pilot study. A total of 1065 files were assessed in the study, which were dated from one year preceding IREC approval. The researcher then signed out the files selected for that day on a record log sheet containing the relevant file numbers and took them to a clinic room. The files were analysed to exclude 217 files that did not meet the inclusion criteria. Those file numbers were then documented on a spreadsheet.

3.7.4.2 PHASE 2

The sample that met the inclusion criteria were equally divided between the researcher and research assistant. The files were analysed to gather information regarding demographics, presence of CVD/non-CVD, presenting MSC, region of main complaint, risk factors of CVD, type and duration of medication; and the prevalence of CVD at the DUT CDC. This information was coded for recording and documented on the final data sheet (Appendix 2). Only the first two files were coded on the final data sheet and the rest were entered directly into an Excel spreadsheet. At the end of each day the researcher returned the files to reception where she signed them back in. Data collection occurred over 19 days.

3.7.4.3 PHASE 3

This involved the analysis and interpretation of the data following statistical analysis and the completion of the written mini-dissertation.

3.8 STATISTICAL ANALYSIS

The data were captured on an Excel spreadsheet and converted to the latest version of Statistical Package for the Social Sciences (SPSS) which was used to statistically and qualitatively analyse the data. All patient files were coded for recording, analysis and reporting, thereby keeping their information confidential (Mouton, 1996) and anonymous (Mouton, 1996).

Statistical analysis included the analysis of information recorded regarding demographic characteristics; morbidity, and prevalence of cardiovascular disease and musculoskeletal disorders; and their associated risk factors. Descriptive statistics such as frequencies and percentages for categorical variables, and mean, standard deviation and range for quantitative variables were used to describe the sample in terms of these and other characteristics. Prevalence was reported along with 95% confidence intervals.

Where associations were found Pearson Chi-square tests or Fisher Exact test were used for categorical variables, and independent t-tests for quantitative variables were utilised to determine the significance of the association, indicating whether the association is greater than chance alone (i.e. a p value <0.05 being considered statistically significant) (Singh, 2014). A two-tailed 0.05 level of significance was used.

Risk factors for CVD were chosen firstly for their clinical importance. These were gender, BMI, age, site of primary MSC, hypertension, family history of CVD, exercise, alcohol and

smoking, use of cardiac and non-cardiac medication including antihypertensives, ACE inhibitors, NSAIDS and similar as discussed in Chapter two. The association between risk factors and presence of CVD was initially tested in univariate logistic regression analysis. Cardiac medications taken only by patients with CVD (for example, anticoagulants, Angiotensin, *beta* blockers and similar) were not assessed using logistic regression analysis due to the presence of cell counts of 0. Those variables with an association of p=<0.1 were then entered into a multivariable logistic regression model in order to assess the role of confounding between related risk factors. The full initial model's odds ratios and 95% confidence intervals were reported (Esterhuizen, 2018).

CHAPTER FOUR

RESULTS

4.1 INTRODUCTION

The data were captured on an Excel spreadsheet and imported into IBM Statistical Package for the Social Sciences (SPSS) version 24 for analysis. All patient files were coded for recording, analysis and reporting, thereby keeping their information confidential (Mouton, 1996) and anonymous (Mouton, 1996).

4.2. DATA SOURCES

Data from both primary and secondary sources were used in this chapter.

4.2.1. THE PRIMARY DATA

Primary sources of data included information collected from the clinic files of patients who presented to the Durban University of Technology Chiropractic Day Clinic (DUT CDC) (Appendix 2).

4.2.2. THE SECONDARY DATA

Secondary sources of data included the use of literature outlined in Chapter Two, which were obtained from journal articles, research dissertations, internet sources, books and personal communication with the statisticians (Singh, 2011; Esterhuizen, 2018), supervisor (Harpham, 2015) and co-supervisor (Korporaal, 2015).

4.2.3 THE FOLLOWING ABBREVIATIONS ARE RELEVANT TO THIS CHAPTER

Table 4.1 Statistical abbreviations

CI	Confidence interval.
N	Refers to the subsample size.
N	Refers to the total sample size.
p	Refers to the *p*-value, which is used in statistical testing to determine the probability of an association between variables which indicates the data's statistical significance. If the *p*-value is very small then it can be concluded that the results are significant (Centers for Disease Control and Prevention, 2017).
OR	Odds ratio.
SD	Standard deviation.
Sig.	Significance value or *p* value.
%	Percentage.
=	Signifies "equals to".
<	Refers to a number "less than" the number reported.
>	Refers to a number "greater than" the number reported.

4.3 REVIEW OF THE OBJECTIVES OF THIS STUDY

The study objectives were outlined in Chapter One in the context of the research aims and objectives as well as the rationale of the study. Here the review of the study objectives serves as a reminder of the required outcomes that this study set out to achieve:

Objective One: To determine the nature of any musculoskeletal disorders that the patient has presented with.

Objective Two: To determine the dual prevalence of cardiovascular disease among the aforementioned patients presenting at the Durban University of Technology Chiropractic Day Clinic.

Objective Three: To identify any diagnosed cardiovascular disease (e.g. cardiac, vascular).

Objective Four: To identify any risk factors predisposing the patients to cardiovascular disease.

Objective Five: To identify any medications that the patient has been prescribed for their cardiovascular disease and the length of time for which this medication has been taken.

Objective Six: To determine if an association exists between the prevalence of and risk factors for the cardiovascular disease, the prescribed medication and the presenting musculoskeletal complaints noted.

The next sections cover the results attained in this study.

4.4 RESULTS

4.4.1 THE PREVALENCE AND NATURE OF MUSCULOSKELETAL COMPLAINTS AT THE DUT CDC

A total of 1066 files from 9 June 2015 to 9 June 2016 were consecutively extracted from the clinic's records. There were 848 files, which met the criteria for this study during this time period.

4.4.1.1 THE PREVALENCE AND LOCATION OF MUSCULOSKELETAL COMPLAINTS AT THE DUT CDC

The prevalence and 95% CI musculoskeletal complaints (MSCs) are shown in Table 4.2. In the 1-year period, the prevalence was 98.7% (95% CI 97.6% to 99.3%).1.3% (11) of patients who presented to the DUT CDC during this period came for a general check-up, and therefore, did not have a primary musculoskeletal complaint. A total of 79.5% (674) of the total sample did not present with a secondary musculoskeletal complaint. For the purpose of this study, the last mentioned refers to a second MSC that was unrelated to the primary MSC. The frequency of the site of the MSCs as demonstrated in the total sample of clinic files (N=848) that were included in the study, is also shown in Table 4.2. The most frequently affected site for both primary and secondary MSCs were the lumbar spine/abdomen followed by the cervical spine. The other areas were less frequently affected.

The most frequent location of primary MSCs were the lumbar spine (25%), followed by the cervical spine (16.2%). Similarly for secondary MSCs, the most common location was the lumbar spine (4.2%), followed by the cervical spine (3.4%).

Table 4.2 Prevalence (95% CI 97.6% to 99.3%) and location of primary and secondary MSCs at the DUT CDC

MSC	Prevalence	Site	Frequency	Percent
Primary	**98.7% (95% CI 97.6% to 99.3%)**	Head	18	2.1
		Cervical spine	137	16.2
		Thoracic spine / chest/ ribs	78	9.2
		Lumbar spine / abdomen	212	25.0
		Sacro-iliac joint / pelvis	50	5.9
		Hip / thigh	26	3.1
		Knee / leg	94	11.1
		Foot / ankle	48	5.7
		Shoulder / brachium	89	10.5
		Elbow / forearm	5	0.6
		Hand / wrist	13	1.5
		Jaw	38	4.5
		Multiple locations	26	3.1
		Entire left side	2	0.2
		Entire right side	1	0.1
Secondary	**20.7% (95% CI 17.9% to 23.4%)**	Head	22	2.6
		Cervical spine	29	3.4
		Thoracic spine / chest / ribs	16	1.9
		Lumbar spine / abdomen	36	4.2
		Sacro-iliac joint / pelvis	7	0.8
		Hip/ thigh	8	0.9
		Knee / leg	13	1.5
		Foot / ankle	18	2.1
		Shoulder / brachium	16	1.9
		Elbow / forearm	0	0.0

		Hand / wrist	7	0.8
		Jaw	0	0.0
		Multiple locations	2	0.2
		Entire left side	0	0.0
		Entire right side	0	0.0

4.4.1.2 NATURE OF MSCs OF PATIENTS WHO PRESENTED TO THE DUT CDC

4.4.1.2.1 DURATION OF MSC

For this study, complaint durations of less than 4 weeks were considered as acute, less than 4 weeks with a previous occurrence was considered acute-on-chronic, between 1-6 months was considered as sub-acute and more than 6 months was considered as chronic. Chronic MSCs were the most frequently reported for both primary (32.3%) and secondary MSCs (8.6%). The second most frequently reported duration was acute MSCs (28.4% and 5.0% primary and secondary MSCs, respectively). The duration of primary MSCs were not documented in 1.3% of clinic records.

The information stated in Table 4.4 indicate that there were no statistically significant difference in the onset of primary MSCs between the two genders (p=0.675; Fisher Exact test), although all types of onset of primary MSCs were slightly higher in males.

Table 4.3 Duration of primary MSCs at the DUT CDC

Duration		Frequency	Percent
Valid	Acute	241	28.8
	Acute on chronic	174	20.8
	Sub-acute	148	17.7
	Chronic	274	32.7
	Total	837	100.0

Table 4.4 Duration of primary MSCs relative to gender

			Gender		
			Male	Female	Total
Duration	Acute	Count	135	106	241
		% within Gender	30.1	27.2	28.8
	Acute on chronic	Count	95	79	174
		% within Gender	21.2	20.3	20.8
	Sub-acute	Count	79	69	148
		% within Gender	17.6	17.7	17.7
	Chronic	Count	139	135	274
		% within Gender	31.0	34.7	32.7
Total		Count	448	389	837
		% within Gender	100.0	100.0	100.0

Pearson chi-square test invalid due to low cell counts

Table 4.5 Duration of secondary MSCs at the DUT CDC

Duration		Frequency	Percent
Valid	Not documented	665	79.5
	Acute	42	5.0
	Acute on chronic	20	2.4
	Sub-acute	37	4.4
	Chronic	73	8.7
	Total	837	100.0

4.4.1.2.2 CHARACTER OF MSC

As illustrated in Figures 4.1 and 4.3, the most frequently reported character of pain documented in the total sample was sharp (213) followed by dull (116); dull and aching (106) for primary MSCs, and dull (37) followed by sharp (32); dull and aching (11) for secondary MSCs. Other frequently reported pain characters are shown in Figure 4.2.

A comparison of pain character of primary MSCs between male and female is illustrated in Table 4.6. It revealed a similar result as above, although sharp pain and dull pain were more frequently reported in males (30.3% and 15.1%, respectively). Dull and aching pain were equally prevalent in both genders. In addition, pain character of secondary MSCs between male and female were also similar.

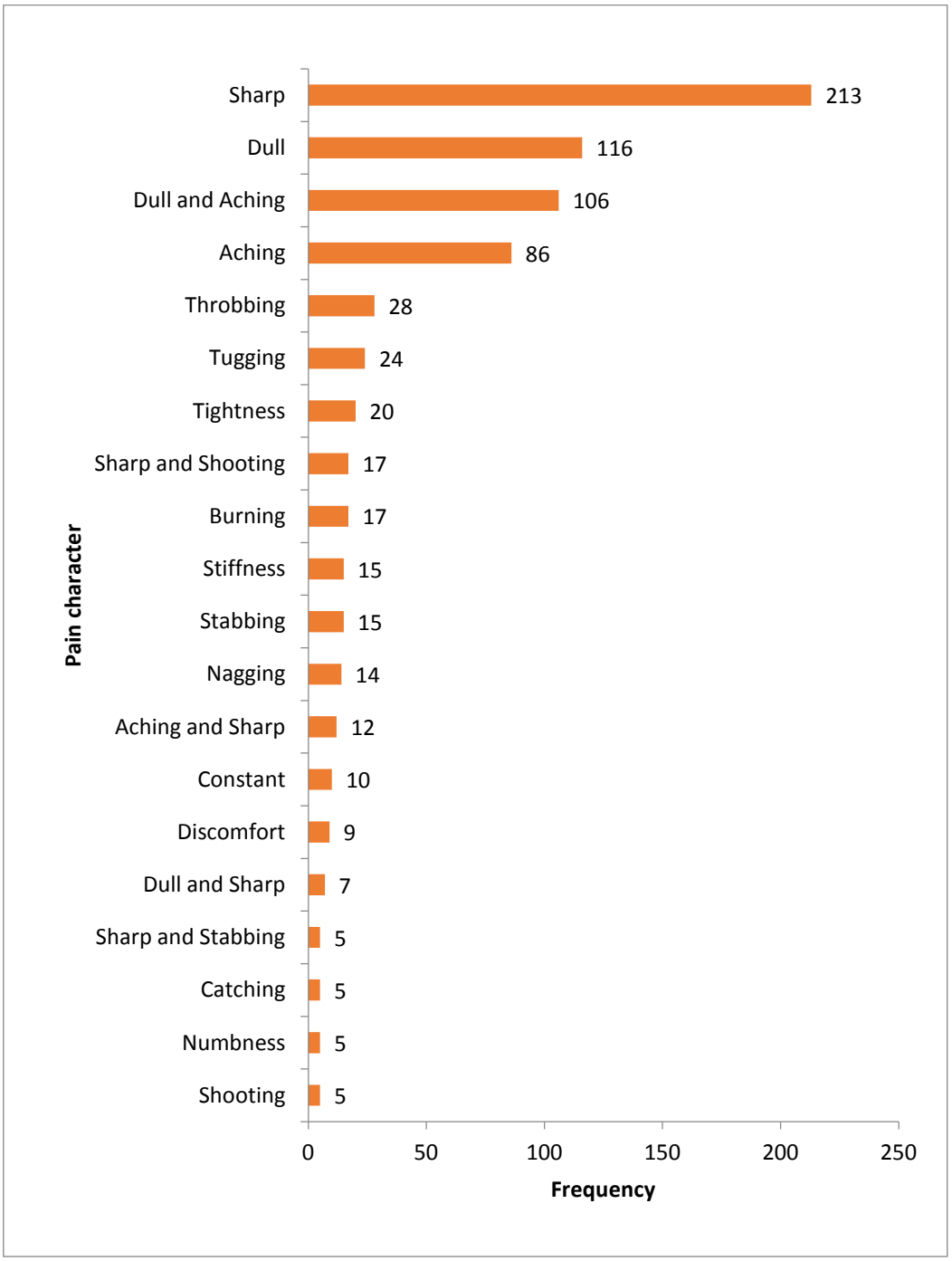

Figure 4.1 Most frequent pain character of primary MSCs at the DUT CDC

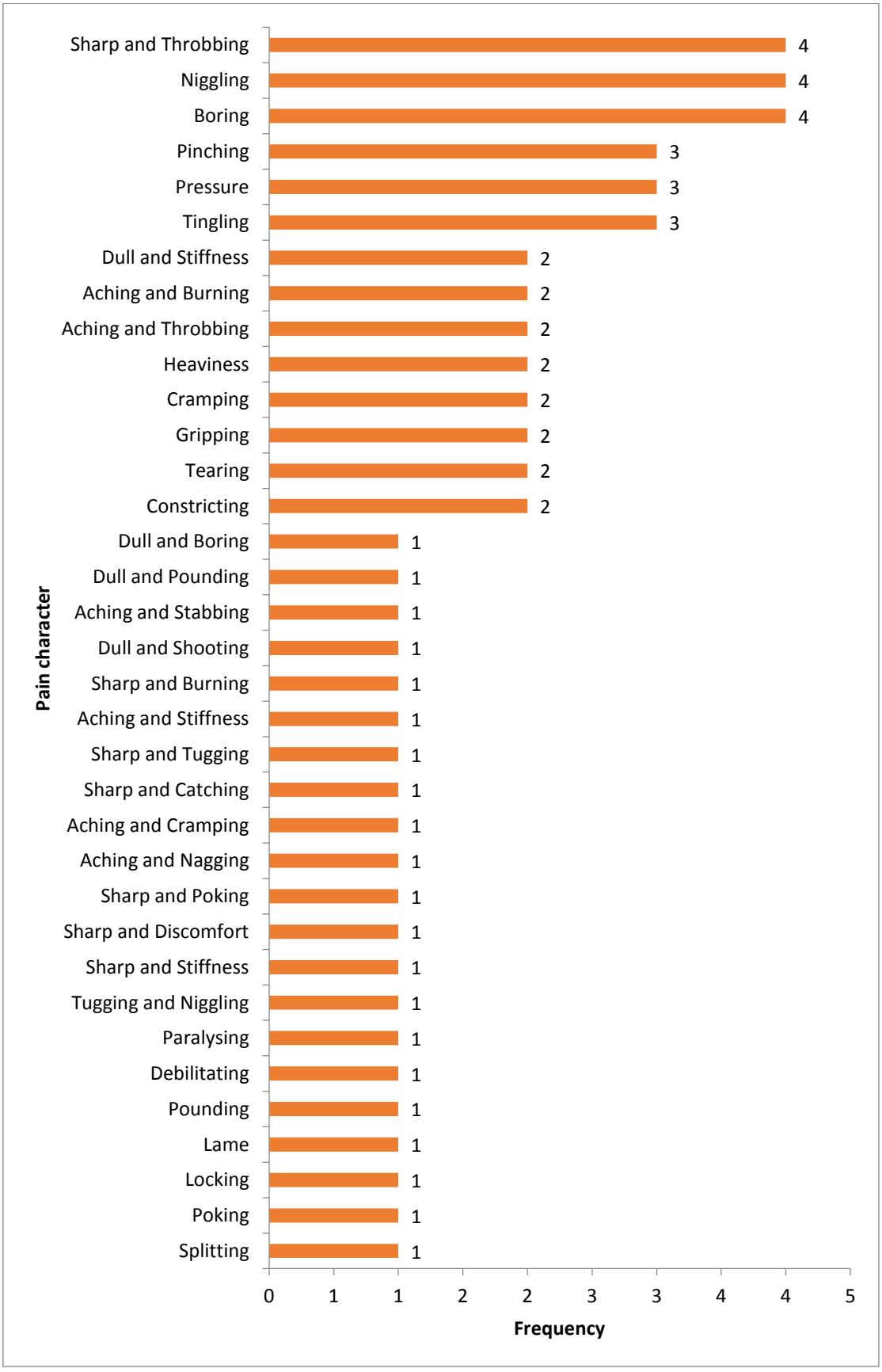

Figure 4.2 Less frequent pain character of primary MSCs at the DUT CDC

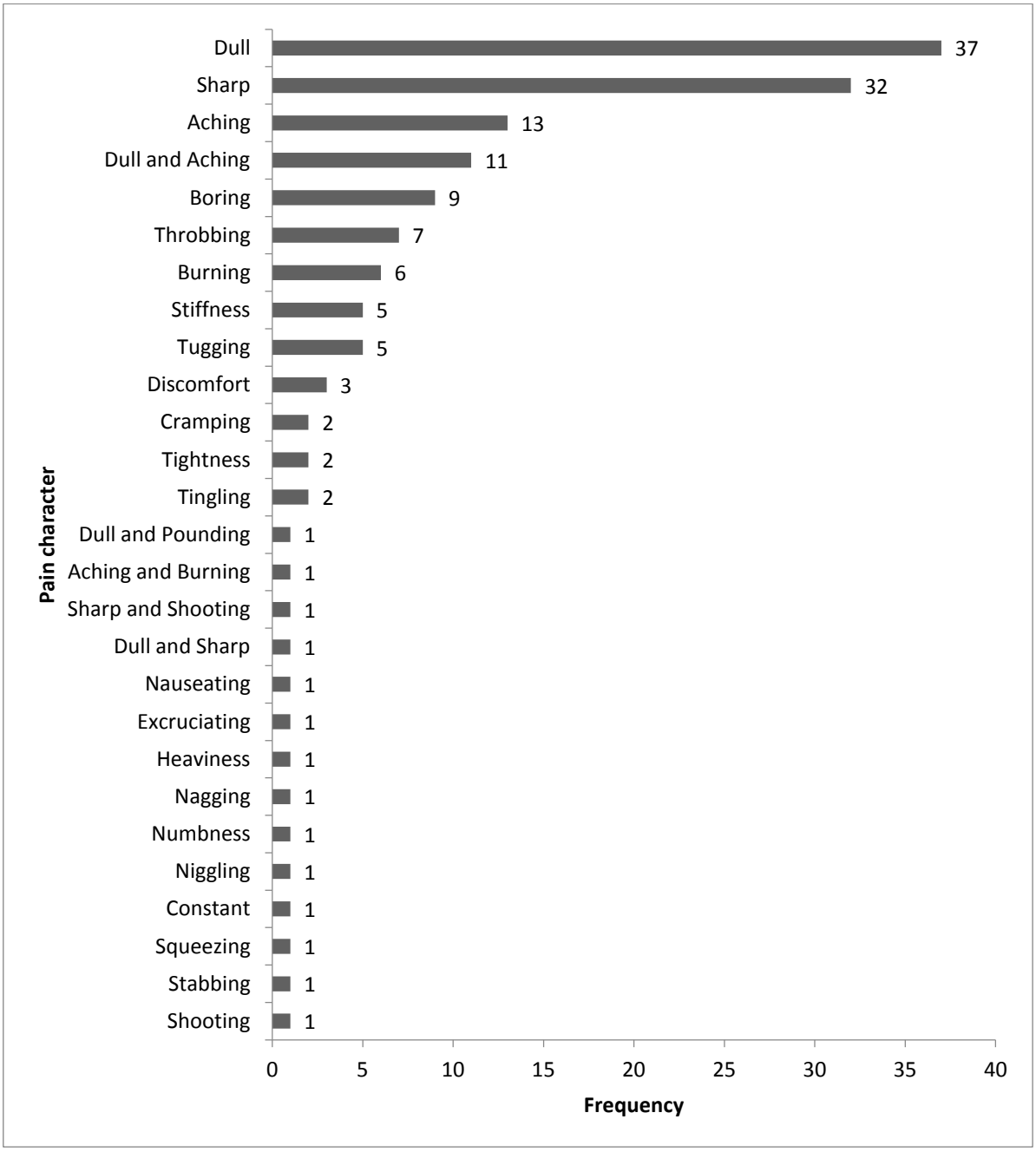

Figure 4.3 Character of secondary MSCs at the DUT CDC

Table 4.6 Pain character of primary MSCs relative to gender

			Gender		
			Male	Female	Total
Character of primary MSCs	Sharp	Count	128	85	213
		% within Gender	30.3	23.4	27.1
	Dull	Count	64	52	116
		% within Gender	15.1	14.3	14.7
	Dull and Aching	Count	53	53	106
		% within Gender	12.5	14.6	13.5%
	Aching	Count	42	44	86
		% within Gender	9.9	12.1	10.9
	Stabbing	Count	12	3	15
		% within Gender	2.8	0.8	1.9
	Tugging	Count	12	12	24
		% within Gender	2.8	3.3	3.0
	Stiffness	Count	11	4	15
		% within Gender	2.6	1.1	1.9
	Nagging	Count	4	10	14
		% within Gender	0.9	2.7	1.8
	Burning	Count	7	10	17
		% within Gender	1.7	2.7	2.2
	Constricting	Count	0	2	2
		% within Gender	0.0	0.5	0.3
	Boring	Count	4	0	4
		% within Gender	0.9	0.0	0.5
	Tearing	Count	1	1	2
		% within Gender	0.2	0.3	0.3
	Tingling	Count	1	2	3
		% within Gender	0.2	0.5	0.4
	Throbbing	Count	9	19	28
		% within Gender	2.1	5.2	3.6
	Shooting	Count	2	3	5
		% within Gender	0.5	0.8	0.6
	Splitting	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Niggling	Count	3	1	4
		% within Gender	0.7	0.3	0.5
	Constant	Count	5	5	10
		% within Gender	1.2	1.4	1.3
	Tightness	Count	12	8	20
		% within Gender	2.8	2.2	2.5
	Discomfort	Count	5	4	9
		% within Gender	1.2	1.1	1.1
	Poking	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Gripping	Count	1	1	2
		% within Gender	0.2	0.3	0.3
	Numbness	Count	3	2	5
		% within Gender	0.7	0.5	0.6
	Cramping	Count	1	1	2

		% within Gender	0.2	0.3	0.3
	Catching	Count	2	3	5
		% within Gender	0.5	0.8	0.6
	Locking	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Pressure	Count	1	2	3
		% within Gender	0.2	0.5	0.4
	Heaviness	Count	2	0	2
		% within Gender	0.5	0.0	0.3
	Lame	Count	1	0	1
		% within Gender	0.2	0.0	0.1
	Pinching	Count	0	3	3
		% within Gender	0.0	0.8	0.4
	Pounding	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Debilitating	Count	1	0	1
		% within Gender	0.2	0.0	0.1
	Paralysing	Count	1	0	1
		% within Gender	0.2	0.0	0.1
	Aching and Throbbing	Count	2	0	2
		% within Gender	0.5	0.0	0.3
	Aching and Sharp	Count	10	2	12
		% within Gender	2.4	0.5	1.5
	Dull and Sharp	Count	4	3	7
		% within Gender	0.9	0.8	0.9
	Tugging and Niggling	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Sharp and Stiffness	Count	1	0	1
		% within Gender	0.2	0.0	0.1
	Sharp and Discomfort	Count	1	0	1
		% within Gender	0.2	0.0	0.1
	Sharp and Stabbing	Count	3	2	5
		% within Gender	0.7	0.5	0.6
	Sharp and Shooting	Count	6	11	17
		% within Gender	1.4	3.0	2.2
	Sharp and Poking	Count	1	0	1
		% within Gender	0.2	0.0	0.1
	Aching and Nagging	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Sharp and Throbbing	Count	2	2	4
		% within Gender	0.5	0.5	0.5
	Aching and Burning	Count	1	1	2
		% within Gender	0.2	0.3	0.3
	Aching and Cramping	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Sharp and Catching	Count	1	0	1
		% within Gender	0.2	0.0	0.1
	Sharp and Tugging	Count	0	1	1
		% within Gender	0.0	0.3	0.1

	Aching and Stiffness	Count	1	0	1
		% within Gender	0.2	0.0	0.1
	Sharp and Burning	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Dull and Shooting	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Dull and Stiffness	Count	1	1	2
		% within Gender	0.2	0.3	0.3
	Aching and Stabbing	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Dull and Pounding	Count	0	1	1
		% within Gender	0.0	0.3	0.1
	Dull and Boring	Count	1	0	1
		% within Gender	0.2	0.0	0.1
Total		Count	423	364	787
		% within Gender	100.0	100.0	100.0%

4.4.1.2.3 RADIATION OF MSC

Table 4.7 shows the most commonly reported sites of radiation of primary and secondary MSCs. 31.5 % (263) of primary MSCs (837 of the total sample of 848) had a site of radiation in addition to 23% (40) of the 174 who also presented with a secondary MSC. The most common site of radiation for primary MSCs were the left leg (7.9%) followed by the right leg (6.8%) and left arm (5.8%). The left leg and right leg (1.4%) were equally common sites of radiation for secondary MSCs, followed by the cervical spine (1.2%). The sites of radiation of primary MSCs were not documented in one clinic file.

Table 4.7 Site of radiation of primary and secondary MSCs

Site	Frequency		Percent	
	Primary	Secondary	Primary	Secondary
Not documented	1	0	0.1	0.0
No site	571	134	68.2	16.0
Eye	2	0	0.8	0
Eye and cervical spine	0	1	0.0	2.5
Jaw	1	1	0.4	2.5
Jaw, cervical spine, left arm, right arm, thoracic spine, lumbar spine, pelvis, left leg and right leg	0	1	0.0	2.5
Jaw and pelvis	1	0	0.4	0.0
Head	16	5	6.0	12.5
Head, cervical spine and thoracic spine	1	0	0.4	0.0
Head and cervical spine	2	0	0.8	0.0
Head and left arm	1	0	0.4	0.0
Cervical spine	15	7	5.7	17.5
Cervical spine and thoracic spine	6	0	2.3	0.0
Cervical spine, thoracic spine and pelvis	1	0	0.4	0.0
Cervical spine and left arm	1	0	0.4	0.0
Cervical spine, left arm and thoracic spine	0	1	0.0	2.5
Cervical spine and right arm	1	0	0.4	0.0
Cervical spine, left arm, right arm and lumbar spine	1	0	0.4	0.0
Chest	1	0	0.4	0.0
Chest and left arm	1	0	0.4	0.0
Chest and right arm	1	0	0.4	0.0
Abdomen	2	0	0.8	0.0
Abdomen and thoracic spine	1	0	0.4	0.0

Thoracic spine	9	1	3.4	2.5
Thoracic spine, left arm and lumbar spine	1	0	0.4	0.0
Thoracic spine and left arm	2	0	0.8	0.0
Thoracic spine and lumbar spine	3	0	1.1	0.0
Thoracic spine, left arm, right arm, lumbar spine and pelvis	1	0	0.4	0.0
Thoracic spine, left arm and right arm	1	0	0.4	0.0
Thoracic spine and pelvis	1	0	0.4	0.0
Left arm	26	2	9.8	5
Left arm and left leg	1	1	0.4	2.5
Left arm and right arm	10	0	3.8	0.0
Left leg	35	4	13.3	10
Left leg and thoracic spine	1	0	0.4	0.0
Left leg, right leg and pelvis	4	1	1.5	2.5
Left leg and right leg	17	4	6.5	10
Left leg and pelvis	5	1	2.0	2.5
Right arm	32	1	12.1	2.5
Right arm and thoracic spine	2	0	0.8	0.0
Right leg	23	5	8.7	12.5
Right leg and thoracic spine	1	0	0.4	0.0
Right leg and pelvis	10	1	3.8	2.5
Lumbar spine	4	1	1.5	2.5
Lumbar spine, head, left arm, left leg, right arm and right leg	1	0	0.4	0.0
Lumbar spine, left arm, left leg and thoracic spine	1	0	0.4	0.0
Lumbar spine, left arm, left leg, pelvis and thoracic spine	1	0	0.4	0.0
Lumbar spine and right leg	1	0	0.4	0.0
Lumbar spine, pelvis, left leg and right leg	1	0	0.4	0.0
Pelvis	13	2	4.9	5
Pelvis and lumbar spine	1	0	0.4	0.0

4.4.1.2.4 SEVERITY OF MSC

The majority of the patients who presented to the DUT CDC with a primary MSC (98.7%), reported that the pain was moderate (52.7%) with 26.9% having severe pain. Moderate pain (11.1%) was also most commonly reported by the 20.5% of patients who reported a secondary MSC, with only 6.1% having severe pain.

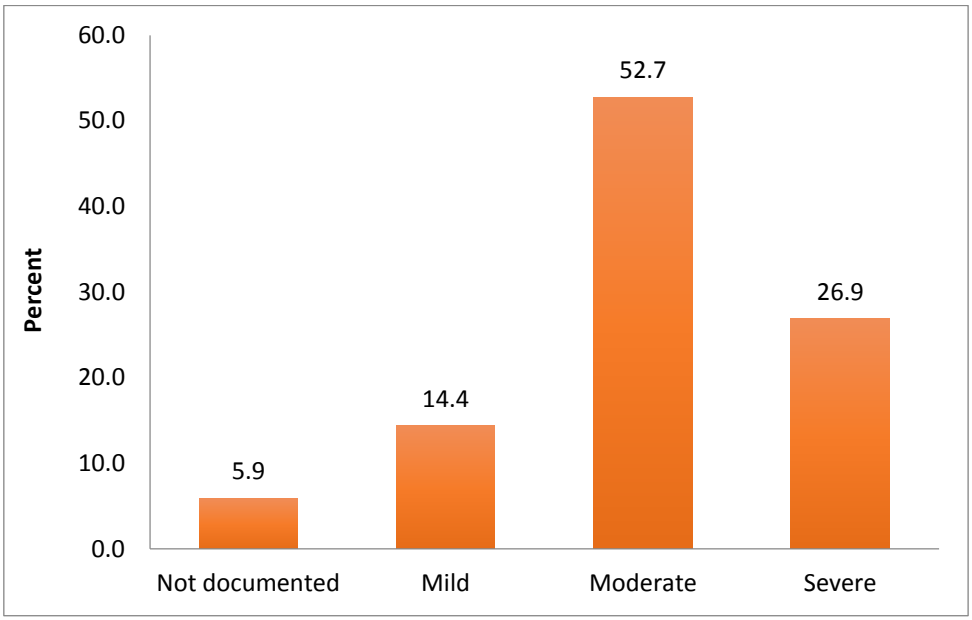

Figure 4.4 Severity of primary MSCs

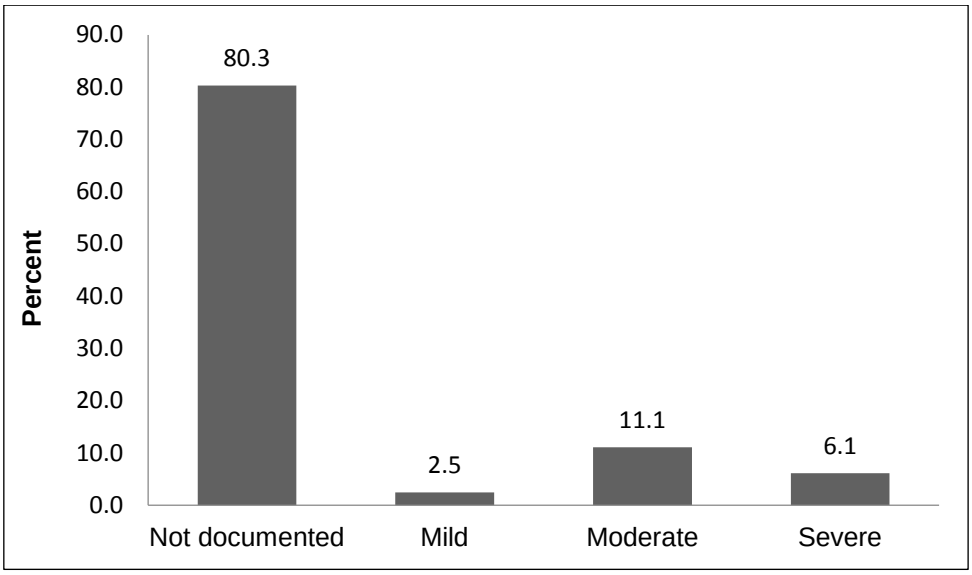

Figure 4.5 Severity of secondary MSCs

4.4.2 DEMOGRAPHICS OF PATIENTS WHO PRESENTED TO THE DUT CDC

4.4.2.1 AGE

Age of the sample ranged from 5 weeks to 86 years. The mean age was 37.87 years (SD 16.53 years). The age group distribution of the sample is shown in Table 4.8. The majority were young, in the 20-29 year age group (32.4%). When age was compared between the two genders, females were shown to have a significantly higher mean age than males (t=-2.7 (843 df; *p*=0.006). Mean age of the two genders are shown in Table 4.9.

Table 4.8 Age group distribution of the sample (N=848)

Age	Frequency	Percent
Not documented	**3**	0.4
<12 months	3	0.4
1-9	2	0.2
10-19	75	8.8
20-29	270	31.8
30-39	140	16.5
40-49	119	14.0
50-59	128	15.1
60-69	73	8.6
70-79	31	3.7
80-89	4	0.5

Table 4.9 Mean age relative to gender (N=848)

Gender		Age
Male	Mean	36.40
	N	452
	Std. Deviation	15.50
Female	Mean	39.56
	N	393
	Std. Deviation	17.52
Total	Mean	37.87
	N	845
	Std. Deviation	16.53

4.4.2.2 GENDER

Table 4.10 shows the gender distribution of the total sample. Overall there were 53.5% males and 46.5% females in the sample. There were no clinic files in which gender was omitted.

Table 4.10 Gender distribution of the sample (N=848)

Gender		Frequency	Percent
Valid	Male	454	53.5
	Female	394	46.5
Total		848	100.0

4.4.2.3 RACE/ETHNICITY

Table 4.11 shows the race distribution of the sample. The majority of the sample in which race was recorded were Indian (4.5%) followed by African (4.4%). A statistically significant result was yielded when the race distribution between male and female genders were compared (p=0.022; Fisher Exact test). Majority of males were Indian while females tended to be African. However, race was not documented in 87.7% of the sample.

Table 4.11 Race/ethnicity distribution of the sample (N=848)

Race/ethnicity		Frequency	Percent
Valid	Indian	38	4.5
	African	37	4.4
	White	24	2.8
	Coloured	5	0.6
	Total	104	12.3
Missing		744	87.7
Total		848	100.0

Table 4.12 Race distribution in the sample (N=848) relative to gender

			Gender		
			Male	Female	Total
Race	Not documented	Count	388	356	744
		% within Gender	85.5	90.4	87.7
	African	Count	18	19	37
		% within Gender	4.0	4.8	4.4
	Coloured	Count	3	2	5
		% within Gender	0.7	0.5	0.6
	Indian	Count	26	12	38
		% within Gender	5.7	3.0	4.5
	White	Count	19	5	24
		% within Gender	4.2	1.3	2.8
Total		Count	454	394	848
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 10.736

4.4.2.4 HEIGHT, WEIGHT AND BODY MASS INDEX (BMI)

These variables will be discussed later in this chapter under 4.4.6, as they have been identified as risk factors for CVD and will be discussed as such.

4.4.3 THE PREVALENCE OF CARDIOVASCULAR DISEASE (CVD) AT THE DUT CDC

The prevalence of CVD is shown in Figure 4.6. In the 1-year period from 9 June 2015 to 9 June 2016, the prevalence of CVD was 25.2% (95% CI 22.37% to 28.33%). Nearly 75% of the total sample (N=848) did not have a record of CVD. When the prevalence of CVD was compared between male and female, it produced a statistically significant result (p=0.009; Fisher Exact test). There was a higher prevalence of CVD in females compared to males as indicated by the information stated in Table 4.13.

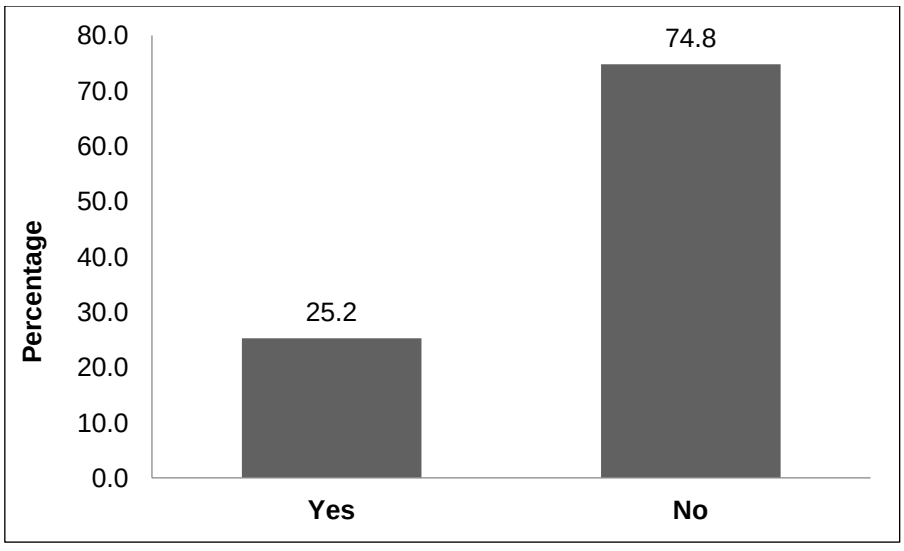

Figure 4.6 Does this file have any record of CVD the first visit to the DUT CDC?

Table 4.13 Prevalence of CVD relative to gender

			Does this file have record of CVD at the first visit to the DUT CDC?		
			Yes	No	Total
Gender	**Male**	Count	98	356	454
		% within group	45.8	56.2	53.5
		% of Total	11.6	42.0	53.5
	Female	Count	116	278	394
		% within group	54.2	43.8	46.5
		% of Total	13.7	32.8	46.5
Total		Count	214	634	848
		% within group	100.0	100.0	100.0
		% of Total	25.2	74.8	100.0

Pearson chi-square test 6.899

4.4.3.1 MOST FREQUENTLY RECORDED PREVIOUSLY DIAGNOSED CARDIOVASCULAR DISEASES

As the information stated in Table 4.14 illustrates, hypertension was the most frequently recorded previously diagnosed CVD in the subsample (n=214). However, the total of this table is larger than the total sample, as numerous patients had a combination of CVDs. Other previously diagnosed CVDs are also shown in Table 4.14.

Table 4.14 Frequency of previously diagnosed CVD in patients presenting to the DUT CDC

		Frequency	Percent
Valid	HTN	99	11.7
	Hypercholesterolaemia	53	6.3
	VVs	30	3.5
	Hypotension	12	1.4
	Unspecified valvular heart disease	8	0.9
	HTN and CVA	6	0.7
	Hypercholesterolaemia and VVs	5	0.6
	CVA	4	0.5
	HTN and angina	4	0.5
	Coronary heart disease (angina)	4	0.5
	Arrhyhmias	3	0.4
	HTN and congestive cardiac failure (CCF)	3	0.4
	Deep vein thrombosis (DVT)	2	0.2
	CHD (atrial and ventricular septal defects)	2	0.2
	Unspecified heart disease	2	0.2
	Unspecified	2	0.2
	HTN and MI	1	0.1
	CHD (ventricular septal defect)	1	0.1
	RHD	1	0.1
	HTN, CVA and myocardial infarction (MI)	1	0.1
	Rheumatic fever	1	0.1
	HTN and unspecified valvular heart disease	1	0.1
	Pericarditis	1	0.1
	MI	1	0.1
	Unspecified PVD	1	0.1

	MI and hypotension	1	0.1
	HTN and RHD	1	0.1
	CHD and pre-eclampsia	1	0.1
	Pulmonary embolism	1	0.1
	CCF	1	0.1
	HTN and rheumatic fever	1	0.1
	Total	254	30.0
No previously diagnosed CVD		534	70.0
Total		848	100.0

4.4.4 PREVALENCE OF MSCs AMONG CVD PATIENTS WHO PRESENTED TO THE DUT CDC

Two-hundred and fourteen (214) files were found to have a recorded diagnosed CVD. However, only two of the files in the subsample had no main MSC as those patients presented to the DUT CDC for a check-up. Therefore, 212 (99.1%) files had a primary MSC while 55 (26.0%) also had a secondary MSC.

4.4.4.1 NATURE OF MSCs OF CVD PATIENTS WHO PRESENTED TO THE DUT CDC

4.4.4.1.1 DURATION OF MSC

Chronic MSCs were most frequently reported for both primary (38.3%) and secondary MSCs (13.6%). The second most frequently reported duration were acute MSCs (24.8% and 6.5% primary and secondary MSCs, respectively).

Table 4.15 Duration of primary MSCs in CVD patients who presented to the DUT CDC

		Frequency	Percent
Valid	Not documented	2	0.9
	Acute	53	24.8
	Acute on chronic	45	21.0
	Sub-acute	32	15.0
	Chronic	82	38.3
	Total	214	100.0

Table 4.16 Duration of secondary MSCs in CVD patients who presented to the DUT CDC

		Frequency	Percent
Valid	Not documented	158	73.8
	Acute	14	6.5
	Acute on chronic	5	2.3
	Sub-acute	8	3.7
	Chronic	29	13.6
	Total	214	100.0

4.4.4.1.2 SITE OF MSC

The frequency of the site of the MSCs as demonstrated in the sample of clinic files which demonstrated a history of CVD (n=214) are shown in Table 4.17. However, two of the files in the subsample did not demonstrate a main MSC as those patients presented to the DUT CDC for a check-up. The most frequently affected site for primary MSCs were the lumbar spine/abdomen (26.2%) followed by the cervical spine (15.4%). Of the 214 who had a history of CVD, 25.7% had a secondary musculoskeletal complaint. The most frequently affected site for secondary MSCs were the head (5.1%) and the cervical spine (4.7%). When these results were compared between male and female, a non-significant result was obtained (*p*=0.597; Fisher Exact test), although females showed a tendency to present more frequently with lumbar spine complaints than males.

Table 4.17 Location of primary and secondary musculoskeletal complaints (MSCs) of CVD patients at the DUT CDC

MSC	Site	Frequency	Percent
No MSC (n=214)	None	2	0.9
Primary	Head	6	2.8
	Cervical spine	33	15.4
	Thoracic spine / chest / ribs	17	7.9
	Lumbar spine / abdomen	56	26.2
	Sacro-iliac joint / pelvis	23	10.7
	Hip / thigh	3	1.4
	Knee / leg	16	7.5
	Foot / ankle	12	5.6
	Shoulder / brachium	26	12.1
	Elbow / forearm	1	0.5
	Hand / wrist	1	5.1
	Jaw	11	4.5
	Multiple locations	4	1.9
	Entire left side	2	0.9
	Entire right side	1	0.5
Secondary	Head	11	5.1
	Cervical spine	10	4.7
	Thoracic spine /chest / ribs	4	1.9
	Lumbar spine / abdomen	8	3.7
	Sacro-iliac joint / pelvis	3	1.4
	Hip / thigh	2	0.9
	Knee / leg	5	2.3
	Foot / ankle	6	2.8
	Shoulder / brachium	6	2.8
	Elbow / forearm	0	0.0
	Hand/wrist	1	0.5
	Jaw	0	0.0
	Multiple locations	0	0.0
	Entire left side	0	0.0
	Entire right side	0	0.0

Table 4.18 Site of primary MSCs relative to gender

			Gender		
			Male	Female	Total
Site	No Complaint	Count	1	1	2
		% within Gender	1.0	0.9	0.9
	Head	Count	2	4	6
		% within Gender	2.0	3.4	2.8
	Cervical spine	Count	17	16	33
		% within Gender	17.3	13.8	15.4
	Thoracic spine / chest / ribs	Count	8	9	17
		% within Gender	8.2	7.8	7.9
	Lumbar spine / abdomen	Count	27	29	56
		% within Gender	27.6	25.0	26.2
	SI joint / pelvis	Count	10	13	23
		% within Gender	10.2	11.2	10.7
	Hip / thigh	Count	3	0	3
		% within Gender	3.1	0.0	1.4
	Knee / leg	Count	6	10	16
		% within Gender	6.1	8.6	7.5
	Foot and ankle	Count	5	7	12
		% within Gender	5.1	6.0	5.6
	Shoulder / brachium	Count	12	14	26
		% within Gender	12.2	12.1	12.1
	Elbow / forearm	Count	1	0	1
		% within Gender	1.0	0.0	0.5
	Hand and wrist	Count	1	0	1
		% within Gender	1.0	0.0	0.5
	Jaw	Count	3	8	11
		% within Gender	3.1	6.9	5.1
	Multiple locations	Count	0	4	4
		% within Gender	0.0	3.4	1.9
	Entire left side	Count	1	1	2
		% within Gender	1.0	0.9	0.9
	Entire right side	Count	1	0	1
		% within Gender	1.0	0.0	0.5
Total		Count	98	116	214
		% within Gender	100.0	100.0	100.0

Pearson chi-square tests 13.560

4.4.4.1.3 CHARACTER OF MSC

The most frequently reported character of pain documented in the subsample of CVD patients were sharp (19.6%) followed by dull (14.5) for primary MSCs and dull (5.1%) followed by dull and aching (3.3%) for secondary MSCs. Other frequently reported pain characters are shown in Figures 4.7 and 4.8.

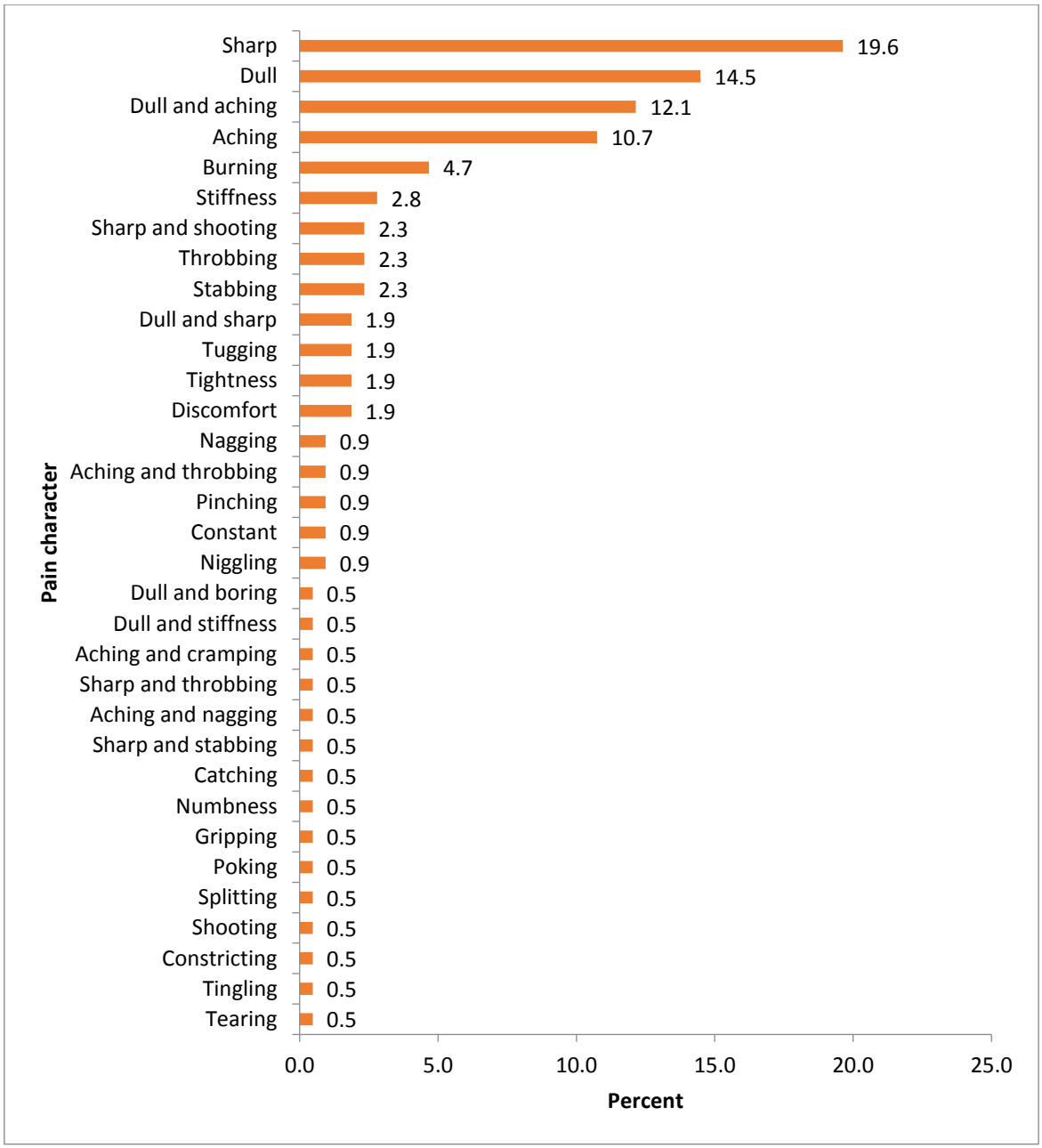

Figure 4.7 Character of primary MSCs of CVD patients at the DUT CDC

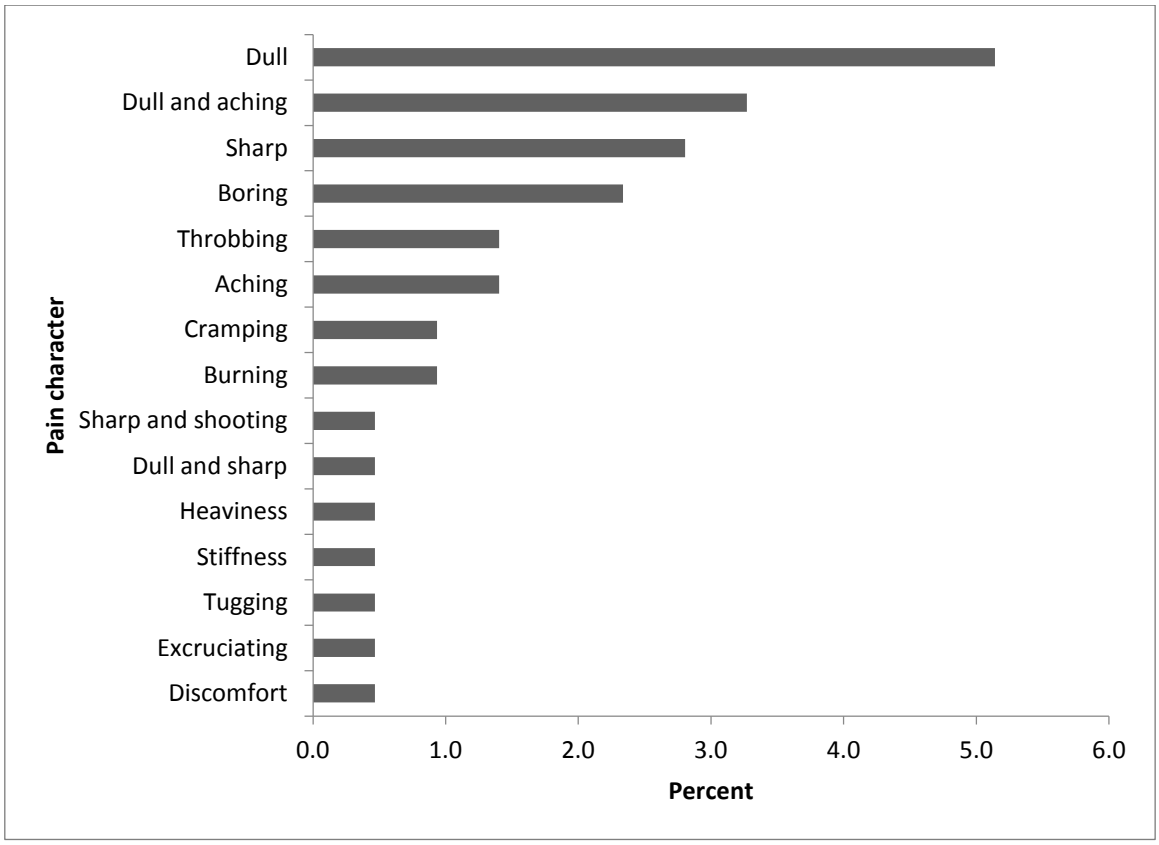

Figure 4.8 Character of secondary MSCs of CVD patients at the DUT CDC

4.4.4.1.4 RADIATION OF MSC

Table 4.19 shows the most commonly reported sites of radiation of primary and secondary MSCs in the files who had a recorded CVD. 43.9 % (94) of primary MSCs had a site of radiation in addition to 7.1% (17) of the 55 who also presented with a secondary MSC. The most common site of radiation for primary MSCs were the left leg (13.6%) followed by the right leg and right arm (9.8% each). The right leg (2.8%) was the most common site of radiation for secondary MSCs, followed by the cervical spine, left arm and left leg (equally affected with 1.9%). The site of radiation was not documented in two clinic files for primary MSCs and 158 for secondary MSCs.

Table 4.19 Site of radiation of primary and secondary MSCs of CVD patients

Site	Frequency		Percent	
	Primary	Secondary	Primary	Secondary
Not documented	2	158	0.9	73.8
No site	118	39	55.1	18.2
Eye	1	0	0.5	0.0
Jaw	1	0	0.5	0.0
Head	5	1	2.3	0.5
Cervical spine	10	4	4.7	1.9
Chest	1	0	0.4	0.0
Chest and left arm	1	0	0.4	0.0
Chest and right arm	1	0	0.4	0.0
Abdomen	2	0	0.8	0.0
Thoracic spine	11	1	5.1	0.5
Left arm	17	4	7.9	1.9
Left leg	29	4	13.6	1.9
Right arm	21	1	9.8	0.5
Right leg	21	6	9.8	2.8
Lumbar spine	7	0	3.3	0.0
Pelvis	18	2	8.4	0.9

4.4.4.1.5 SEVERITY OF MSC

The majority of CVD patients who presented to the DUT CDC with a primary MSC, reported that the pain was moderate (47.7%) with 30.8% having severe pain. Moderate pain (12.6%) was also most commonly reported by the 55 patients who reported a secondary MSC, with only 10.3% having severe pain.

Table 4.20 Severity of primary MSCs of CVD patients at the DUT (n=214)

		Frequency	Percent
Valid	Not documented	16	7.5
	Mild	30	14.0
	Moderate	102	47.7
	Severe	66	30.8
	Total	214	100.0

Table 4.21 Severity of primary MSCs of CVD patients at the DUT CDC (n=214)

		Frequency	Percent
Valid	Not documented	160	74.8
	Mild	5	2.3
	Moderate	27	12.6
	Severe	22	10.3
	Total	214	100.0

4.4.5 DEMOGRAPHICS OF CVD PATIENTS WHO PRESENTED TO THE DUT CDC

4.4.5.1 AGE

Age of the subsample who demonstrated a history of CVD ranged from 12 to 86 years. The mean age was 50.38 years (SD 16.42 years). The age group distribution of the subsample is shown in Table 4.22. The majority were in the 50-59 year age group (27.6%) followed by the 60-69 year age group (22.4%). Mean age of the two genders are shown in Table 4.23. Based on the information stated in Table 4.23, it is evident that a statistically insignificant difference (p=0.284; Fisher Exact test) in the ages of male and female CVD patients were identified. However, females tended to have a higher mean age than males.

Table 4.22 Age group distribution in the subsample (n=214)

Age	Frequency	Percent
12-19	7	3.3
20-29	24	11.2
30-39	20	9.3
40-49	27	12.6
50-59	59	27.6
60-69	48	22.4
70-79	26	12.2
80-86	3	1.4

Table 4.23 Mean age relative to gender (n=214)

Gender		Age
Male	Mean	50.0
	N	98
	Std. Deviation	15.2
Female	Mean	52.5
	N	116
	Std. Deviation	17.7
Total	Mean	51.3
	N	214
	Std. Deviation	16.6

4.4.5.2 GENDER

Table 4.24 shows the gender distribution of the 214 (25.3%) files in the total sample (N=848) that demonstrated a history of CVD. The majority of the subsample were females (54.2%) followed by males (45.8%). This differs significantly from the gender distribution in the total sample where the majority were males (p =0.009; Fisher Exact test). There were no clinic files in which gender was omitted.

Table 4.24 Gender distribution of the subsample (n=214)

Gender		Yes	No
Male	Count	98	356
	%within group	45.8	56.2
	% of Total	11.6	42.0
Female	Count	116	278
	%within group	54.2	43.8
	% of Total	13.7	32.8
Total	Count	214	634
	%within group	100.0	100.0
	% of Total	25.2	74.8

Pearson chi-square tests 6.899

4.4.5.3 RACE/ETHNICITY

Table 4.25 shows the race distribution of the subsample with CVD. Only 24 of the 214 had a valid race recorded. The majority of the subsample were Indian (5.1%) followed by African (4.2%). The race distribution in the subsample is similar to that of the total sample. When race distribution was compared between male and female, the result was statistically insignificant (p=0.520; Fisher Exact). Mean height, weight and BMI of the four race groups are shown in Table 4.27. Height (p=0.098; Fisher Exact test) was the only statistically significant variation between the race groups. No significant differences were found when the mean age (p=0.104; Fisher Exact test), weight (p=0.932; Fisher Exact test) and BMI (p=0.550; Fisher Exact test) were compared between races. However, race was not documented in 88.8% of the subsample.

Table 4.25 Race/ethnicity distribution of the subsample (n=214)

		Frequency	Percent
Valid	Indian	11	5.1
	African	9	4.2
	White	3	1.4
	Coloured	1	0.5
	Total	24	11.2
Missing		190	88.8
Total		214	100.0

Table 4.26 Race distribution of the subsample (n=214) relative to gender

			Gender		Total
			Male	Female	
Race	African	Count	3	6	9
		% within Gender	25.0	50.0	37.5
	Coloured	Count	1	0	1
		% within Gender	8.3	0.0	4.2
	Indian	Count	6	5	11
		% within Gender	50.0	41.7	45.8
	White	Count	2	1	3
		% within Gender	16.7	8.3	12.5
Total		Count	12	12	24
		% within Gender	100.0	100.0	100.0

Pearson chi-square test invalid due to low cell counts

Table 4.27 Mean age, weight, height and BMI relative to race (n=214)

Race		**Age**	**Weight**	**Height**	**BMI**
African	Mean	41.3	79.4	1.6	32.3
	N	9	9	8	8
	Std. Deviation	16.5	19.7	0.1	10.0
Indian	Mean	56.0	77.8	1.7	28.0
	N	11	11	11	11
	Std. Deviation	14.5	15.0	0.1	5.7
White	Mean	53.7	85.4	1.8	26.8
	N	3	3	3	3
	Std. Deviation	29.1	23.4	0.1	4.4
Coloured	Mean	18.0	78.0	1.7	26.3
	N	1	1	1	1
	Std. Deviation	-	-	-	-
Total	Mean	48.6	79.3	1.7	29.2
	N	24	24	23	23
	Std. Deviation	18.7	17.0	0.1	7.4

4.4.5.4 HEIGHT, WEIGHT AND BMI

The height and weight were not documented in 33 (15.4%) and 19 (8.3%) files respectively. Height and weight were utilised to calculate the BMI of each patient. BMI was then grouped into five categories as shown in Table 4.28. The majority of the patients were obese (65 collectively) followed by overweight (61). Forty-four patients in the sample were of normal weight with only nine (9) being underweight. Mean height, weight and BMI of the two genders are shown in Table 4.29. As indicated by the information stated in this table, there was a statistically significant difference in the distribution of weight (p=0.001; Fisher Exact test), height (p=<0.001; Fisher Exact test) and BMI (p=0.037; Fisher Exact test) between male and female.

Table 4.28 Body mass index of the subsample (n=214)

BMI (kg/m^2)	Category	Frequency	Percent
11.20-18.40	Underweight	9	4.2
18.60-24.80	Normal weight	44	20.6
25.00-29.80	Overweight	61	28.5
30.00-40.00	Obese	50	23.4
>40.00	Morbidly obese	15	7.0
Total		**179**	**83.8**

Table 4.29 Mean weight, height and BMI relative to gender (n=214)

Group		Weight	Height	BMI
Male	Mean	83.5054	1.7275	27.6179
	N	92	85	84
	Std. Deviation	16.61615	0.08768	4.76890
Female	Mean	75.0379	1.5964	29.8105
	N	103	96	95
	Std. Deviation	18.25148	0.09730	8.44658
Total	Mean	79.0328	1.6580	28.7816
	N	195	181	179
	Std. Deviation	17.96143	0.11355	7.03457

4.4.6 PREVALENCE OF CVD RISK FACTORS AT THE DUT CDC

Some of the risk factors that influence the prevalence of CVD in this population included non-modifiable risk factors for example age (Buttar *et al.,* 2005), gender (World Heart Federation, 2016), ethnicity (World Heart Federation, 2017) and family history of CVD (Centre for Genetics Education, 2012); in addition to modifiable risk factors for example hypertension, hypercholesterolaemia, tobacco use, harmful use of alcohol, obesity, physical inactivity , unhealthy diet, diabetes mellitus (WHO, 2013a), metabolic syndrome (Seaman and Palombo, 2014), connective tissue disease (Husain *et al.*, 2010) and the use of specific medications (Buttar *et al.,* 2005).

4.4.6.1 NON-MODIFIABLE RISK FACTORS

The non-modifiable risk factors age, gender and race/ethnicity of the total sample has previously been addressed in section 4.3.2.

4.4.6.1.1 FAMILY HISTORY OF CVD

Overall, 71.1% of the total sample had a family history of CVD. A large percentage had a family history of multiple CVDs (15.1%). Of the 603 with a family history of CVD, 17.9% had hypertension and 10.7% had peripheral vascular disease. In 82 (9.7%) files the type of CVD were not specified, these were documented as unspecific heart disease.

The distribution of family history of CVD in the subsample of CVD patients (214) is similar to that in the total sample (N=848). 24.8% reported various combinations of CVD. This was the most frequently reported followed by hypertension (22.0%) and peripheral vascular disease (14.1%). Table 4.44 demonstrates the other CVDs documented in the family history of the total sample and the subsample of CVD patients.

Table 4.30 Distribution of family history of CVD at the DUT CDC

		Total sample (N=848)		CVD sub-sample (n=214)	
Group	**Subgroup**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Unspecified	Unspecified heart disease	82	9.7	23	10.7
Subtotal		**82**	**9.7**	**23**	**10.7**
Peripheral vascular	Hypercholesterolaemia	74	8.7	23	10.7
	Hypercholesterolaemia and VVs	3	0.4	3	1.4
	VVs	5	0.6	1	0.5
	Deep vein thrombosis (DVT)	1	0.1	0	0.0
	Unspecified peripheral vascular disease	2	0.2	1	0.5
	Thrombosis	4	0.5	1	0.5
	Aneurysm	2	0.2	1	0.5
	Hypercholesterolaemia and DVT	1	0.1	0	0.0
Subtotal		**92**	**10.8**	**30**	**14.1**
Hypertensive heart disease	HTN	152	17.9	47	22.1
	Hypotension	2	0.2	1	0.5
Subtotal		**154**	**18.1**	**48**	**22.6**
Cerebrovascular disease	CVA	86	10.1	23	10.7
	Transient ischaemic attack	2	0.2	1	0.5
Subtotal		**88**	**10.3**	**24**	**11.2**
Valvular heart disease	Unspecified valvular heart disease	2	0.2	0	0.0
	RHD	1	0.1	0	0.0
Subtotal		**3**	**0.3**	**0**	**0.0**
Coronary heart disease	MI	49	5.8	22	10.3
	Angina	4	0.5	2	0.9
Subtotal		**53**	**6.3**	**24**	**11.2**
Combinations	HTN and CVA	49	5.8	16	7.5
	HTN and MI	21	2.5	8	3.7
	HTN, CVA and MI	15	1.8	3	1.4
	MI and CVA	12	1.4	5	2.3
	HTN and angina	4	0.5	1	0.5
	CVA and coronary heart disease	3	0.4	1	0.5
	MI and coronary heart disease	3	0.4	2	0.9
	HTN and hypotension	3	0.4	1	0.5
	CVA and VSD	2	0.2	0	0.0
	CVA and HF	2	0.2	0	0.0
	HTN and CCF	2	0.2	1	0.5
	HTN, CVA and arrhythmia	2	0.2	1	0.5
	Coronary heart disease and CCF	1	0.1	0	0.0
	Coronary heart disease and pre- eclampsia	1	0.1	0	0.0
	CVA and valvular heart disease	1	0.1	0	0.0

	CVA and hypotension	1	0.1	0	0.0
	HTN and arrhythmia	1	0.1	0	0.0
	HTN and HF	1	0.1	1	0.5
	PE, MI and CVA	1	0.1	1	0.5
	MI, CVA and CCF	1	0.1	1	0.5
	MI, coronary heart disease and CCF	1	0.1	1	0.5
	MI, CVA and RF	1	0.1	0	0.0
Subtotal		**128**	**15.1**	**43**	**24.8**
Heart failure	Unspecified HF	2	0.2	0	0.0
	CCF	1	0.1	0	0.0
Subtotal		**3**	**0.3**	**0**	**0.0**
TOTAL		**603**	**71.1**	**192**	**89.7**

4.4.6.2 MODIFIABLE RISK FACTORS

4.4.6.2.1 OVERWEIGHT AND OBESITY

The height and weight were not documented in 111 (13.1%) and 74 (8.7%) files respectively. Height and weight were utilised to calculate the BMI of each patient. BMI was then grouped into five categories as shown in Table 4.30. The majority of the patients were of normal weight (301) followed by overweight (221). 150 of the sample were obese with 28 being morbidly obese. BMI could not be calculated in 120 (14.2%) files. Statistically significant difference were observed in the mean height (*p*=<0.001; Fisher Exact test), weight (*p*=<0.001; Fisher Exact test) and BMI (*p*=0.007; Fisher Exact test) between genders. Trends suggest that gender affected body weight, height and BMI (Table 4.31).

Table 4.31 Body mass index of the sample (N=848)

BMI (kg/m^2)	Category	Frequency	Percent
11.20-18.40	Underweight	28	3.3
18.60-24.80	Normal weight	301	35.5
25.00-29.80	Overweight	221	26.1
30.00-40.00	Obese	150	17.7
>40.00	Morbidly obese	28	3.3
Total		**728**	**85.8**

Table 4.32 Mean height, weight and BMI of the sample (N=848) relative to gender

Group		Height	Weight	BMI
Male	Mean	**1.73**	**78.86**	**25.96**
	N	390	409	387
	Std. Deviation	0.13	16.44	4.53
Female	Mean	**1.61**	**70.33**	**27.19**
	N	347	365	341
	Std. Deviation	0.12	18.05	7.48
Total	Mean	**1.68**	**74.83**	**26.45**
	N	737	774	728
	Std. Deviation	0.14	17.72	612

4.4.6.2.2 PHYSICAL INACTIVITY

The level of physical activity of patients recorded at the initial visit were documented as YES (if it was simply recorded as yes), NO (if simply recorded as no), UNKNOWN (if recorded as yes but the type of exercise was unclear), CARDIO or WEIGHT TRAINING (if recorded as yes and the type of exercise was noted). A greater part of the sample did not engage in any form of physical activity (33.5%). Cardio (32.7%) was the most frequent type of physical activity documented followed by weight training (12.1%). The type of physical activity was unknown in only 1.5%. Table 4.33 illustrates that there are statistically significant discrepancies in the level of physical activity between male and females (*p*=<0.001; Fisher Exact test). Females who presented to the DUT CDC tended to be less physically active compared to males

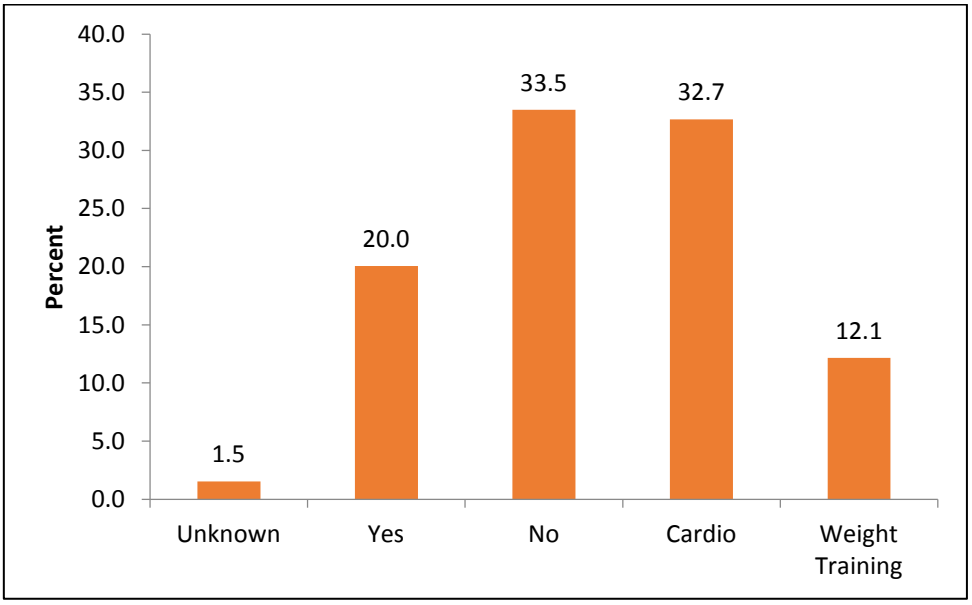

Figure 4.9 Level of physical activity of the sample (N=848)

Table 4.33 Level of physical activity of the sample (N=848)

		Frequency	Percent
Valid	Unknown	13	1.5
	Yes	170	20.0
	No	284	33.5
	Cardio	277	32.7
	Weight Training	103	12.1
	Total	847	99.9
Missing		1	0.1
Total		848	100.0

Table 4.34 Level of physical activity relative to gender (N=848)

			Gender		Total
			Male	Female	
Physical activity	Not documented	Count	6	7	13
		% within Gender	1.3	1.8	1.5
	Yes	Count	98	72	170
		% within Gender	21.6	18.3	20.1
	No	Count	123	161	284
		% within Gender	27.1	41.0	33.5
	Cardio	Count	157	119	276
		% within Gender	34.6	30.3	32.6
	Weight training	Count	70	34	104
		% within Gender	15.4	8.7	12.3
Total		Count	454	393	847
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 24.394

4.4.6.2.3 BLOOD PRESSURE ABNORMALITIES

Blood pressure readings recorded at the initial visit were classified into six categories. Figure 4.10 demonstrates the blood pressure recordings of the total sample. The majority of the sample were categorised as normotensive (58.7%) while 40.3% had blood pressure abnormalities. Of the 342 with blood pressure abnormalities, 67.8% were pre-hypertensive and 20% had Grade I hypertension. Blood pressure could not be recorded in eight (0.9%) clinic files. This was as a result of the patient being either too small (e.g. paediatric patients) or too large (e.g. overweight/obese patients). As the information stated in Table 4.35 suggest, there was a statistically significant difference in blood pressure abnormalities between the two genders (p=0.001; Fisher Exact test), blood pressure abnormalities were more frequently recorded in males who presented to the DUT CDC.

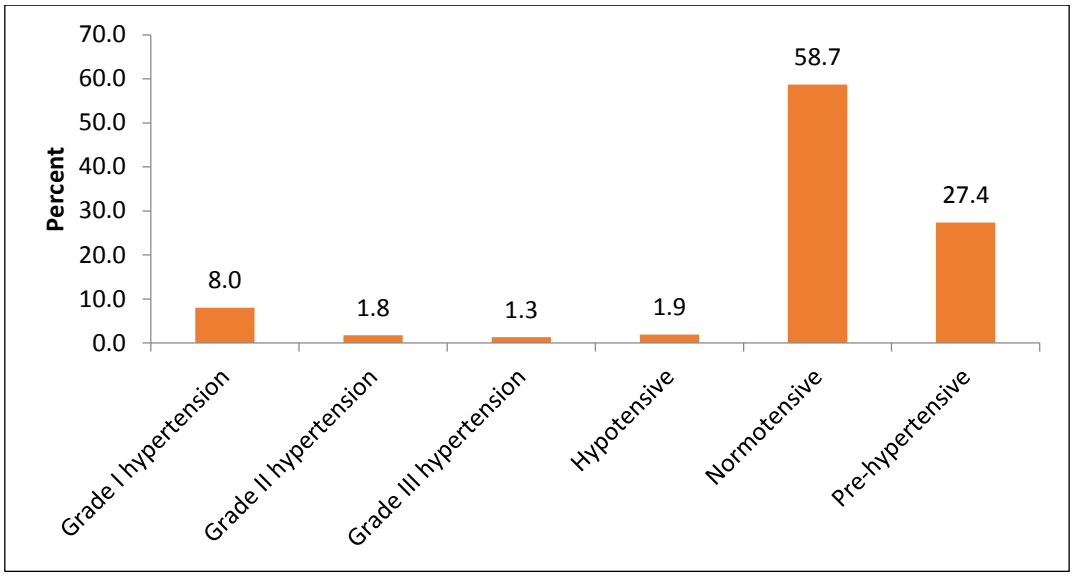

Figure 4.10 Blood pressure recordings of the total sample at the initial visit to the DUT CDC

Table 4.35 Blood pressure recordings at the initial visit to the DUT CDC

		Frequency	Percent
Valid	Grade I	68	8.0
	Grade 2	15	1.8
	Grade 2I	11	1.3
	Hypotensive	16	1.9
	Normotensive	498	58.7
	Prehypertensive	232	27.4
	Total	840	99.1
Missing		8	0.9
Total		848	100.0

Figure 4.11 demonstrates the blood pressure recordings of the patients who demonstrated a history of CVD. In the subsample, 36.8% were pre-hypertensive followed by normotensive (35.4%) and Grade I hypertension (18.9%). Only 1.4% of this sample was hypotensive. Significant variation (p=<0.001; Fisher Exact test) in the types of blood pressure abnormalities were observed between the sample (N=848) and subsample (n=214).

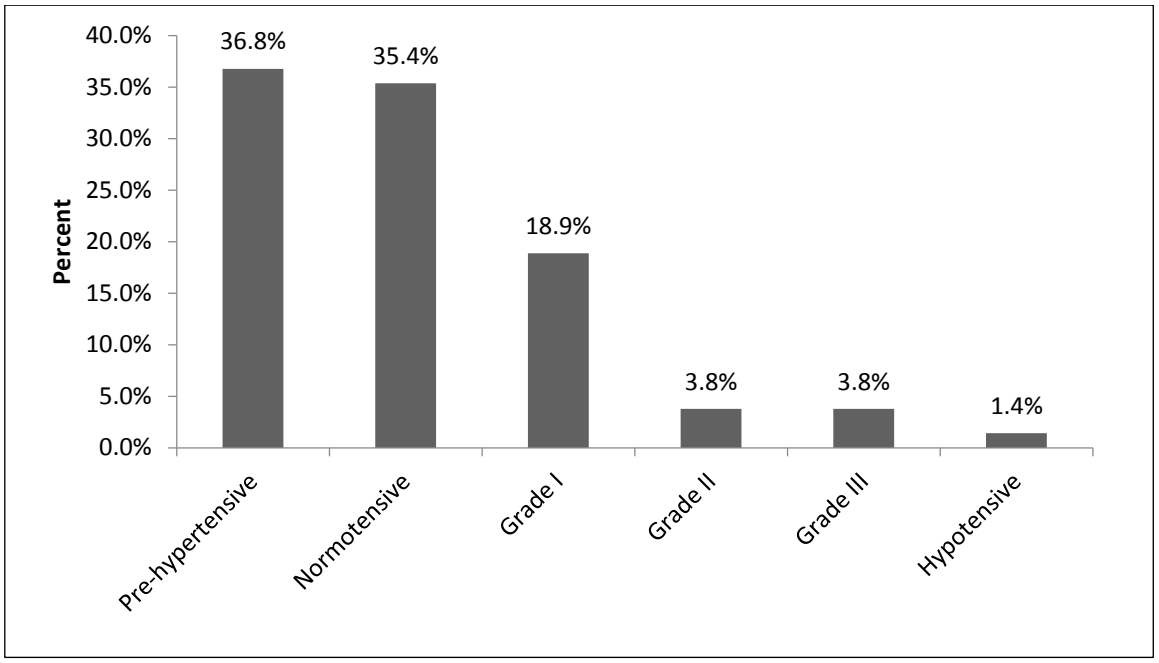

Figure 4.11 Blood pressure recordings of CVD patients who presented to the DUT CDC

Table 4.36 Blood pressure recordings of the subsample (n=214) relative to the total sample (N=848)

			CVD	Non-CVD	Total
Category	**Grade I**	Count	40	28	68
		% within group	18.9	4.5	8.1
		% of Total	4.8	3.3	8.1
	Grade 2	Count	8	7	15
		% within group	3.8	1.1	1.8
		% of Total	1.0	0.8	1.8
	Grade 2I	Count	8	3	11
		% within group	3.8	0.5	1.3
		% of Total	1.0	0.4	1.3
	Hypotensive	Count	3	13	16
		% within group	1.4	2.1	1.9
		% of Total	0.4	1.5	1.9
	Normotensive	Count	75	423	498
		% within group	35.4	67.4	59.3
		% of Total	8.9	50.4	59.3
	Prehypertensive	Count	78	154	232
		% within group	36.8	24.5	27.6
		% of Total	9.3	18.3	27.6
Total		Count	212	628	840
		% within group	100.0	100.0	100.0
		% of Total	25.2	74.8	100.0

Pearson chi-square test 96.411

Table 4.37 Blood pressure recordings relative to gender (N=848)

			Gender		
			Male	**Female**	**Total**
Blood pressure	Not recorded	Count	4	3	7
		% within Gender	0.9	0.8	0.8
	Grade I	Count	40	28	68
		% within Gender	8.8	7.1	8.0
	Grade II	Count	12	3	15
		% within Gender	2.6	0.8	1.8
	Grade III	Count	5	6	11
		% within Gender	1.1	1.5	1.3
	Hypotensive	Count	2	14	16
		% within Gender	0.4	3.6	1.9
	Normotensive	Count	253	245	498
		% within Gender	55.7	62.3	58.8
	Prehypertensive	Count	138	94	232
		% within Gender	30.4	23.9	27.4
Total		Count	454	393	847
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 20.940

4.4.6.2.4 TOBACCO USE

From Figure 4.12 it would seem that the majority of the total number of files (N=848), are non-smokers followed by those who have not previously smoked. Greater than 18% of the sample were currently smoking and 17.7% had previously smoked at the initial visit to the DUT CDC. Table 4.37 demonstrates the frequency of smoking in the total sample. Comparison of smoking status between male and female, yielded statistically insignificant results for current smokers (p=0.137; Fisher Exact test). However, a significant relationship was found between the number of ex-smokers (p=0.095; Fisher Exact test), as more males were recorded to be ex-smokers.

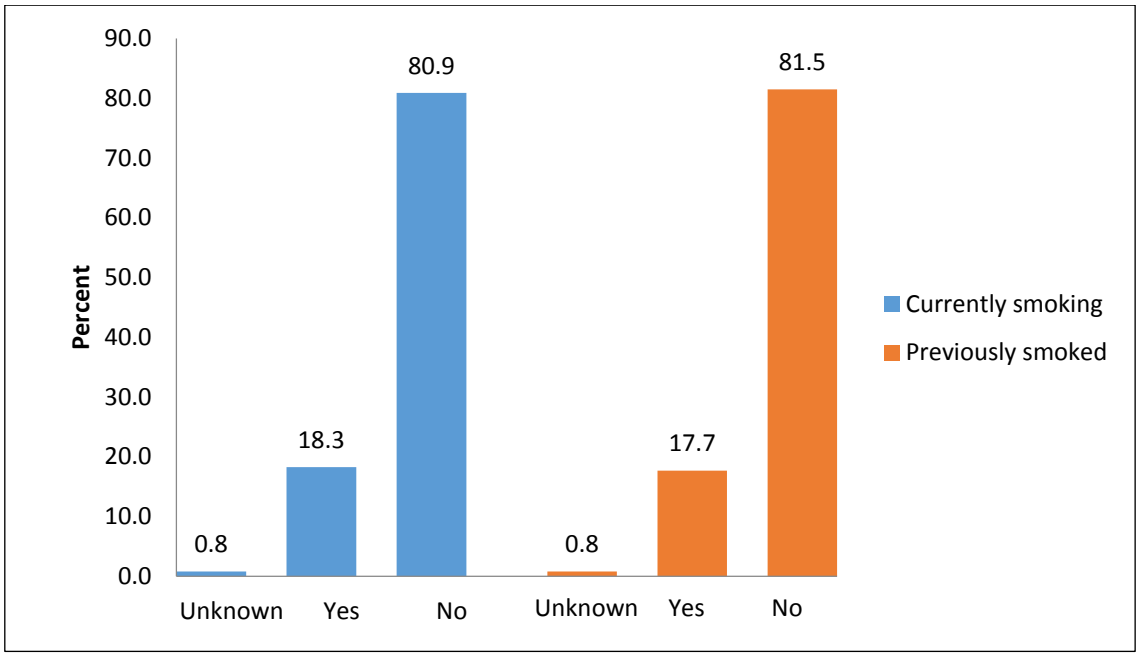

Figure 4.12 Smoking status of the sample (N=848)

Table 4.38 Smoking status of the sample (N=848)

	Currently smoking	Frequency	Percent
Valid	Unknown	7	0.8
	Yes	155	18.3
	No	686	80.9
	Total	848	100.0
	Previously smoked	**Frequency**	**Percent**
	Unknown	7	0.8
	Yes	150	17.7
	No	691	81.5
	Total	848	100.0

Table 4.39 Current smoking status relative to gender (N=848)

			Gender		Total
			Male	Female	
Currently smoking	Not documented	Count	4	3	7
		% within Gender	0.9	0.8	0.8
	Yes	Count	94	61	155
		% within Gender	20.7	15.5	18.3
	No	Count	356	330	686
		% within Gender	78.4	83.8	80.9
Total		Count	454	394	848
		% within Gender	100.0	100.0	100.0

Pearson chi-square test invalid due to low cell counts

4.40 Previous smoking status relative to gender (N=848)

			Gender		
			Male	Female	Total
Previously smoked	Not documented	Count	4	3	7
		% within Gender	0.9	0.8	0.8
	Yes	Count	92	58	150
		% within Gender	20.3	14.7	17.7
	No	Count	358	333	691
		% within Gender	78.9	84.5	81.5
Total		Count	454	394	848
		% within Gender	100.0	100.0	100.0

Pearson chi-square test invalid due to low cell counts

4.4.6.2.5 ALCOHOL USE

A large percentage of the total sample was documented to not use alcohol (53.3%). However, almost half of the sample was currently consuming alcohol (46.3%). Alcohol consumption was only omitted in 0.4% of clinic files. Table 4.40 shows the frequency of alcohol use in the sample. Table 4.41 illustrates that there was a significant variation in alcohol use by male and female patients (*p*=<0.001; Fisher Exact test), in that males were more likely to consume alcohol.

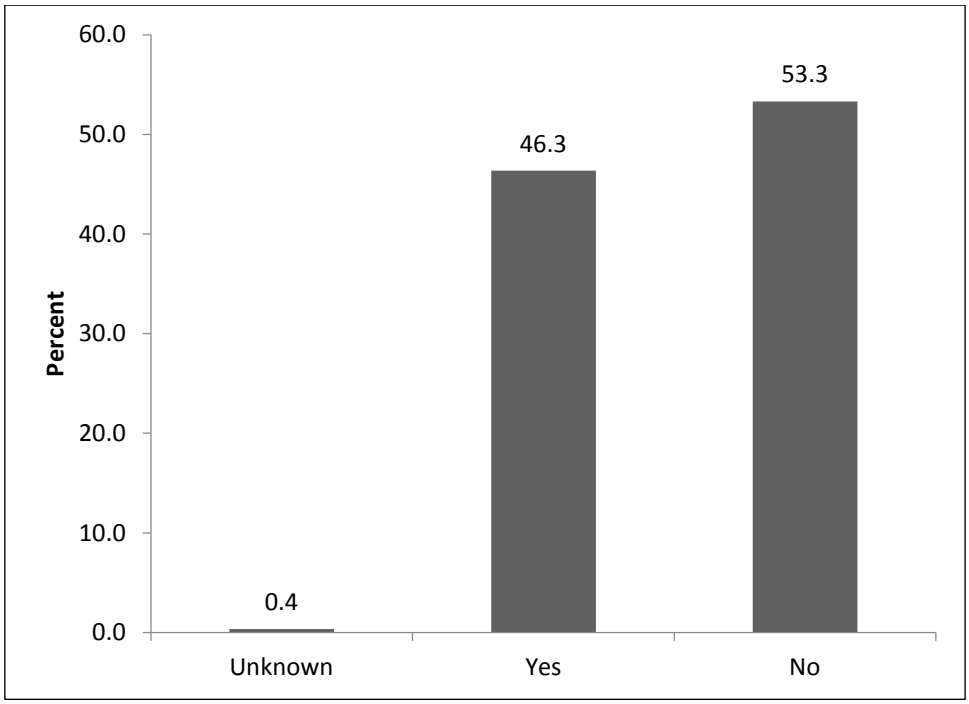

Figure 4.13 Alcohol use in the total sample (N=848)

Table 4.41 Alcohol use in the total sample (N=848)

		Frequency	Percent
Valid	Unknown	3	0.4
	Yes	393	46.3
	No	452	53.3
	Total	848	100.0

Table 4.42 Alcohol use relative to gender (N=848)

			Gender		
			Male	Female	Total
Alcohol use	Not documented	Count	2	1	3
		% within Gender	0.4	0.3	0.4
	Yes	Count	244	149	393
		% within Gender	53.7	37.5	46.3
	No	Count	208	244	452
		% within Gender	45.8	61.9	53.3
Total		Count	454	394	848
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 27.753

4.4.6.2.6 DIET

Figure 4.14 indicates the diet preferences of the total sample. More than 10% were high in fat and 7.4% high in carbohydrates. In a large percentage of the sample diet specifications were not noted. This was documented as unspecified which constitutes 71.5% of the sample. Table 4.42 compares the diet preferences of the total sample (N=848). It can be seen from Table 4.43 that there is a statistically insignificant difference in the dietary preferences between male and females (p=0.431; Fisher Exact test).

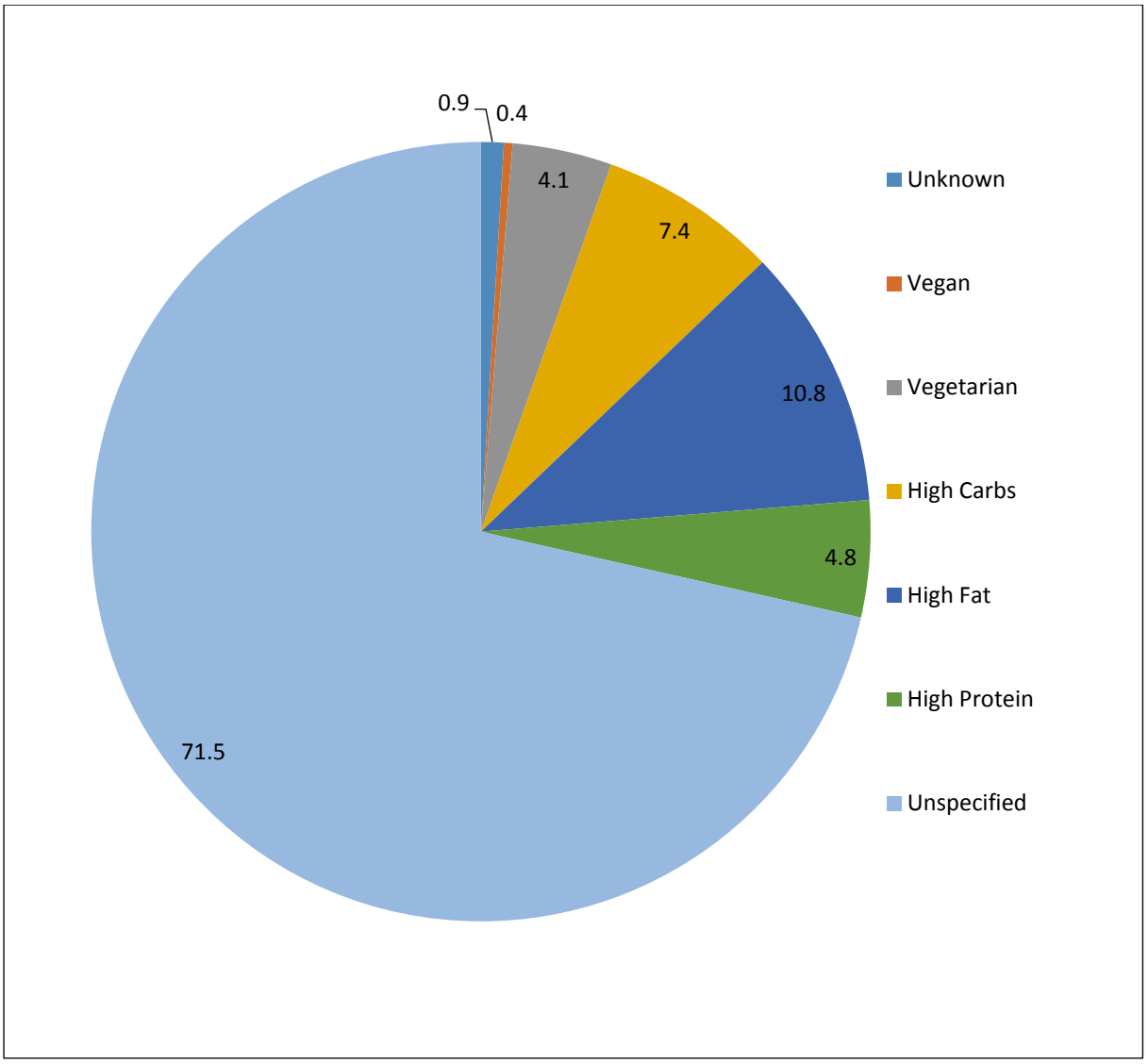

Figure 4.14 Diet distribution of the sample (N=848)

Table 4.43 Comparison of diet distribution of the sample

		Frequency	Percent
Valid	Unknown	8	0.9
	Vegan	3	0.4
	Vegetarian	35	4.1
	High Carbs	63	7.4
	High Fat	92	10.8
	High Protein	41	4.8
	Unspecified	606	71.5
	Total	848	100.0

Table 4.44 Diet distribution relative to gender (N=848)

			Gender		
			Male	Female	Total
Diet	Not documented	Count	5	3	8
		% within Gender	1.1	0.8	0.9
	Vegan	Count	1	1	2
		% within Gender	0.2	0.3	0.2
	Vegetarian	Count	14	21	35
		% within Gender	3.1	5.3	4.1
	High carbohydrate	Count	31	32	63
		% within Gender	6.8	8.1	7.4
	High fat	Count	47	45	92
		% within Gender	10.4	11.4	10.8
	High protein	Count	25	16	41
		% within Gender	5.5	4.1	4.8
	Unspecified	Count	332	275	607
		% within Gender	73.1	69.8	71.6
Total		Count	454	394	848
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 7.904

4.4.6.2.7 DIABETES MELLITUS

In total only 9.8% of the total sample had diabetes mellitus (DM), as shown in Table 4.45. Of the 78 who had DM, 74.4% had unspecified DM followed by 18% who had Type 2 DM. Figure 4.52 demonstrates the portion of the sample (N=848) who had a combination of DM and other endocrine diseases in addition to those who had DM only. The most frequent combination was unspecified DM and hypothyroidism (0.4%). A comparison of the prevalence of endocrine disorders between male and female yielded statistically insignificant results (*p*=0,778; Fisher Exact) and the % in males and females were almost identical. Thus, endocrine disorders were equally prevalent in both genders.

Table 4.45 Type and frequency of diabetes mellitus demonstrated in the sample (N=848)

		Frequency	Percent
Valid	Unspecified diabetes mellitus	58	6.8
	Type 2 diabetes mellitus	14	1.6
	Type I diabetes mellitus	3	0.4
	Gestational diabetes mellitus	3	0.4
	Total	**78**	**9.2**

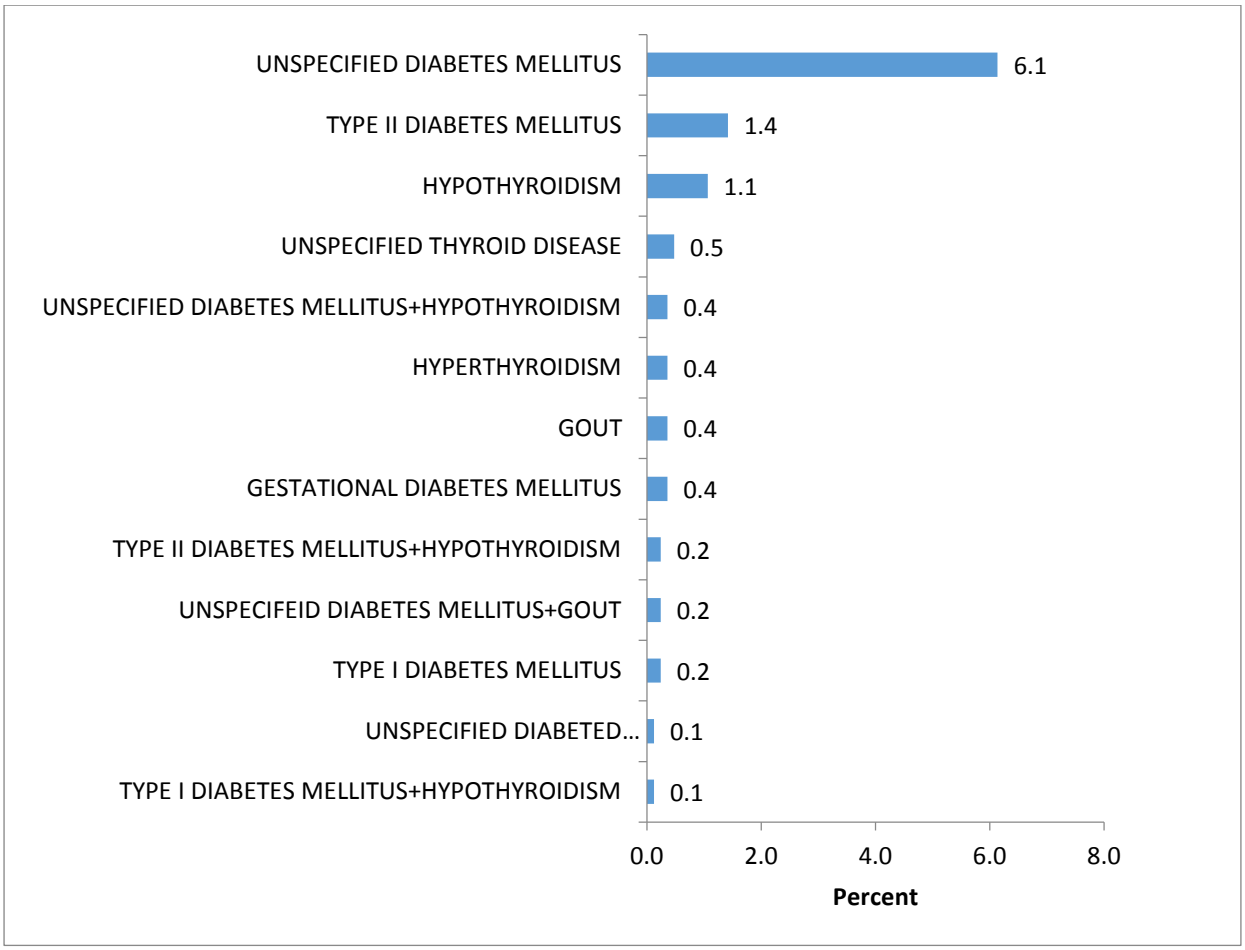

Figure 4.15 Frequency of DM and combinations of DM with other endocrine disease in the sample (N=848)

Table 4.46 DM and combinations of DM with other endocrine disease relative to gender

			Gender		
			Male	Female	Total
Endocrine disorders	NO	Count	403	348	751
		% within Gender	88.8	88.6	88.6
	YES	Count	51	46	97
		% within Gender	11.2	11.8	11.4
Total		Count	454	394	848
		% within Gender	100.0	100.0	100.0

Pearson chi-square test invalid due to low cell count

4.4.6.2.8 CONNECTIVE TISSUE DISEASE

In the total sample only 1.1% had a pre-existing connective tissue disease. Rheumatoid arthritis (0.8%) was the most frequently reported connective tissue disease. The frequency and specific types of connective tissue diseases documented in the sample are shown in Table 4.47.

Table 4.47 Frequency and type of connective tissue disease in the sample (N=848)

		Frequency	Percent
Valid	Systemic lupus erythematosus	1	0.1
	Rheumatoid arthritis	7	0.8
	Ankylosing spondylitis	1	0.1
	Mixed connective tissue disorder	1	0.1
	Total	**10**	**1.1**

4.4.6.2.9 HYPERCHOLESTEROLAEMIA

While up to 92 patients had a history of peripheral vascular disease (PVDs), only 6 had a combination of hypercholesterolaemia and other PVDs. Seventy-four (74) had a history of hypercholesterolaemia only. Table 4.48 shows the combination of frequency of the combination of hypercholesterolaemia and other PVDs. As the information stated in Table 4.49 indicates, there was a statistically significant difference (p=0.004; Fisher Exact test) in the frequency of PVDs between the two genders. PVDs were more frequently reported in females.

Table 4.48 Frequency of hypercholesterolaemia with/without other peripheral vascular disease in the sample

		Frequency	Percent
Valid	Hypercholesterolaemia	74	8.7
	Hypercholesterolaemia and varicose veins (VVs)	3	0.4
	Unspecified peripheral vascular disease	2	0.2
	Hypercholesterolaemia and DVT	1	0.1
Total		**92**	**10.8**

Table 4.49 Prevalence of PVDs relative to gender (N=848)

			Gender		
			Male	Female	Total
Peripheral vascular disease	NO	Count	418	339	757
		% within Gender	92.1	86.1	89.3
	YES	Count	36	55	91
		% within Gender	7.9	14.0	10.7
Total		Count	454	394	848
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 9.234

4.4.6.2.10 USE OF SPECIFIC MEDICATIONS

From the Table 4.50, it is evident that a large variety of both prescription and over-the-counter medications that may induce CVD in previously healthy individuals or exacerbate

pre-existing CVD, were documented in the sample. Of the 426 patients, the most frequently used medications were NSAIDs (12.5%) followed by analgesics (9.4%) and anti-diabetics (7.3%). Other less frequently used medications are listed in Table 4.50. The higher total of this table versus the total number of patients is attributable to the use of more than one type of prescription and/or over-the-counter medications by a large number of patients. Based on the information stated in Table 4.51, it is evident that gender affected the use of non-cardiac medication. More females reported the use of NSAIDs (p=0.001; Fisher Exact test), OCP (p=<0.001; Fisher Exact test), thyroid agents (p=0.005; Fisher Exact test), corticosteroids (p=0.007; Fisher Exact test) and unspecified analgesics (p=0.007; Fisher Exact test).

Table 4.50 Frequency of the use and type of non-cardiac medication in the sample (N=848)

Drug class		Frequency	Percent
Analgesics	Unspecified analgesics	80	9.4
	Cox 2 inhibitors	1	0.1
	Non-steroidal anti-inflammatory (NSAIDs)	106	12.5
Antidepressants		25	3.0
Anti-diabetics/antihyperglycaemic agents		62	7.3
Anti-epileptics		19	2.2
Anti retrovirals		9	1.1
Anti-psychotics		5	0.6
Anti-rheumatics		6	0.7
Corticosteroids		30	3.5
Hormones/ contraception	Hormone replacement therapy (HRT)	13	1.5
	Intramuscular contraceptive injection	4	0.5
	Oral contraceptive pill (OCP)	19	2.2
	Fertility treatment	1	0.1
	Androgen therapy	1	0.1
Proton pump inhibitors		16	2.0
Recreational/performance enhancing		9	1.1
Steroids		4	0.4
Thyroid agents		16	2.0
Total		**426**	**50.3**

Table 4.51 Use of non-cardiac medication relative to gender

Non-cardiac medication			Gender		Total
			Male	Female	
Analgesics	Unspecified analgesics	Count	31	49	80
		% within Gender	3.7	5.8	9.4
	COX 2 inhibitors	Count	1	0	1
		% within Gender	0.1	0.0	0.1
	NSAIDs	Count	40	66	106
		% within Gender	4.7	7.8	12.5
Antidepressants		Count	8	17	25
		% within Gender	0.9	2.0	2.9
Anti-diabetics		Count	30	32	62
		% within Gender	3.6	3.8	7.4
Anti-epileptics		Count	6	13	19
		% within Gender	0.7	1.5	2.2
Anti-retrovirals		Count	3	6	9
		% within Gender	0.4	0.7	1.1
Anti-psychotics		Count	3	2	5
		% within Gender	0.3	0.2	0.6
Anti-rheumatics		Count	2	4	6
		% within Gender	0.2	0.5	0.7
Corticosteroids		Count	14	16	30
		% within Gender	1.7	1.9	3.5
Hormones/contraception	HRT	Count	3	10	13
		% within Gender	0.4	1.2	1.5
	Intramuscular contraceptive injection	Count	0	4	4
		% within Gender	0.0	0.5	0.5
	OCP	Count	0	19	19
		% within Gender	0.0	2.2	2.2
	Fertility treatment	Count	0	1	1
		% within Gender	0.0	0.1	0.1
	Androgen therapy	Count	1	0	1
		% within Gender	0.1	0.0	0.1
Proton pump inhibitors		Count	11	5	16
		% within Gender	1.3	0.6	1.9
Recreational/performance enhancing		Count	7	2	9
		% within Gender	0.8	0.2	1.1
Steroids		Count	2	2	4
		% within Gender	0.2	0.2	0.5
Thyroid agents		Count	3	13	16
		% within Gender	0.4	1.5	1.9
Total		Count	165	261	426
		% within Gender	19.6	30.7	50.3

Pearson chi-square test invalid due to low cell counts

4.4.6.2.11 MENTAL WELLNESS

Psychological wellness was documented in 21.5% of the sample. Of the 182, the most frequently reported social factor was depression (34%) followed by anxiety (32.4%) and stress (26.4%). Other less frequently reported social factors are listed in Table 4.52.

Table 4.52 Frequency of psychological wellness in the total sample (N=848)

		Frequency	Percent
Valid	Depression	62	7.3
	Anxiety	59	7.0
	Stress	48	5.7
	Anxiety and stress	12	1.4
	Anxiety, stress and mood swings	1	0.1
Total		182	21.5

4.4.7 PREVALENCE OF NON-MODIFIABLE AND MODIFIABLE RISK FACTORS IN CVD PATIENTS WHO PRESENTED TO THE DUT CDC

A lack of the management of modifiable risk factors has been demonstrated to affect the prognosis of CVD in patients with pre-existing CVD. Some of the risk factors that influence the prevalence of CVD in this population included modifiable risk factors such as hypertension, hypercholesterolaemia, tobacco use, harmful use of alcohol, obesity, physical inactivity, unhealthy diet, diabetes mellitus (WHO, 2013a), metabolic syndrome (Seaman *et al.*, 2014), connective tissue disease (Husain *et al.*, 2010) and the use of specific medications that may exacerbate pre-existing CVD (American Heart Association, 2016).

4.4.7.1 NON-MODIFIABLE RISK FACTORS

Age, gender and race which have been identified as non-modifiable risk factors for CVD, have been discussed under 4.4.5 as demographics of CVD patients who presented to the DUT CDC.

4.4.7.1.1 FAMILY HISTORY OF CVD

Majority (89.7%) of the subsample (n=214) had a family history of CVD. A large percentage had a family history of multiple CVDs (24.8%). Of the 192 with a family history of CVD, 22.0% had HTN and 14.1% had PVD. In 23 (10.7%) files the type of CVD was not specified, these were documented as unspecified heart disease.

The family history of CVD in the subsample (n=214) is similar to that of the total sample however, higher frequencies were noted in the subsample. Table 4.59 demonstrates the other CVDs documented in the family history of CVD patients.

Table 4.53 Distribution of family history of CVD of patients with a diagnosed CVD who presented to the DUT CDC

		CVD sample (*n*=214)	
Group	**Subgroup**	**Frequency**	**Percentage**
	Unspecified heart disease	23	10.7
Subtotal		**23**	**10.7**
Peripheral vascular disease (PVD)	Hypercholesterolaemia	23	10.7
	Hypercholesterolaemia and VVs	3	1.4
	VVs	1	0.5
	DVT	0	0.0
	Unspecified PVD	1	0.5
	Thrombosis	1	0.5
	Aneurysm	1	0.5
	Hypercholesterolaemia and DVT	0	0.0
Subtotal		**30**	**14.1**
Hypertensive heart disease	HTN	47	22.1
	Hypotension	1	0.5
Subtotal		**48**	**22.6**
Cerebrovascular disease	CVA	23	10.7
	Transient ischaemic attack	1	0.5
Subtotal		**24**	**11.2**
Valvular heart disease	Unspecified valvular heart disease	0	0.0
	RHD	0	0.0
Subtotal		**0**	**0.0**
Coronary heart disease	MI	22	10.3
	Angina	2	0.9
Subtotal		**24**	**11.2**
Combinations	HTN and CVA	16	7.5
	HTN and MI	8	3.7
	HTN, CVA and MI	3	1.4
	MI and CVA	5	2.3
	HTN and angina	1	0.5
	CVA and coronary heart disease	1	0.5
	MI and coronary heart disease	2	0.9
	HTN and hypotension	1	0.5
	CVA and VSD	0	0.0
	CVA and HF	0	0.0
	HTN and CCF	1	0.5
	HTN, CVA and arrhythmia	1	0.5
	Coronary heart disease and CCF	0	0.0
	Coronary heart disease and pre-ecclampsia	0	0.0
	CVA and valvular heart disease	0	0.0
	CVA and hypotension	0	0.0
	HTN and arrhythmia	0	0.0
	HTN and HF	1	0.5
	PE, MI and CVA	1	0.5
	MI, CVA and CCF	1	0.5
	MI, coronary heart disease and CCF	1	0.5
	MI, CVA and RF	0	0.0
Subtotal		**43**	**24.8**
Heart failure	Unspecified HF	0	0.0
	CCF	0	0.0
Subtotal		**0**	**0.0**
TOTAL		**192**	**89.7**

4.4.7.2 MODIFIABLE RISK FACTORS

4.4.7.2.1 OVERWEIGHT AND OBESITY

This risk factor has been discussed previously in Section 4.3.5.4, and revealed that the mean weight in the subsample was 79.0 and the mean BMI was 28.8. A statistically significant difference in the weight distribution between male and female (p=0.001; Fisher Exact test) was identified, however, as well as a significant difference in the BMI between the genders (p=0.037; Fisher Exact test) with females having a higher mean BMI than the male gender.

4.4.7.2.2 PHYSICAL INACTIVITY

The level of physical activity of patients recorded at the initial visit was documented as YES (if it was simply recorded as yes), NO (if simply recorded as no), UNKNOWN (if recorded as yes but the type of exercise was unclear), CARDIO or WEIGHT TRAINING (if recorded as yes and the type of exercise was noted). Figure 4.16 shows that a greater part of CVD patients did not engage in any form of physical activity (50.7%). Cardio (23.9%) was the most frequent type of physical activity documented followed by weight training (6.5%). The type of physical activity was unknown in only 1.4%. Table 4.53 illustrates that there is no statistically significant variation in the level of physical activity between male and females (p=0.121; Fisher Exact test). Females who presented to the DUT CDC tended to be less physically active compared to males.

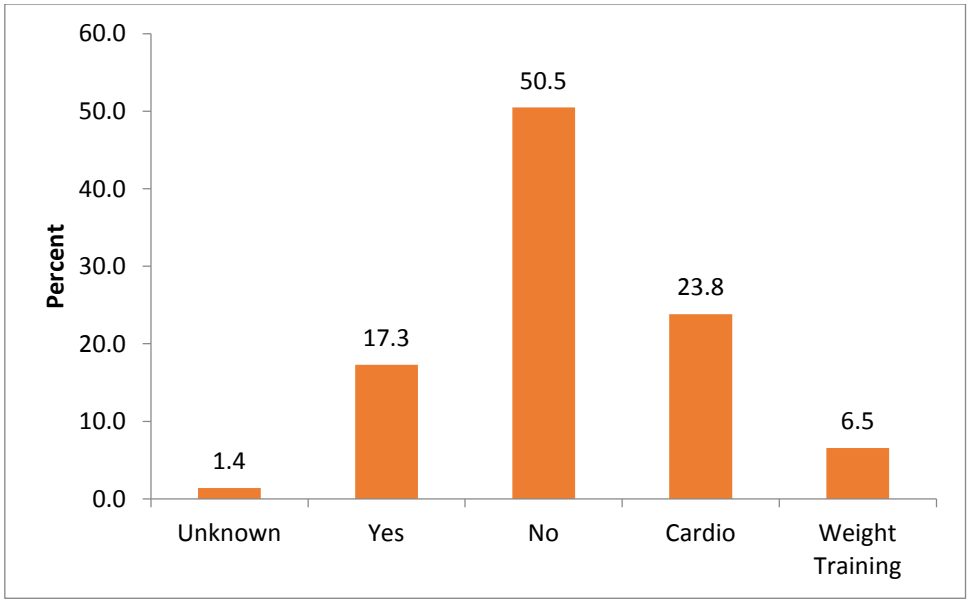

Figure 4.16 Level of physical activity of the sample (n=214)

Table 4.54 Level of physical activity of CVD patients relative to gender

			Gender		Total
			Male	Female	
Physical activity	Unknown	Count	1	2	3
		% within Gender	1.0	1.7	1.4
	Yes	Count	19	18	37
		% within Gender	19.4	15.7	17.4
	No	Count	42	66	108
		% within Gender	42.9	57.4	50.7
	Cardio	Count	26	25	51
		% within Gender	26.5	21.7	23.9
	Weight Training	Count	10	4	14
		% within Gender	10.2	3.5	6.6
Total		Count	98	115	213
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 6.972

4.4.7.2.3 BLOOD PRESSURE ABNORMALITIES

Figure 4.17 demonstrates the blood pressure recordings of the patients who demonstrated a history of CVD. In the subsample 36.8% were pre-hypertensive followed by normotensive (35.4%) and Grade I hypertension (18.9%). Only 1.4% of the subsample was hypotensive. Based on the information stated in Table 4.54, there was a non-statistically significant gender variation in blood pressure (p=0.417; Fisher Exact test), although more females had normal blood pressure reading than males.

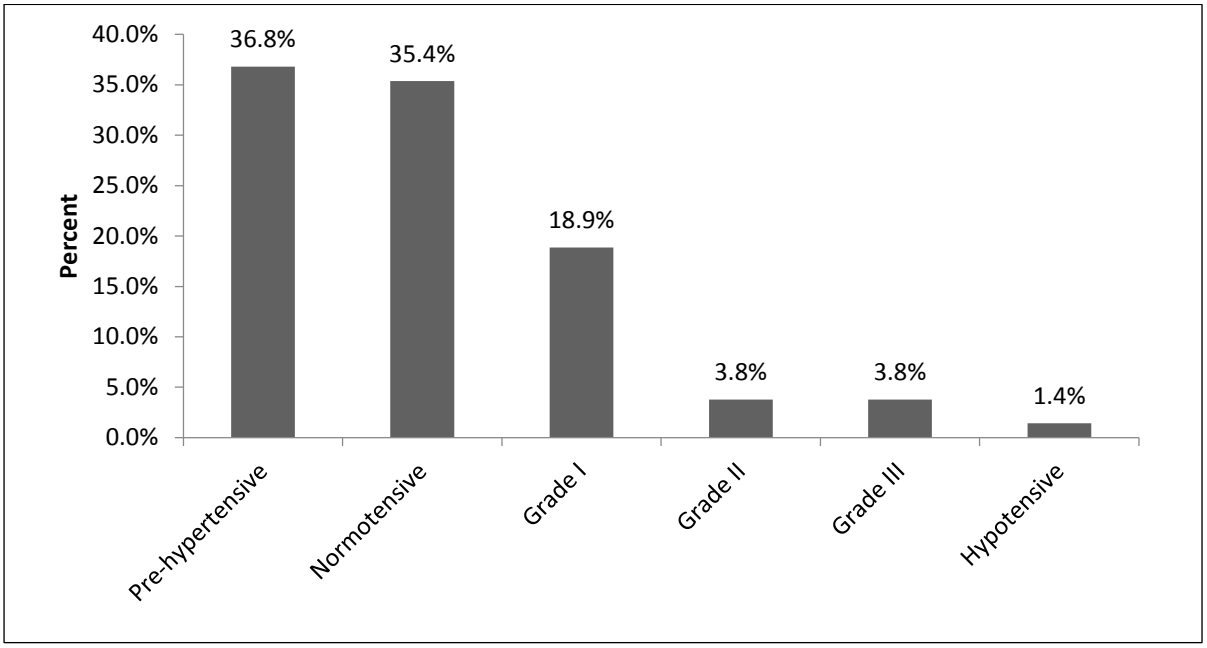

Figure 4.17 Blood pressure recordings of CVD patients who presented to the DUT CDC

Table 4.55 Blood pressure recordings of CVD patients relative to gender

			Gender		Total
			Male	Female	
Blood pressure recordings	**Grade I**	Count	20	20	40
		% within Gender	20.4	17.5	18.9
	Grade 2	Count	5	3	8
		% within Gender	5.1	2.6	3.8
	Grade 2I	Count	4	4	8
		% within Gender	4.1	3.5	3.8
	Hypotensive	Count	0	3	3
		% within Gender	0.0	2.6	1.4
	Normotensive	Count	30	45	75
		% within Gender	30.6	39.5	35.4
	Prehypertensive	Count	39	39	78
		% within Gender	39.8	34.2	36.8
Total		Count	98	114	212
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 5.323

4.4.7.2.4 TOBACCO USE

From Figure 4.18 it would seem that the majority of the subsample (n=214), are non-smokers (87.4%) followed by those who have not previously smoked (83.6%). 12.1% were currently smoking and 15.9% has previously smoked at the initial visit to the DUT CDC. Tables 4.56 and 4.57 demonstrate the frequency of smoking in the subsample. Cross tabulations of smoking status between male and female, yielded statistically insignificant results (p=0.202 for current smokers and p=0.208 for ex-smokers), although more males were recorded to be current smokers in addition to ex-smokers.

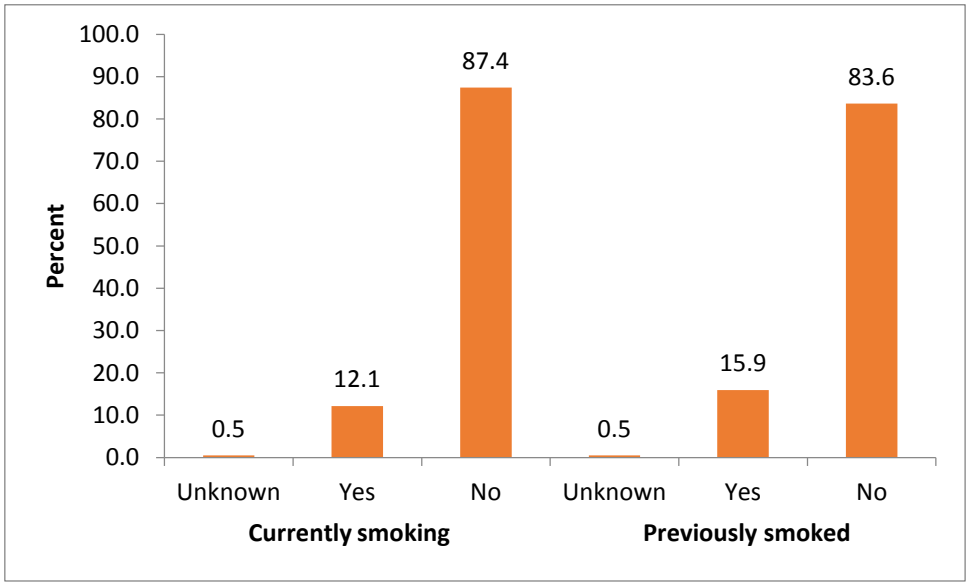

Figure 4.18 Smoking status of the sample (n=214)

Table 4.56 Current smoking status of CVD patients relative to gender

			Gender		
			Male	Female	Total
Currently smoking	Yes	Count	15	11	26
		% within Gender	15.3	9.6	12.1
	No	Count	83	104	187
		% within Gender	84.7	90.0	87.4
Total		Count	98	115	213
		% within Gender	100.0	100.0	100.0

Pearson chi-square test invalid due to low cell counts

Table 4.57 Previous smoking status of CVD patients relative to gender

			Gender		
			Male	Female	Total
Previously smoked	Yes	Count	19	15	34
		% within Gender	19.4	13.0	15.9
	No	Count	79	100	179
		% within Gender	80.6	87.0	83.6
Total		Count	98	115	213
		% within Gender	100.0	100.0	100.0

Pearson chi-square test invalid due to low cell counts

4.4.7.2.5 ALCOHOL USE

A large percentage of the subsample were documented to not use alcohol (62.1%). However, more than two thirds of the subsample were currently consuming alcohol (37.9%). Table 4.57 illustrates, that there was a significant variation in alcohol use by male and female patients (p=0.001; Fisher Exact test), in that males were more likely to consume alcohol.

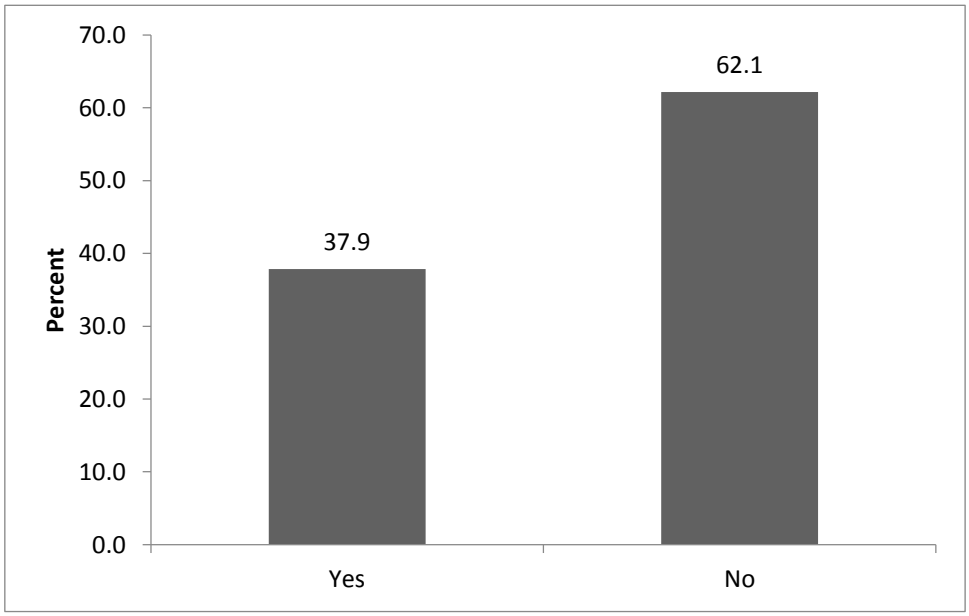

Figure 4.19 Alcohol use in the sample (n=214)

Table 4.58 Alcohol consumption of CVD patients relative to gender

			Gender		
			Male	Female	Total
Alcohol use	Yes	Count	49	32	81
		% within Gender	50.0	27.6	37.9
	No	Count	49	84	133
		% within Gender	50.0	72.4	62.1
Total		Count	98	116	214
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 11.345

4.4.7.2.6 DIET

Figure 4.20 indicates the diet preferences of the subsample, 4.2% were high in fat and 13.6% high in carbohydrates. In a large percentage of the sample diet specifications were not noted. This was documented as unspecified which constitutes 70.6% of the subsample. It can be seen from Table 4.58 that there is a statistically insignificant difference in the dietary preferences between male and females (p=0.119; Fisher Exact test).

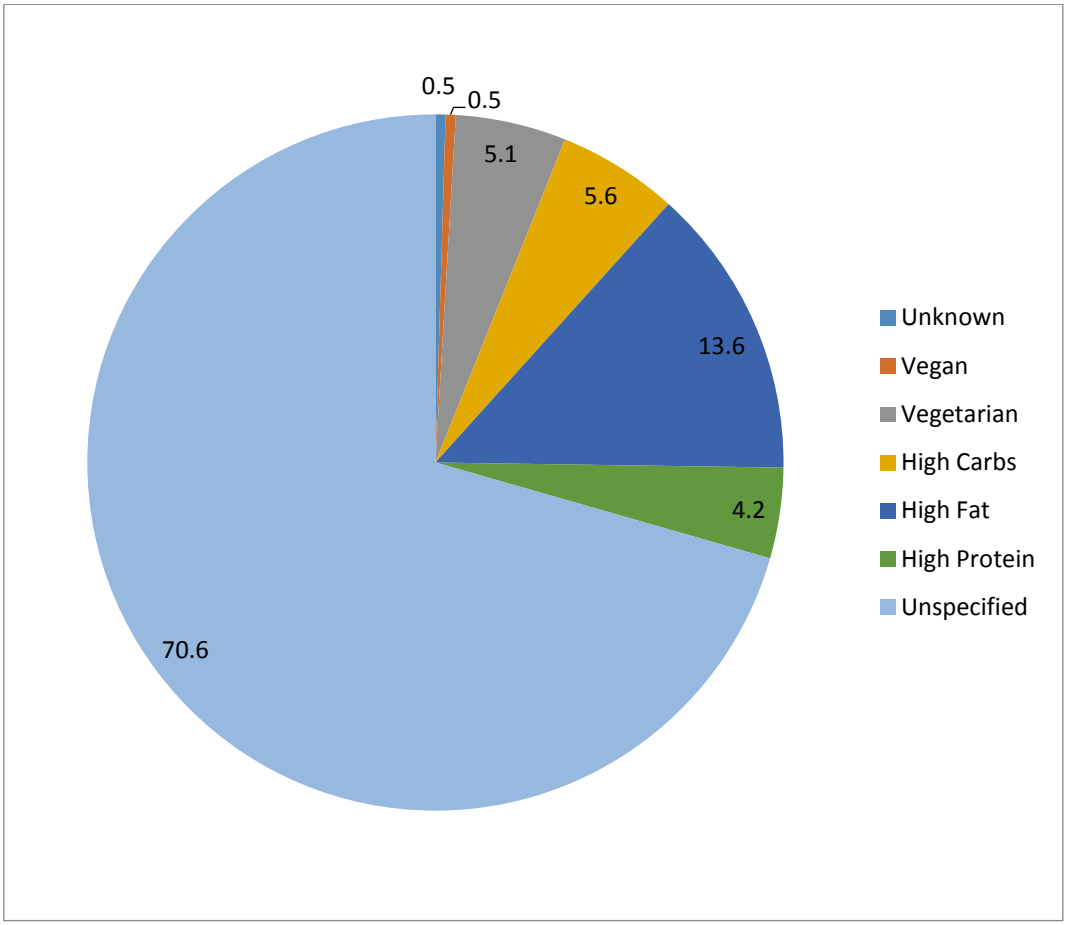

Figure 4.20 Diet distribution of the sample (*n*=214)

Table 4.59 Diet distribution relative to gender

			Gender		
			Male	Female	Total
Diet	Vegan	Count	1	0	1
		% within Gender	1.0	0.0	0.5
	Vegetarian	Count	4	7	11
		% within Gender	4.1	6.1	5.1
	High Carbs	Count	2	10	12
		% within Gender	2.0	8.7	5.6
	High Fat	Count	10	19	29
		% within Gender	10.2	16.4	13.6
	High Protein	Count	5	4	9
		% within Gender	5.1	3.4	4.2
	Unspecified	Count	76	75	151
		% within Gender	77.6	65.0	70.6
Total		Count	98	115	213
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 8.761

4.4.7.2.7 DIABETES MELLITUS

In total, 22.0% of the subsample had DM, as shown in Table 4.60. Of the 47 who had DM, 17.3% had unspecified DM followed by 3.7% who had Type 2 DM. Figure 4.21 demonstrates the portion of the subsample (n=214) who had a combination of DM and other endocrine diseases in addition to those who had DM only. The most frequent combination was unspecified DM and hypothyroidism (0.9%). A comparison of the prevalence of endocrine disorders between male and female yielded statistically insignificant results (*p*=0.438; Fisher Exact test), as endocrine disorders were nearly equally reported by both genders.

Table 4.60 Type and frequency of diabetes mellitus demonstrated in the subsample (n=214)

		Frequency	Percent
Valid	Unspecified diabetes mellitus	37	17.3
	Type 2 diabetes mellitus	8	3.7
	Type I diabetes mellitus	2	0.9
	Gestational diabetes mellitus	0	0.0
	Total	**47**	**22.0**

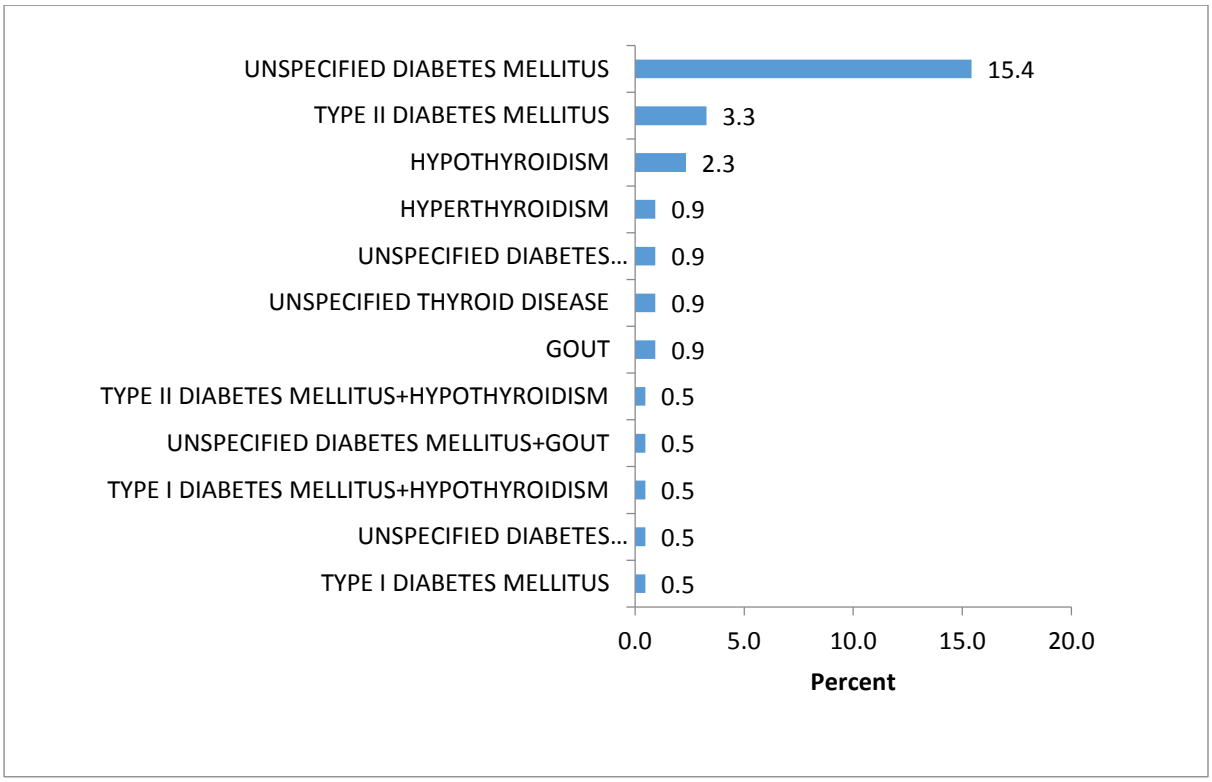

Figure 4.21 Frequency of DM and combinations of DM with other endocrine disease in the subsample (n=214)

Table 4.61 DM and combinations of DM with other endocrine disease relative to gender

			Gender		Total
			Male	Female	
Endocrine disorders	NO	Count	69	88	157
		% within Gender	70.4	75.9	73.4
	YES	Count	29	28	57
		% within Gender	29.6	24.1	26.6
Total		Count	98	116	214
		% within Gender	100.0	100.0	100.0

Pearson chi-square test invalid due to low cell count

4.4.7.2.8 CONNECTIVE TISSUE DISORDERS

In the subsample only 2.4% had a pre-existing connective tissue disease. Rheumatoid arthritis (1.9%) was the most frequently reported connective tissue disease. The frequency and specific types of connective tissue diseases documented in the subsample is shown in Table 4.62.

Table 4.62 Frequency and type of connective tissue disease in the subsample (n=214)

		Frequency	Percent
Valid	Systemic lupus erythematosus	0	0.0
	Rheumatoid arthritis	4	1.9
	Ankylosing spondylitis	0	0.0
	Mixed connective tissue disease	1	0.5
	Total	**5**	**2.4**

4.4.7.9 HYPERCHOLESTEROLAEMIA

While up to 87 patients had a history of PVDs, only 5 had a combination of hypercholesterolaemia and other PVDs. Fifty-two (52) had a history of hypercholesterolaemia only. Table 4.63 shows the frequency of the combination of hypercholesterolaemia and other PVDs. As the information stated in Table 4.64 indicates, there was a statistically insignificant difference (p=0.125; Fisher Exact test) in the frequency of PVDs between the two genders, although PVDs were more frequently reported in females.

Table 4.63 Frequency of hypercholesterolaemia with/without other PVDs in the subsample (n=214)

		Frequency	Percent
Valid	Hypercholesterolaemia	52	24.3
	Varicose veins (VVs)	27	12.6
	Hypercholesterolaemia and VVs	5	2.3
	Deep vein thrombosis (DVT)	2	0.9
	Unspecified peripheral vascular disease	1	0.5
Total		**87**	**40.7**

Table 4.64 Prevalence of PVDs relative to gender (n=214)

			Gender		
			Male	**Female**	**Total**
Peripheral vascular disease	NO	Count	64	63	127
		% within Gender	65.3	54.3	59.3
	YES	Count	34	53	87
		% within Gender	34.7	45.7	40.7
Total		Count	98	116	214
		% within Gender	100.0	100.0	100.0

Pearson chi-square test 9.234

4.4.7.2.9 USE OF SPECIFIC MEDICATION

From the table below, it is evident that a large variety of both prescription and OTC medications that may induce CVD in previously healthy individuals or exacerbate pre-existing CVD, were documented in the subsample. Of the 178 CVD patients who reported using these medications, the most frequently used medications were NSAIDs (19.2%) followed by anti-diabetics (18.2%) and unspecified analgesics (12.1%). Other less frequently used medications are listed in Table 4.65. The high frequency the use of these medications is attributable to the use of more than one type of prescription and/or OTC medications by a large number of patients. From the information stated in Table 4.66, it is evident that a there was a statistically insignificant discrepancy in the use of non-cardiac medication between the two genders (p=>0.05 for all types of medication). However, more female CVD patients reported the use of prescription and OTC medication at their initial visit to the DUT CDC.

Table 4.65 Frequency of the use and type of non-cardiac medication in the subsample (n=214)

Drug class		Frequency	Percent
Analgesics	Unspecified analgesics	26	12.1
	Cox 2 inhibitors	0	0.0
	Non-steroidal anti-inflammatory (NSAIDs)	41	19.2
Antidepressants		12	5.6
Anti-diabetics/ anti-hyperglycaemic agents		39	18.2
Anti-epileptics		5	2.3
Antiretrovirals		3	1.4
Anti-psychotics		2	0.9
Anti-rheumatics		1	0.5
Corticosteroids		13	6.1
Hormones/ contraception	Hormone replacement therapy (HRT)	5	2.3
	Intramuscular contraceptive injection	1	0.5
	Oral contraceptive pill (OCP)	6	2.8
	Fertility treatment	0	0.0
	Androgen therapy	1	0.5
Proton pump inhibitors		7	3.3
Recreational/performance enhancing		2	0.9
Steroids		2	0.9
Thyroid agents		12	5.6
Total		**178**	**83.1**

Table 4.66 Use of non-cardiac medication relative to gender

Non-cardiac medication			Gender		Total
			Male	Female	
Analgesics	Unspecified analgesics	Count	7	19	26
		% within Gender	3.3	8.9	12.1
	COX 2 inhibitors	Count	0	0	0
		% within Gender	0.0	0.0	0.0
	NSAIDs	Count	16	25	41
		% within Gender	7.5	11.7	19.2
Antidepressants		Count	5	7	12
		% within Gender	2.3	3.3	5.6
Anti-diabetics		Count	19	20	39
		% within Gender	8.9	9.3	18.2
Anti-epileptics		Count	1	4	5
		% within Gender	0.5	1.9	2.3
Anti-retrovirals		Count	1	2	3
		% within Gender	0.5	0.9	1.4
Anti-psychotics		Count	1	1	2
		% within Gender	0.5	0.5	0.9
Anti-rheumatics		Count	0	1	1
		% within Gender	0.0	0.5	0.5
Corticosteroids		Count	6	7	13
		% within Gender	2.8	3.3	6.1
Hormones/contraception	HRT	Count	1	4	5
		% within Gender	0.5	1.9	2.3
	Intramuscular contraceptive injection	Count	0	1	1
		% within Gender	0.0	0.5	0.5
	OCP	Count	0	6	6
		% within Gender	0.0	2.8	2.8
	Fertility treatment	Count	0	0	0
		% within Gender	0.0	0.0	0.0
	Androgen therapy	Count	1	0	1
		% within Gender	0.5	0.0	0.5
Proton pump inhibitors		Count	6	1	7
		% within Gender	2.8	0.5	3.3
Recreational/performance enhancing		Count	2	0	2
		% within Gender	0.9	0.0	0.9
Steroids		Count	1	1	2
		% within Gender	0.5	0.5	0.9
Thyroid agents		Count	3	9	12
		% within Gender	1.4	4.2	5.6
Total		Count	70	108	178
		% within Gender	32.7	50.5	83.2

Pearson chi-square test invalid due to low cell counts

4.4.7.2.10 MENTAL WELLNESS

Psychological wellness was documented in 26.6% of the subsample. Of the 57, the most frequently reported social factor was depression (9.4%) followed by anxiety (8.4%) and stress (6.5%). Other less frequently reported social factors are listed in Table 4.67.

Table 4.67 Frequency of psychological wellness in the subsample (n=214)

		Frequency	Percent
Valid	Depression	20	9.3
	Anxiety	18	8.4
	Stress	14	6.5
	Anxiety and stress	4	1.9
	Anxiety, stress and mood swings	1	0.5
Total		**57**	**26.6**

4.4.8 THE USE AND TYPE OF CVD MEDICATION UTILISED BY PATIENTS WHO PRESENTED TO THE AT THE DUT CDC

4.4.8.1 INCIDENCE OF CVD MEDICATION AT THE DUT CDC

A total of 240 (28.3%) patients in the total sample (N=848) reported the use of cardiovascular medication, which is demonstrated in Table 4.70. It is evident from this table that the use of cardiovascular medication exceeds the 214 (25.2%) clinic files with a documented diagnosed CVD.

4.4.8.2 TYPES OF CVD MEDICATION UTILISED BY PATIENTS WHO PRESENTED TO THE DUT CDC

A total of 129 (15.2%) of the sample (N=848) were documented to use cardiac medication. Table 4.68 shows the types of cardiovascular medication used by the patients who presented to the DUT CDC. This table highlights the frequency of the use of one type of CVD medication in the sample. The most common single CVD medication used were unspecified anti-hypertensives (3.7%), followed by lipid lowering drugs (1.0%) and anticoagulants (0.2%).

A large percentage of the sample, were using a combination of CVD medication in addition to anti-diabetic medication. The most frequently identified combination was unspecified anti-hypertensives and anti-diabetics (1.3%) followed by unspecified anti-hypertensives and cholesterol-lowering drugs (1.1%) and anti-diabetics and cholesterol-lowering drugs (0.8%). Other less frequently used combinations are shown in Table 4.69. It is evident from the information stated in Table 4.70, that the females who presented to the DUT CDC used

more CVD medication than males. However, this variation is statistically insignificant as the *p*=>0.05 (Fisher Exact test) for all types of CVD medication compared.

Table 4.68 Types of CVD medication identified at the DUT CDC

Type		Frequency	Percent
Anti-hypertensives	ACE inhibitors	3	0,4
	Alpha-2 receptor agonists	1	0.1
	Diuretics	1	0.1
	Unknown name	31	3.7
Blood thinners	Anticoagulants	2	0.2
Cholesterol lowering (Statins)		8	1.0
Total		**46**	**5.5**

Table 4.69 Frequency of the use of multiple CVD medications identified at the DUT CDC

	Combination	Frequency	Percent
1	Anti-hypertensives and anti-diabetics	11	1.3
2	Anti-hypertensives and cholesterol-lowering	9	1.1
3	Anti-diabetics and cholesterol-lowering	7	0.8
4	Ace inhibitors and anti-hypertensives	5	0.6
5	Anti-hypertensives and beta blockers	5	0.6
6	Anti-hypertensives and calcium channel blockers	4	0.5
7	Ace inhibitors, anti-hypertensives, anti-diabetics and cholesterol-lowering	4	0.5
8	Anti-hypertensives and diuretics	3	0.4
9	Anti-hypertensives, anti-diabetics and cholesterol-lowering	3	0.4
10	Anti-hypertensives, anti-diabetics, calcium channel blockers and cholesterol-lowering	2	0.2
11	Ace inhibitors, anti-hypertensives and anti-diabetics	2	0.2
12	Anti-hypertensives, calcium channel blockers and diuretics	2	0.2
13	Anti-hypertensives, diuretics and cholesterol-lowering	2	0.2
14	Anticoagulants and cholesterol-lowering	1	0.1
15	Anticoagulants and anti-diabetics	1	0.1
16	Anticoagulants, Angiotensin 2 receptor blockers and anti-hypertensives	1	0.1
17	Anti-hypertensives, Angiotensin 2 receptor blockers and calcium channel blockers	1	0.1
18	Ace inhibitors, anti-hypertensives, anti-diabetics and calcium channel blockers	1	0.1
19	Ace inhibitors, alpha-2 receptor blockers, alpha blockers, anti-platelets, anticoagulants Angiotensin 2 receptor blockers, anti-hypertensives, cholesterol-lowering and vasodilators	1	0.1
20	Anticoagulants, Angiotensin 2 receptor blockers, anti-hypertensives and calcium channel blockers	1	0.1
21	Anticoagulants, anti-hypertensives and anti-diabetics	1	0.1
22	Calcium channel blocker and cholesterol-lowering	1	0.1
23	Ace inhibitors, anti-hypertensives and diuretics	1	0.1
24	Anticoagulants, Angiotensin 2 receptor blockers, anti-hypertensives, anti-diabetic, calcium channel blocker and cholesterol-lowering	1	0.1
25	Antifibrinolytics, anti-hypertensives and cholesterol-lowering	1	0.1
26	Ace inhibitors, anti-hypertensives and calcium channel blockers	1	0.1
27	Angiotensin 2 receptor blockers and anti-hypertensives	2	0.2
28	Ace inhibitors, anti-hypertensives, anti-diabetics, beta blockers, calcium channel blockers and cholesterol-lowering	1	0.1
29	Ace inhibitors, anti-hypertensive, anti-diabetics, cholesterol-lowering and diuretics	1	0.1
30	Ace inhibitor, anticoagulants and anti-hypertensives	1	0.1

31	Ace inhibitors, anti-hypertensives, calcium channel blocker and diuretics	1	0.1
32	Ace inhibitors, alpha blocker, angiotensin 2 receptor blockers, anti-hypertensives and cholesterol-lowering	1	0.1
33	Anti-hypertensives, beta blockers and calcium channel blockers	1	0.1
34	Anticoagulants, angiotensin 2 receptor blockers, anti-hypertensives and beta blockers	1	0.1
35	Alpha blockers and anti-hypertensives	1	0.1
36	Anti-hypertensives, calcium channel blockers and combination beta blocker/diuretic	1	0.1
37	Anticoagulants, anti-hypertensives and calcium channel blockers	1	0.1
Total		**83**	**9.8**

Table 4.70 Use of CVD medication relative to gender

CVD medication			Gender		Total
			Male	Female	
Anti-hypertensives	ACE inhibitors	Count	12	11	22
		% within Gender	1.4	1.3	2.7
	Alpha receptor antagonists	Count	2	1	3
		% within Gender	0.9	0.1	0.4
	Alpha-2 receptor agonists	Count	2	0	2
		% within Gender	0.2	0.0	0.2
	Angiotensin 2 receptor blockers	Count	5	2	7
		% within Gender	0.6	0.2	0.8
	Beta blockers	Count	8	3	11
		% within Gender	0.9	0.4	1.3
	Calcium channel blockers	Count	9	8	17
		% within Gender	1.1	0.9	2.0
	Central agonists	Count	1	0	1
		% within Gender	0.1	0.0	0.1
	Diuretics	Count	2	9	11
		% within Gender	0.2	1.1	1.3
	Peripheral adrenergic inhibitors	Count	1	0	1
		% within Gender	0.1	0.0	0.1
	Unknown name	Count	48	58	106
		% within Gender	5.7	6.8	12.5
	Vasodilators	Count	1	0	1
		% within Gender	0.1	0.0	0.1
Blood thinners	Anticoagulants	Count	9	4	13
		% within Gender	1.1	0.5	1.5
	Antifibrinolytic	Count	0	1	1
		% within Gender	0.0	0.1	0.1
	Antiplatelets	Count	1	0	1
		% within Gender	0.1	0.0	0.1
Cholesterol lowering (Statins)		Count	20	21	41
		% within Gender	2.4	2.5	4.8
Digoxin		Count	1	0	1
		% within Gender	0.1	0.0	0.1
Total		Count	**122**	**118**	**240**
		% within Gender	**14.4**	**14.0**	**28.3**

Pearson chi-square test invalid due to low cell counts

4.4.8.3 THE LENGTH OF TIME OF THE USE OF CVD MEDICATION IDENTIFIED AT THE DUT CDC

From table 4.71 and 4.72 it is evident that in the greater part of the sample (N=848), the length of time for which various CVD medications were used, were not documented. Nearly all patients who reported the duration of the use of medication were using CVD medication

chronically. Unspecified anti-hypertensives (6.1%) and anti-hypertensives as a whole (9.4%) were taken for the longest length of time followed cholesterol lowering drugs (5.1%). The length of time of the use of unspecified anti-hypertensives were also the best documented among all cardiac medications.

However, the length of time of the use CVD medication was not recorded in the majority of the sample, thus these results should be considered statistically invalid.

Table 4.71 Length of time of the use of CVD medication by patients who presented to the DUT CDC (N=848)

Type		Percent of duration			
		Unknown	Acute	Subacute	Chronic
Anti-hypertensives	ACE inhibitors	97.2	0.0	0.0	2.8
	Alpha antagonists	100.0	0.0	0.0	0.0
	Alpha-2 receptor agonists	100.0	0.0	0.0	0.0
	Angiotensin 2 receptor antagonists	99.1	0.0	0.0	0.9
	Beta blockers	98.1	0.0	0.0	1.9
	Calcium channel blockers	97.7	0.0	0.0	2.4
	Central agonists	100.0	0.0	0.0	0.0
	Diuretics	98.6	0.0	0.0	1.4
	Peripheral adrenergic inhibitors	100.0	0.0	0.0	0.0
	Unknown name	91.6	0.9	1.4	6.1
	Vasodilators	100.0	0.0	0.0	0.0
Glycosides	Digoxin	100.0	0.0	0.0	0.0
Blood thinners	Anticoagulants	98.6	0.0	0.0	1.4
	Antiplatelets	100.0	0.0	0.0	0.0
Cholesterol lowering (Statins)		94.9	0.0	0.0	5.1

Table 4.72 Length of time of the use of CVD medication by patients who presented to the DUT CDC (N=848)

Type		Percent of duration			
		Unknown	Acute	Subacute	Chronic
Anti-hypertensives	ACE inhibitors	99.3	0.0	0.0	0.7
	Alpha antagonists	100.0	0.0	0.0	0.0
	Alpha-2 receptor agonists	100.0	0.0	0.0	0.0
	Angiotensin 2 receptor antagonists	99.8	0.0	0.0	0.2
	Beta blockers	99.5	0.0	0.0	0.5
	Calcium channel blockers	99.3	0.0	0.0	0.7
	Central agonists	100.0	0.0	0.0	0.0
	Diuretics	99.6	0.0	0.0	0.4
	Peripheral adrenergic inhibitors	100.0	0.0	0.0	0.0
	Unknown name	97.5	0.2	0.7	1.5
	Vasodilators	100.0	0.0	0.0	0.0
Glycosides	Digoxin	100.0	0.0	0.0	0.0
Blood thinners	Anticoagulants	99.6	0.0	0.0	0.4
	Antifibrinolytics	100.0	0.0	0.0	0.0
	Antiplatelets	100.0	0.0	0.0	0.0
Cholesterol lowering (Statins)		98.7	0.0	0.0	1.3

4.4.9 ASSOCIATIONS BETWEEN RISK FACTORS AND CVD IN PATIENTS WHO PRESENTED WITH BOTH CVD AND MSCs

4.4.9.1 ANALYSIS OF RISK FACTORS FOR CVD

Univariate logistic regression analysis was used to assess crude odds ratios and 95% Cls for the associations between the selected risk factors and CVD. These are shown in tables 4.73 and 4.74. Being female, increasing age and BMI, having MSC in the SI joint/pelvis, hypertension or pre-hypertension, a family history of CVD, lack of exercise, and smoking were all significant unadjusted risk factors for having CVD. Table 4.74 shows that all of the drugs tested had a crude association with CVD.

Table 4.73 Univariate logistic regression analysis of demographic and clinical risk factors for CVD

		No CVD		CVD		Crude OR (95% CI)
		Count	Column %	Count	Column %	
Gender	Male	356	56.2	98	45.8	reference
	Female	278	43.8	116	54.2	1.5 (1.1-2.1)
Age : mean(SD)		33.4	13.7	51.3	16.6	1.08 (1.06-2.0)
BMI: mean(SD)		25.8	5.6	28.8	7.0	1.08 (1.05-1.11)
Site of primary MSCs	Knee/ leg	78	12.3	16	7.5	reference
	Cervical spine	104	16.4	33	15.4	1.6 (0.8-3.0)
	Head	12	1.9	6	2.8	2.4 (0.8-7.5)
	Thoracic spine / chest/ ribs	61	9.6	17	7.9	1.2 (0.6-2.9)
	Lumbar spine / abdomen	156	24.6	56	26.2	1.8 (0.9-3.3)
	SI joint / pelvis	27	4.3	23	10.7	4.2 (1.9-9.0)
	Hip / thigh	23	3.6	3	1.4	0.6 (0.2-2.4)
	Foot / ankle	36	5.7	12	5.6	1.6 (0.7-3.8)
	Shoulder / brachium	63	9.9	26	12.1	2.0 (0.9-4.1)
	Elbow / forearm	4	0.6	1	0.5	1.2(0.1-11.6)
	Hand / wrist	12	1.9	1	0.5	0.4 (0.1-3.4)
	Jaw	27	4.3	11	5.1	2.0 (0.8-4.8)
	Multiple locations	22	3.5	7	3.3	1.6 (0.6-4.2)
	No complaint	9	1.4	2	0.9	1.1 (0.2-5.5)
Hypertension	Normotensive	423	67.4	75	35.4	reference
	Grade 1	28	4.5	40	18.9	8.1 (4.7-13.9)
	Grade 2	7	1.1	8	3.8	6.5 (2.3-18.3)
	Grade 3	3	0.5	8	3.8	15.0 (3.9-58.0)
	Hypotensive	13	2.1	3	1.4	1.3 (0.4-4.7)
	Pre-hypertensive	154	24.5	78	36.8	2.9 (2.0-4.1)
Family history of CVD	No	626	98.9	58	27.1	reference
	Yes	7	1.1	156	72.9	2.5 (1.7-3.5)
Exercise	Unknown	10	1.6	3	1.4	1.9 (0.5-7.8)
	Yes	133	21.0	37	17.5	1.8 (0.9-3.5)
	No	176	27.8	108	50.9	3.9 (2.1-7.2)
	Cardio	226	35.6	50	23.6	1.4 (0.7-2.7)
	Weights	89	14.0	14	6.6	reference
Alcohol	Yes	308	49.1	79	37.3	0.6 (0.5-0.9)
	No	319	50.9	133	62.7	reference
Smoking	Yes	129	20.5	26	12.2	1.9 (1.3-2.9)
	No	499	79.5	187	87.8	reference

Table 4.74 Univariate logistic regression analysis of drugs associated with CVD

		CVD				Crude OR (95% CI)
		NO		YES		
		Count	Column %	Count	Column %	
Anti-hypertensives	Yes	8	1.3	98	46.0	66.7 (31.6-140.8)
	No	626	98.7	115	54.0	Reference
ACE inhibitors	Yes	3	0.5	20	9.4	21.8 (6.4-74.1)
	No	631	99.5	193	90.6	Reference
Anti-diabetic	Yes	23	3.7	39	18.2	5.9 (3.4-10.1)
	No	606	96.3	175	81.8	Reference
NSAIDS	Yes	69	10.9	37	17.3	1.71 (1.1-2.6)
	No	564	89.1	177	82.7	reference
Thyroid agents	Yes	4	0.6	12	5.6	9.4 (3.0-29.3)
	No	630	99.4	202	94.4	reference
Antidepressants	Yes	13	2.1	12	5.6	2.8 (1.3-6.3)
	No	621	97.9	202	94.4	reference
Corticosteroids	Yes	17	2.7	13	6.1	2.3 (1.1– 4.9)
	No	616	97.3	201	93.9	reference
Analgesic combination	Yes	18	2.8	14	6.5	2.4 (1.2-4.9)
	No	615	97.2	200	93.5	reference

4.4.9.2 MULTIVARIABLE LOGISTIC REGRESSION ANALYSIS OF RISK FACTORS FOR CVD

Adjusted odds ratios and 95% Cls are shown in Table 4.75 for the association between the selected risk factors and CVD. Most of the medications lost significance after adjustment for other factors. However, anti-hypertensives remained significantly associated with CVD. Those who were taking anti-hypertensives were 36.6 times more likely to have CVD than those who were not taking these medication (p=<0.001) after adjustment for all other factors in the model. BMI were no longer associated with CVD, but increasing age (p=<0.001) continued to be associated. In terms of site of the primary MSCs, the SI joint/pelvis (p=0.005) was still strongly associated with having CVD. Patients with CVD were 7.1 times more likely to present to the DUT CDC with MSCs located in the SI joint/pelvis. Additionally, head (OR 7.1; p=0.019), shoulder/brachium (OR 3.1; p=0.090) and thoracic spine/chest/rib (OR 4.9; p=0.015) MSCs were also found to be associated with having CVD after adjustment for confounding. Only grade 1 HTN was associated with CVD, presumably because the model was adjusted for taking anti-hypertensives. A family history of CVD (OR 2.1; p=0.006) and to a certain extent smoking (OR 1.9; p=0.054) was still associated with having CVD.

Table 4.75 Multivariable logistic regression analysis of risk factors for CVD

		Sig.	Odds Ratio	95% CI for Odds Ratio	
				Lower	Upper
Step 1[a]	Anti-hypertensives	<0.001	36.6	12.6	106.2
	ACE inhibitors	0.734	0.7	0.1	4.6
	Anti-diabetic	0.851	0.9	0.3	2.5
	NSAIDS	0.903	1.0	0.5	2.1
	Thyroid agents	0.078	5.1	0.8	30.6
	Antidepressants	0.266	2.0	0.6	6.9
	Corticosteroids	0.109	2.7	0.8	8.9
	Analgesic combination	0.160	2.1	0.8	5.7
	Female gender	0.735	1.1	0.7	1.8
	BMI	0.345	1.0	1.0	1.1
	Age	<0.001	1.1	1.0	1.1
	Primary site (vs Knee/leg)	0.112	-	-	-
	Cervical spine	0.103	2.7	0.8	9.1
	Head	0.019	7.3	1.4	38.1
	Thoracic spine / chest / ribs	0.015	4.9	1.4	17.5
	Lumbar spine	0.145	2.4	0.8	7.5
	SI joint / pelvis	0.005	7.1	1.8	28.2
	Hip / thigh	0.718	0.7	0.1	5.9
	Foot /ankle	0.792	1.2	0.3	5.5
	Shoulder / brachium	0.090	3.1	0.9	11.3
	Elbow / forearm	0.415	2.9	0.2	37.9
	Hand/ wrist	0.755	1.5	0.1	17.8
	Jaw	0.089	3.8	0.8	17.2
	Multiple location	0.317	2.4	0.4	12.9
	No complaint	0.009	14.1	1.9	102.9
	Hypertension (vs normotensive)	0.238	-	-	-
	Grade 1	0.043	2.5	1.0	6.0
	Grade 2	0.572	1.6	0.3	9.0
	Grade 3	0.085	9.6	0.7	125.4
	Hypotension	0.736	1.5	0.2	13.4
	Pre-hypertension	0.514	1.2	0.7	2.1
	Family history of CVD	0.006	2.1	1.3	3.6
	Exercise (vs weights)	0.429	-	-	-
	Unknown	0.321	2.4	0.4	12.9
	Yes	0.524	1.4	0.5	3.5
	No	0.219	1.7	0.7	4.2
	Cardio	0.951	1.0	0.4	2.5
	Alcohol	0.837	0.9	0.6	1.6
	Current smoker	0.054	1.9	1.0	3.8
	Constant	<0.001	0.001	-	-

4.5 SUMMARY

The above results seem to suggest that the demographic and clinical risk factors for CVD between the CVD and non-CVD groups vary considerably. The CVD group is dominated by females, who tend to be older (mean age 51.3), have a higher BMI (mean BMI 28.8), decreased level of physical activity, a family history of CVD and tended to use both CVD and non-CVD medications. Conversely, the non-CVD group consisted of predominantly males who are younger (mean age 33.5), have a lower BMI (mean BMI 25.8), and were 1.3 times more likely to be hypertensive; and almost 2 times more likely to smoke tobacco.

In line with the use of CVD medications such as anti-hypertensives (OR 66.7; CI 31.6-140.8) and ACE inhibitors (OR 21.8; CI 6.4-74.1), a strong association was found with CVD. In addition, non-CVD medication such as antidepressants (OR 2.8; CI 1.3-6.3), anti-diabetics (OR 5.9; CI 3.4-10.1), NSAIDS (OR 1.7; CI 1.1-2.6), thyroid agents (OR 9.4; CI 3.0-29.3), corticosteroids (OR 2.3; CI 1.1–4.9) and analgesic combination drugs (OR 2.4; CI 1.2-4.9) were also shown to have a strong relationship with the development of CVD.

However, as univariate regression analysis is strongly influenced by confounders, it may be erroneous to draw direct correlations. Thus, the results of the univariate logistic regression analysis may only be described as trends (which may or may not follow logical reasoning based on the literature).

When all the variables were entered into a multivariable logistic regression model, many of these variables lost their significant relationships after adjustment for confounding/influencing factors. This suggests that many of these risk factors may actually be inter-related (co-dependent) and thus not independently associated with CVD. In addition, the trends observed and effects of confounder may be explained by the known/confirmed association between many of the selected risk factors and CVD as discussed in Chapter Two (section 2.3.5). For example, numerous non-cardiac medications have been shown to induce/exacerbate CVD, while patients who have been diagnosed with CVD are expected to utilise cardiac medication such as anti-hypertensives (Steyn, 2007; American Heart Association, 2016). Other variables that may have confounded the correlations between the above mentioned variables and CVD include occupation, socioeconomic status and the dosage of medication utilised by patients. Lack of data regarding the duration/length of time of use of medication and the intensity of physical activity may also have influenced the outcome of this study.

With multivariable analysis, it was found that many of the medications lost significance although antihypertensive (p=<0.001) and thyroid agents (p=0.078) (Buttar et al., 2005; American Heart Association, 2016; World Heart Federation, 2016) remained associated with CVD. CVD patients had a greater likelihood of utilising anti-hypertensives (p=<0.001) and thyroid agents (p=0.078). They were also most likely to present with both CVD and MSD risk factors including: increasing age (p=<0.001), family history of CVD (p=0.006) and smoking (p=0.054) (with the latter possibly being affected by the small sample size). Only grade 1 HTN (OR 2.5; p=0.043) was associated with CVD, as the model was adjusted for taking anti-hypertensives. This would be consistent with the literature where precursors to grade 1 HTN are also responsible for the development of CVD (Steyn, 2007).

With regards to the site of primary MSCs, patients who presented to the DUT CDC with MSCs and CVD are 7 times more likely to present with MSCs located in the SI joint/pelvis (p=0.005) and head (p=0.019). CVD patients are also more likely to present with thoracic spine/chest/ribs (p=0.015) and shoulder/brachium (p=0.090) complaints than non-CVD patients. These associations may be as a result of vessel changes (aortic, carotid, vertebral and/or temporal artery) in line with the precursor diseases responsible for grade 1 HTN and the development of CVD. The effect of blood flow to these regions may result in secondary changes in the muscle function/ability to function and/the inability of the joints to heal (leading to increased degenerative changes).

The results of this study suggest that patients who seek treatment at the DUT CDC may present with both MSDs and CVD. Moreover, this study suggests that there may be an association between CVD and the presenting MSC. It is evident that the presentation of MSDs in CVD patients is multifactorial involving the use of cardiac and non-cardiac medication, and the presence of common CVD and MSD risk factors. However this study cannot conclusively comment on these pathophysiological changes, which would be the domain of a future study to investigate and explain. In addition, the current study can only speculate on causality based on known mechanisms in the literature, however reverse causality may exist (viz. a lack of exercise, presence of MSCs may actually predispose to the CVDs). Therefore a longitudinal study would be necessary to determine this causality and confirm the associations found in this study.

One limitation of this study however is that it was unable to determine the causality of the relationship between the CVD and MSDs, the significant risk factors identified, the medications utilised and the onset of associated CVD/non-CVD conditions, their exacerbations or their amelioration.

CHAPTER FIVE
DISCUSSION OF RESULTS

5.1 INTRODUCTION

This chapter reviews the results obtained through the statistical analysis of the data. The sample size for the present study included a total of 1066 files of new patients who presented to the Durban University of Technology Chiropractic Day Clinic (DUT CDC) from 9 June 2015 to 9 June 2016. The files were consecutively extracted from the clinic's records. From this 1066, there were 848 files which met the inclusion criteria for this study. The remainder of the files were excluded due to the exclusion criteria.

5.2 INTERPRETATION OF RESULTS

5.2.1 THE PREVALENCE OF MUSCULOSKELETAL COMPLAINTS AT THE DUT CDC

In the 1-year period, the prevalence of musculoskeletal complaints (MSCs) was 98.7% (95% CI 97.6% to 99.3%). This result is supported by the findings of Leboeuf-Yde *et al.* (1997); Hurwitz *et al.* (1998); Rubinstein *et al.* (2000); Coulter *et al.* (2002); Hartvigsen *et al.* (2002) and Leboeuf-Yde *et al.* (2005), who the demonstrated that nearly all patients who present to chiropractors in private practice worldwide, seek chiropractic treatment for their MSCs. This result, to a great extent, is comparable with studies conducted at chiropractic teaching clinics abroad by Waalen et al. (1994); Bryant *et al.* (2003); Holt *et al.* (2005) and Lishchyna *et al.* (2012), where the majority of patients presented with MSCs.

Eleven (1.3%) out of the 848 files that were included in the study, did not present with a MSC. These patients presented to the DUT CDC for a general check-up. This concurs with Meeker *et al.* (2002), who states that the majority of patients visit chiropractors for MSCs. In spite of the fact that patients recognise that chiropractors treat MSDs, these patients have a propensity to only seek treatment when they experience pain. This contradicts the philosophy of the chiropractic profession which is to enhance health through health promotion and prevent disease and injury (Egan, 2006).

However, numerous studies have also demonstrated that a percentage of patients seeking chiropractic care do so for prevention, wellness and general health concerns (Meeker, 2002; Hawk *et al.,* 2012). Similarly, Kent (2002) found that chiropractors are increasingly providing wellness care to patients that is cost-effective and offers better quality of life. They have also been observed to incorporate lifestyle modification advice into their management. In a study

investigating the extent to which patients seek wellness care from chiropractors who have been recognized to incorporate evaluations and interventions to maintain wellness and prevent disease in their practices, revealed that over 40% of patients who sought treatment did so for health improvement and/or disease prevention (Blum *et al.,* 2008). The results of the current study concurs with those of Kent (2002); Meeker *et al.* (2002); Blum *et al.* (2008) and those of Hawk *et al.* (2012), and suggest that a fraction of patients who present to the DUT CDC, do so for wellness care.

5.2.2 THE NATURE MSCs OF PATIENTS WHO PRESENTED TO THE DUT CDC

5.2.2.1 LOCATION OF MSCs

The most frequently recorded site for both primary and secondary MSCs were the lumbar spine/abdomen (25.0% and 4.2%, respectively) followed by the cervical spine (16.2% and 3.4%, respectively). This result is consistent with that of surveys conducted across the world on the characteristics of patients presenting to chiropractors in private practice, where spinal pain was demonstrated to be the most common reason for seeking chiropractic care. Spine-related symptoms were reported by 64%-86% of these chiropractic patients (Leboeuf-Yde *et al.,* 1997; Rubinstein *et al.,* 2000; Coulter *et al.,* 2002; Hartvigsen *et al.,* 2002; Leboeuf-Yde *et al.,* 2005). LBP in particular was confirmed as the most frequently reported complaint of patients who presented to chiropractors in private practice in various countries world-wide (Shekelle *et al.*, 1991; Waalen *et al.,* 1994; Hurwitz *et al.,* 1998; Mior *et al.,* 2008; Lishchyna *et al.*, 2012).

Nyiendo *et al.* (1989) conducted a comparative study on patients and patient complaints at six chiropractic college teaching clinics. The percentage of lumbar spine complaints varied from 31% to 41% in all clinics and more patients reported LBP than any other single complaint. These results are inconsistent with that of retrospective studies conducted at the DUT CDC in which the prevalence of various MSCs recorded over an eleven year period (1995-2005) was retrospectively analysed. Of the 7 487 patient files that were analysed, 1 342 (17.9%) had cervical pain (Venketsamy, 2007) and 1 296 (17.3%) had lumbo-sacral pain (Jaman, 2007). However, these results were obtained from a sample of only 30% of 24 487 files recorded at the DUT CDC for the period 1995 to 2005, thus it may not be a true reflection of the population from which the sample was obtained.

The results of the current study suggest that patients most frequently present to the DUT CDC with lumbar/abdomen complaints. The increasing presentation of LBP could be explained by the characteristics of LBP such as the frequency and chronicity of LBP-frequently, the symptoms of LBP may not resolve completely, and patients experience

exacerbations of chronic LBP (Woolf *et al.,* 2003); and the frequency of risk factors for LBP in the sample- increasing age, physical inactivity, tobacco use, being overweight and obesity, psychological factors such as anxiety, depression, and emotional instability which have all been identified in this sample; and are all associated with the occurrence of LBP (Woolf *et al.,* 2003).

The increasing knowledge of the scope of chiropractic; its effectiveness in the treatment of LBP; the greater awareness of minor back symptoms and willingness to report them; may also be related to the increasing presentation of LBP patients to both chiropractic teaching clinics and chiropractors in general.

Additionally, the increasing awareness of chiropractic teaching clinics may also account for this result. The DUT CDC and other teaching clinics offer low cost treatment which provides patients a cost-effective alternative for the treatment and management of chronic/recurrent MSCs such as LBP. The latter is especially true for patients who have exhausted their medical aid benefits.

5.2.2 2 DURATION OF MSC

Chronic MSCs were most frequently reported for both primary (32.3%) and secondary MSCs (8.6%) followed by acute MSCs (28.4% and 5.0% primary and secondary MSCs, respectively), which compares closely to the findings of Waalen *et al.* (2005), Mior *et al.* (2008) and those of Lishchyna *et al.* (2012), where chronic MSCs were more frequently reported than acute MSCs by chiropractic teaching clinic patients.

Furthermore, the data collected in this study goes against the Hurwitz *et al*. (1998) study on the use of chiropractic services in the United States and Canada, where more than 40% of the patients in private practice had acute MSCs and approximately 20% had chronic MSCs, but is in keeping with the findings of Mahomed (2007), where the majority of complaints in private practice in South Africa (SA), where 58% were chronic while 28.8% were acute. The results of the current study suggest that most patients present to the DUT CDC with chronic MSCs.

From these results it is postulated that over a quarter of new patients who presented to the DUT CDC delayed seeking treatment which caused their MSCs to be presented as chronic. This may be attributed to the larger percentage of males in the sample. Males may possibly be delaying treatment due to a lack of awareness of the DUT CDC or a lack of knowledge of the scope of chiropractic or their perception of the profession (Mahomed, 2007). Another

possible explanation for this result is the unsatisfactory progress/outcome of the medical treatment of MSCs. Tatalias (2006), reported that females were more likely to use alternative healthcare, as they are perceived to have a better understanding of alternative healthcare. This may attributed to poor experiences with medical treatment, causing them to seek alternative medical options (Tatalias, 2006).

Medical treatment of MSCs also includes the use of prescription and over-the-counter (OTC) medication which is represented under Section 4.4.6.10. It reveals that a large percentage of the sample was using one/more medications at their first visit to the DUT CDC, which may also be a possible explanation for high incidence of chronic MSCs. While chiropractic treatment is more cost effective than other treatments and surgical interventions; the use of prescription and OCT medication may be even more cost effective. MSDs have been ranked the second most important risk factor for restricted activity and use of prescription and OTC medications (Manga, 2000; Dagenais *et al.*, 2012). Patients may attempt to self manage pain with OTC medication; or medication that has been prescribed by their general practitioner rather than pay for a consult that could be considered more expensive. This speaks to the perception that chiropractic is not regarded as the first port of entry for the public when it comes to pain management. This may result in a delay in seeking treatment at the DUT CDC or private chiropractors.

However, occasionally, MSCs are unresponsive to medication or medical treatment which results in patients resorting to alternative treatment options including chiropractic. It is also possible that patients only seek treatment at the DUT CDC when their medical aid benefits have been exhausted as it provides a cost-effective alternative for continued treatment and management of chronic MSCs. This may be contrasting to private practice where patients are more likely to cease chiropractic treatment once their medical aid funds have been exhausted and then resort to the use of prescription and OTC medication.

5.2.2.3 CHARACTER OF MSC

As illustrated under Section 4.4.1.2.2, the most frequently reported character of pain documented in the sample was sharp (213) followed by dull (116) dull and aching (106) for primary MSCs, and dull (37) followed by sharp (32) dull and aching (11) for secondary MSCs. Paucity in the literature regarding the frequency of the pain character of patients seeking treatment at chiropractic teaching clinics or private chiropractors does not allow for comparability of these results. However, the frequency of sharp and dull pain characters may be ascribed to the inability of the patient to accurately describe their pain. This may result in prompting by the intern by listing possible characters from which the patient will choose; or

deduction by the intern due to the patients' lack of understanding of the concept of pain character. In addition, LBP, which was the most frequently recorded MSC, can range in intensity from a dull, constant ache to a sudden, sharp pain, and could consequently be a potential reason for these results (National Institute of Neurological Disorders and Stroke, 2014). It may also relate to the type of conditions that patients commonly present with as, mechanical facet syndrome typically presents with pain that is dull in nature, sciatica may be sharp, and muscle strain may be experienced as burning pain.

It is important to consider the effect of language on the reporting of information – only one word for pain exists in the isiZulu language. Due to the limited knowledge on the race/ethnicity of the sample, this research can only suggest that the effect of this needs to be considered in a future study.

Furthermore, the results of the current study indicate that there is a difference in the presentation of primary and secondary MSCs. This could be attributed simply to the dissimilarities in the nature of each complaint. It is evident that the two complaints for each patient had a different site and duration which suggest that they are unrelated.

5.2.2.4 RADIATION OF MSC

The most commonly reported sites of radiation of primary and secondary MSCs are represented under Section 4.4.1.2.3 and demonstrate that 31.5 % (263) of primary MSCs had a site of radiation in addition to 23% (40) of the 174 who also presented with a secondary MSC. The most common site of radiation for primary MSCs were the left leg (7.9%) followed by the right leg (6.8%) and left arm (5.8%). The left leg and right leg (1.4%) were equally common sites of radiation for secondary MSCs, followed by the cervical spine (1.2%).

The results of the current study could be attributed to the high incidence of lumbar spine complaints (25.0% and 4.5% for primary and secondary MSCs, respectively). According to Waddell (2004), more than 99.0% of lumbar spine complaints present with LBP. Pain always tends to radiate distally and 70% of patients with LBP may also have pain down one or both legs (Waddell, 2004). Lumbar and sacro-iliac pain tends to be referred to the buttock and posterior leg (and sometimes to the lateral aspect of the leg) (Magee, 2002). This concurs with the sites of radiation in the current study, where 1.4-7.4% of patients reported pain radiating down the left or right leg.

Paucity in the literature concerning the radiation of MSCs of patients seeking treatment at chiropractic teaching clinics or private chiropractors does not allow for comparability of these results. Although, the duration, pain character and site of radiation of primary and secondary MSCs of patients who presented to the DUT CDC between in this one year period, appear to be related to the prevalence of LBP in the sample. This result is in keeping with what chiropractors are expected to treat as demonstrated by Shekelle *et al.* (1991), Waalen *et al.* (1994), Hurwitz *et al.* (1998), Mior *et al. (*2008), and Lishchyna *et al.* (2012), who observed LBP as the most frequently reported complaint of patients seeking chiropractic treatment.

5.2.2.5 SEVERITY OF MSC

The majority of the patients who presented to the DUT CDC with a primary MSC (98.7%), reported that the pain was moderate (52.7%) with 26.9% having severe pain. Moderate pain (11.1%) was also most commonly reported by the 20.5% of patients who reported a secondary MSC, with only 6.1% having severe pain. These results may be attributed to the predominance of males in the sample. The male gender has a propensity to suffer more disabling pain than women (Hurwitz *et al.*, 1997; Power *et al.,* 2001) and females suffer more non-disabling pain, as demonstrated by Hurwitz *et al.* (1997). However, males are also less willing to report symptoms of MSDs and seek treatment (Tatalias, 2006). This may result in the presentation of males in the chronic stage of the condition which tends to have a reduced severity than in the acute stage. Furthermore, pain severity at the DUT CDC is based on the numerical pain rating scale. This method of pain measurement is subjective as the patient is asked to rate their pain intensity from 0-10. As the pain threshold of individuals may vary, many individuals have different perceptions of pain and may therefore interpret this scale in their own way, resulting in exaggeration or underestimation of pain.

5.2.3 DEMOGRAPHICS OF PATIENTS WHO PRESENTED TO THE DUT CDC

5.2.3.1 AGE

The sample ranged from 5 weeks to 86 years of age. The mean age was 37.87 years (SD 16.53 years). When comparing the mean age of the total sample to the findings of other studies, it would appear that the mean age of new patients presenting to chiropractic teaching clinics, is increasing. This is evident in a study concerning the demographic and diagnostic profile of patients presenting to a university chiropractic outpatient clinic in Australia by Bryant *et al*. (2003), where the average age was 36.6 years; in addition to a retrospective analysis of 1004 new patient files opened at the New Zealand College of chiropractic teaching clinic between 1997 and 2001, where the average age of patients were 32 years (Holt *et al.*, 2005). Similarly, in studies conducted at the DUT CDC over an eleven year period between 1995 and 2005, the mean age of patients who presented with cervical

pain (Venketsamy, 2007) and thoracic pain (Benjamin, 2007) was 36.89 and 33.3 years, respectively. In addition, when the mean age between the two five year periods were compared, there was a higher mean age over the second five year period in patients who presented with cervical pain (Venketsamy, 2007), thoracic pain (Benjamin, 2007), lumbo-sacral pain (Jaman, 2007), and upper and lower extremity pain (Kandhai, 2007). This could be attributed to the fact that MSDs are associated with increasing age as a result of the effects of lifestyle on health (Woolf *et al.*, 2003).

The age group distribution of the present sample is represented under Section 4.4.2.1. The majority were young, in the 20-29 year age group (32.4%). This finding is consistent with that of other retrospective studies conducted at the DUT CDC (Jaman, 2007; Kandhai, 2007; Venketsamy, 2007). The age distribution of the current study was biased to the 20-29 year age group, attributed to the high population of students seeking treatment at the DUT CDC for various reasons. Firstly, the DUT CDC is located at a tertiary institution and is therefore easily accessible to students. Secondly, the DUT CDC also offers free treatment to selected students at the university. Lastly, chiropractic student interns may be recruiting patients of their own age group, as shown by Lishchyna *et al.* (2012).

5.2.3.2 GENDER

Gender was recorded in the entire sample of 848 clinic files. The data for gender was represented under Section 4.4.2.2 and revealed that overall 53.5% males and 46.5% females presented to the DUT CDC. This result is consistent with the findings at an Australian chiropractic-teaching clinic by Bryant *et al*. (2003) where 54% were males and 46% were female, as opposed to findings by Holt *et al.* (2005) who reported slightly more females (51.9%) than males (48.1%), as well as that of Jaman (2007) and Kandhai (2007) where the majority of lumbo-sacral and extremity complaints at the DUT CDC were documented in males.

The percentages in this study differ from the gender data in previous studies conducted at the DUT CDC by Benjamin (2007) and Venketsamy (2007), where the majority of patients who presented with thoracic and cervical pain respectively, were female. In addition, a descriptive study of patient complaints by Holt *et al.* (2005) at the New Zealand College of Chiropractic Teaching Clinic, showed that there were slightly more females (51.9%) than males (48.1%) in the random sample of 1004 files.

Analogous to the gender distribution in teaching clinics, 62.8% of patients that presented to private chiropractors in SA were female (Mahomed, 2007). This result supports the findings

of most other studies in America and Europe by Pedersen (1994); Rubinstein *et al.* (2000); Suleman (2001); Hartvigsen *et al.* (2002); Coulter *et al.* (2005); Mootz *et al.* (2005) and Gaumer *et al.* (2006), where the majority of patients who presented to private chiropractors were female. These studies collectively agree with the tendency that females tend to seek CAM therapies to a higher degree than males (Talatias, 2006).

The variation in the gender distribution of chiropractic teaching clinics and private practice patients may be attributed to the patient's presenting MSC. Waalen *et al.* (1994) analysed 15 174 new patients that presented to the CMCC over a five years, and found the number of males (N = 7 657) and females (N = 7 517) to be moderately different, in addition, LBP was confirmed as the most frequently reported complaint of patients. In contrast to retrospective studies conducted at the DUT CDC, 1 342 (17.9%) had cervical pain (Venketsamy, 2007) and 249 (3.3%) had thoracic pain (Benjamin 2007), additionally, of the 7 487 patient files that were analysed, majority were females. While Jaman (2007) and Kandhai (2007) demonstrated the majority of lumbo-sacral- and extremity complaints at the DUT CDC were documented in males. Pedersen, (1994); Hartvigsen *et al.* (2002); Rubinstein *et al.* (2000); Suleman (2001); Coulter *et al.* (2005); Mootz *et al.* (2005) and Gaumer *et al.* (2006), confirmed that the majority of patients who presented to private chiropractors were female and predominantly presented with spinal complaints. It is evident that a trend has emerged based on the results of studies conducted at various teaching clinics and in private practice, in that gender distribution may be related the presenting MSC. In addition there are limitations to the manner in which each of these studies were conducted which may have directly impacted on the ability to compare gender in terms of the main complaint; as well as the representation of the sample relative to the total clinic population for each of the study sites represented by these national and international studies.

The result of the current study suggests that males were more likely to seek treatment for MSCs at the DUT CDC. This result could be attributable to the high prevalence of lumbar spine complaints in the sample and the gender predilection of LBP. The characteristics of the sample population under study, specifically age has been demonstrated to affect gender prevalence of LBP (Olsen *et al.,* 1992; Morris, 2006). With the majority of the sample in the 20-29 year age group (32.4%), it is possible to suggest the higher prevalence of males in this sample is attributable to age, as suggested by the findings of Olsen *et al.* (1992), who found the prevalence of LBP in female population was lower with 48.4% than that for males in this age group. This finding is supported by the statistically significantly lower mean age of males in the current study.

5.2.3.3 RACE/ETHNICITY

Race was omitted in seven hundred and forty-four (744) of 848 files. The race distribution of the percentage of the total sample in which race was recorded, is represented under Section 4.4.2.3 and revealed that the majority of the total sample was Indian (4.5%) followed by Black African (4.4%). Contrary to the studies of the private chiropractic patient population in America and Europe by Coulter *et al.* (2005); Mootz *et al.* (2005) and Gaumer *et al.* (2006), where the majority of patients were White, there were more Indian patients in this study, which is in contrast to the race distribution in private chiropractic practice in SA; where 75.6% of patients were White (Mahomed, 2007). However, due to the low response rate this result may not be representative of private chiropractic patients in SA as it may not have given a true sample of the number of the private clinics in all provinces of SA.

The race distribution of SA chiropractic patients deviates from the demographics of SA, where the majority of the population is Black African (79.0%) and has a low socioeconomic status (Statistics South Africa, 2013b). There are many suggested explanations for this discrepancy. As stated by Statistics SA (2013b), the majority of the Black population is poor and may not have access to chiropractic treatment, either because they are unable to afford chiropractic treatment or there are no chiropractic services available in their community (Kopansky-Giles *et al*., 2007). While chiropractic is covered by 98% of the medical aid schemes, most chiropractors in SA work within the private sector (CASA, 2012). Thus, chiropractic services are mainly available to the middle and higher-income individuals, who tend to be part of medical aid schemes (less than 20.0% of the total SA population) (eThekwini Municipality, 2013). These individuals may also lack knowledge of chiropractic (Mothibi, 2012). Therefore, they would not consider it an option with visits being either to a medical doctor or traditional African healer (Korporaal, 2017). A lack of education on disease prevention, management strategies (including treatment) and provision of education on MSDs has also been documented in this population (Kopansky-Giles *et al*., 2007).

Nonetheless, the results of the current study are aligned with Hurwitz *et al.* (1998) who suggested that the similarities and dissimilarities observed between chiropractic clinic patients may be attributed to the neighbourhood and location of the clinic. The results of this study could not be compared to local teaching clinics as this factor was not documented.

However, as race was not documented in 87.7% of the sample, this variable should be regarded statistically invalid. Although DUT CDC case history has a designated area to document demographic information including race, it is evident from this study that a large percentage of interns fail to record this information. Interns may perceive this information to be irrelevant as it should not affect how the patient is treated or the outcome of the

treatment. Interns may be avoiding asking their patients for this information in fear of creating an uncomfortable environment for both the patient and intern, which may result in deduction of the patient's race based on their name; or completely omitting this section in the case history.

The importance of accurately recording patient information should be brought to the attention of chiropractic interns, as teaching clinics are often used as a data source for research purposes (Walsh, 1992). It is the responsibility of the DUT CDC to maintain a high standard of record keeping as it is vital to the quality of research conducted at the clinic. Failure to accurately recorded patient information could affect the outcome and validity of research studies and hinder the development of new areas of research.

5.2.3.4 HEIGHT, WEIGHT AND BODY MASS INDEX (BMI)

These variables will be discussed later in this chapter under Section 5.2.7.2.1, as they have been identified as modifiable risk factors for CVD and will be discussed as such.

5.2.4 THE PREVALENCE OF CARDIOVASCULAR DISEASE (CVD) AT THE DUT CDC

The prevalence of CVD is represented under Section 4.3.3. In the 1-year period, the prevalence of CVD was 25.2% (95% CI 22.37% to 28.33%). These results coincide with similar results achieved by Prasad *et al*. (2013), who demonstrated that patients with CVD frequently present to chiropractors. Recent studies conducted at the DUT CDC also support the findings of the current study as patients who presented with cervical and lumbo-sacral complaints frequently presented with co-morbidities such as hypertension (HTN) and angina (63.9% and 81.5%, respectively) (Jaman, 2007; Venketsamy, 2007). Cardiac conditions were also the most frequently documented co-morbidity in extremity patients who presented to the DUT CDC (9.2% in upper limb cases and 8.2% in lower limb cases) (Kandhai, 2007). The result of the current study in addition to the above mentioned studies conducted at the DUT CDC emphasise the importance of the awareness of the prevalence of CVD in the general population.

CVD and CVAs are the second largest causes of mortality in SA, after HIV/AIDS. The current prevalence of CVD in the SA population is not available however 210 individuals in SA are estimated to die as a result of CVD daily. Conversely, based on the results of the current study; and those by Ndetan *et al.* (2010) along with Prasad *et al.* (2013), it is evident that a relatively small proportion of these patients present to chiropractors or chiropractic teaching clinics. A possible interpretation of the results of the current study and the aforementioned studies would be the conventional treatment and management of CVD. CVD patients primarily present to medical doctors as chiropractic is generally utilised for MSCs

(Riksman *et al.,* 2011). This is apparent from the higher prevalence of MSCs than CVD at the DUT CDC. However, based on the SA statistics released by the Heart and Stroke Foundation of South Africa (Steyn, 2007) on CVD, it is imperative for chiropractors and chiropractic interns to be aware of prevalence of CVD as the probability of encountering a patient with CVD is relatively high. In addition, Prasad *et al.* (2013) demonstrated that 31.5% of patients presented to chiropractors for cardiac symptoms that are stubborn to standard medical treatment or in cases in which drug side effects are intolerable.

Since a significant percentage of files constituted research files (viz. excluded from this study) (20.1%), incomplete paperwork (0.2%) and files in which the first visit was documented outside of the timeframe (0.2%) were also noted in the sample, it is only possible to state a possible prevalence of the CVD during the selected timeframe (9 June 2015-9 June 2016).

5.2.4.1 MOST FREQUENTLY RECORDED PREVIOUSLY DIAGNOSED CARDIOVASCULAR DISEASE AT DUT CDC

Of the 214 patients who presented to the DUT CDC with a previously diagnosed CVD, 11.7% were hypertensive, 6.3% had hypercholesterolaemia and 3.5% had varicose veins. HTN is considered to be more prevalent in SA than anywhere else in the world, affecting 1 in every 3 adults (Heart and Stroke Foundation of South Africa, 2016). According to Conner *et al.* (2005), the overall prevalence of HTN in SA is 55%. Therefore, the results of this current study are comparatively lower than that of the study conducted by Conner *et al.* (2005). In addition, Ndetan *et al.* (2010) retrospectively reviewed 200 clinic files at two chiropractic teaching clinics in the US and found that 23 out of the 200 (11.5%) patients were HTN. However, the results of the current study are similar to that of other studies conducted at the DUT CDC, where the prevalence of previously diagnosed HTN ranged from 11.1% to 13.6% (Jaman, 2007; Kandhai, 2007; Venketsamy, 2007).

5.2.5 NATURE OF MSCs OF CVD PATIENTS WHO PRESENTED TO THE DUT CDC

5.2.5.1 PREVALENCE OF MSCs AMONG CVD PATIENTS WHO PRESENTED TO THE DUT CDC

Two-hundred and fourteen (214) files were found to have a recorded diagnosed CVD. However, as the information stated under Section 4.4.4 illustrates, only two of the files in the subsample had no main MSC as those patients presented to the DUT CDC for a check-up. Therefore, 212 (99.1%) files had a primary MSC while 55 (26.0%) also had a secondary MSC. These findings are consistent with that of Benjamin (2007); Jaman (2007); Kandhai

(2007) and Venketsamy (2007) who demonstrated that patients with CVD frequently presented to the DUT CDC. However, these patients sought treatment for their MSCs and not their diagnosed CVD.

5.2.5.1.1 DURATION OF MSC

Chronic MSCs were most frequently reported for both primary (38.3%) and secondary MSCs (13.6%) patients with previously diagnosed CVD. The second most frequently reported duration in the subsample was acute MSCs (24.8% and 6.5% for primary and secondary MSCs respectively). These results are similar to that found in the total sample (N=848), in that chronic MSCs were also the most frequently reported for both primary (32.3%) and secondary MSCs (8.6%) followed by acute MSCs (28.4% and 5.0% primary and secondary MSCs, respectively). However, there are discrepancies between the two samples as the percentages for the duration of both primary and secondary MSCs appear to be somewhat higher (statistically insignificantly difference) in patients with previously diagnosed CVD.

These discrepancies may be explained by a large population-based study conducted by Hagen *et al.* (2005), where an inverse relationship between the prevalence of chronic MSCs and BP was demonstrated. The authors found participants with a slightly higher BP, to have a 10-60% lower prevalence of chronic MSCs than normotensive participants. The prevalence of chronic MSCs was highest among participants with a low BP and who were current utilising anti-hypertensive medication. This relationship is thought to be related to the phenomenon of hypertension-associated hypoalgesia, due to an interaction between the CV and pain regulatory systems. It is evident from this study that the mechanism responsible for the BP-pain sensitivity relationship may have a significant impact on chronic pain in the general population (Hagen *et al.,* 2005).

The BP recordings of the patients who demonstrated a history of CVD is represented under Section 4.4.6.2.3 and shows that 36.8% of the subsample were pre-hypertensive followed by normotensive (35.4%) and Grade I-III hypertension (26.5%). These results could be attributed to the findings of Hagen *et al.* (2005), as a greater percentage of CVD patients were normotensive (35.4%) than hypertensive (26.5%), with 36.8% having slightly higher BP. This result implies that the higher prevalence of chronic MSCs is related to the higher prevalence of normotensive CVD patients, as suggested by Hagen *et al.* (2005). Furthermore, a large percentage of this sample were using anti-hypertensive medication at their first visit to the DUT CDC which accounts for the larger percentage of normotensive patients in subsample, further supporting the findings of Hagen *et al.* (2005). However, a

non-significant interaction was found between the use of anti-hypertensives and BP in relation to chronic MSCs by the authors.

Another possible explanation for the increasing presentation of chronic MSCs is the delay in seeking treatment. Patient's may perceive their symptoms to be consequences of aging and thus try to manage themselves with the use of various medications. This is evident from the large percentage of patients who have reported the use of various OTC medications.

5.2.5.1.2 SITE OF MSC

The frequency of the site of the MSCs as demonstrated in the clinic files which demonstrated a history of CVD (n=214) are represented under Section 4.4.4.1.2.

The most frequently affected site for primary MSCs were the lumbar spine/abdomen (26.2%) followed by the cervical spine (15.4%) which is similar to that of the total sample. Of the 212 who had a history of CVD, 25.7% had a secondary MSC. The most frequently affected site for secondary MSCs were the head (5.1%) and the cervical spine (4.7%). This is in contrast to the site of secondary MSCs in the total sample as the majority were located in the lumbar spine/abdomen (4.2%) followed by the cervical spine (3.4%).

A comparison the prevalence of CVD between the two genders in the subsample as represented under section 4.4.3, demonstrates that there was a statistically significant difference in that 54.2% of CVD patients were female yet, lumbar spine complaints were most commonly reported complaint in both CVD patients and the sample as a whole. This may be ascribed to the higher prevalence of a number of risk factors associated with the occurrence of LBP in the female population, as lumbar spine complaints were also more frequently recorded in females with CVD. The females in the subsample had a higher mean age, mean BMI and were less physically active (Woolf *et al.,* 2003). The results of the current study may perhaps support the hypothesis by Kauppila and Tallroth (1993) that back pain may be an early sign of atherosclerosis (ATH). As a diet high in fat was more frequently reported by the females in the subsample, which has been closely related to hypercholesterolaemia and consequently CVD.

5.2.5.1.3 CHARACTER OF MSC

The most frequently reported character of pain documented in the subsample was sharp (19.6%) followed by dull (14.5%) for primary MSCs. As illustrated under Section 4.4.4.1.3, the most frequently reported character of pain documented in the total sample was sharp

(213) followed by dull (116) for primary MSCs, which is similar to that noted in the subsample.

Dull pain (5.1%) was reported by most CVD patients with a secondary MSC, followed by dull and aching (3.3%), while dull (37) followed by sharp (32); dull and aching (11) was reported by the majority of the total sample for secondary MSCs. This result is in contrast to the subsample, as the second most frequent character of secondary MSCs in the total sample was sharp pain.

CVD patients tended to report secondary MSCs that were dull and aching in nature. This discrepancy may be attributable to variation in the site and severity of secondary MSCs between the two samples. The head and cervical spine were the most frequently affected sites in the subsample, while lumbar spine/abdomen and cervical spine were the most frequent sites in the total sample. This study suggest that patients with CVD may be more likely for have complaints that may be associated with the pain referral of the heart, major blood vessels or lack of blood flow to the cranium. If this is the case, chiropractic interns and practitioners should take caution and conduct careful examination of these patients to exclude contraindications to chiropractic manipulation.

5.2.5.1.4 RADIATION OF MSC

The most commonly reported sites of radiation of primary and secondary MSCs in the subsample is represented under Section 4.4.4.1.4, and demonstrates that 43.9 % of primary MSCs had a site of radiation in addition to 7.1% of the 55 who also presented with a secondary MSC. When these results are compared to that of the total sample as represented under Section 4.4.1.2.3, it can be seen that there are discrepancies since only 31.5 % of primary MSCs had a site of radiation in addition to 23% of the 174 who also presented with a secondary MSC. There appears to be a higher prevalence of radiation of MSCs in CVD patients despite the considerably larger total sample of non-CVD patients. This result may be explained by the somewhat higher prevalence of multiple complaints recorded in CVD patients, as 20.7% of the total sample had a secondary MSC while 26.0% of the 212 CVD patients presented with secondary MSC.

In addition, the most common site of radiation for primary MSCs were the left leg (13.6%) followed by the right leg and right arm (9.8% each). This is similar to the most common site of radiation for primary MSCs in the total sample (N=848), which were the left leg (7.9%) followed by the right leg (6.8%), but then there is a discrepancy in that the left arm (5.8%) instead of the right arm was the third most frequent site in the total sample. This could be

attributed the frequency of MSCs affecting the left side of the body, as none of the CVD patients reported complaints at these sites. This would seem to contradict the clinical association suggested in the Section 5.2.5.1.4. It is possible that this pattern of radiation may be attributed to a silent MI which is a common presentation of MI in diabetic patients.

The right leg (2.8%) was the most common site of radiation for secondary MSCs, followed by the cervical spine, left arm and left leg (equally affected with 1.9%). In contrast to the total sample, the left leg and right leg (1.4%) were equally common sites of radiation for secondary MSCs, followed by the cervical spine (1.2%). Based on these results, it is evident that the majority of CVD patients had a secondary MSC that radiated to the right leg. As previously mentioned, LBP frequently radiates down either leg, which could explain these results. It is important to note the percentage of MSCs that radiated down the left arm in CVD patients as it is one of the first signs of underlying CVD such as coronary heart disease (CHD) and MI (WHO, 2013a). CVD is very commonly latent as in the case of CHD and can progress to advanced stages before the patient becomes aware of any symptoms (Bloomfield *et al.,* 2006). Thus timely diagnosis is imperative. However the diagnosis of MI is based on a combination of symptoms which were not assessed in this study (WHO, 2013a).

5.2.5.1.5 SEVERITY OF MSC

The majority of CVD patients who presented with a primary MSC, reported that the pain was moderate (47.7%) with 30.8% having severe pain. The majority of the patients who reported a primary MSC in the total sample, reported that the pain was moderate (52.7%) with 26.9% having severe pain.

Moderate pain (12.6%) was also most commonly reported by the 55 patients who reported a secondary MSC, with only 10.3% having severe pain. Moderate pain (11.1%) was also most commonly reported by the patients who reported a secondary MSC in the total sample, with only 6.1% having severe pain.

It is evident from these results, that severe pain was more frequently reported by CVD patients. These findings may be explained by the association between increased spreading of pain and the prevalence of CVD, HTN, more severe pain characteristics (i.e., intensity, frequency and duration), problems with common daily activities and increased health care seeking as suggested by Grimsby-Ekman *et al.* (2015). The results of the current study may also be ascribed to the use of various CVD and non-CVD medications which are associated with various side-effects that may exacerbate pre-existing MSCs. This is suggested by the percentage of CVD patients who have reported the use of various medications at their initial

visit to the DUT CDC. The use of various medications by the subsample may also allude to the possibility of self-medication by patients in an attempt to treat their symptoms. However, this may be unsuccessful as a result of the severity of their MSCs.

5.2.6 DEMOGRAPHICS OF CVD PATIENTS WHO PRESENTED TO THE DUT CDC

5.2.6.1 AGE

Age of the subsample ranged from 12 to 86 years which concurs with the findings of Maredza *et al.* (2011), who reported an increasing prevalence of CVD in SA amongst all ages. Whilst the onset of most CVDs and other chronic diseases are expected to occur in middle-aged and older age groups, it is evident from the results of the current study, that the influences of cardiovascular (CV) risk factors can commence prior to birth and mat have an impact throughout life (Steyn, 2007). This may be attributed to the effects of CV risk factors on an individual's health which then manifest as CVD (WHO, 2013a).

The mean age of the subsample was 50.38 years with the majority in the 50-59 year age group (27.6%) followed by the 60-69 year age group (22.4%), which is the expected age distribution of CVD in the SA population. The these results also concur with those of Maredza *et al.* (2011), who predicted CVD to become the leading contributor to overall morbidity and mortality in individuals over 50-years of age, along with that of the World Heart Federation, (2017) , who found the risk of CVA to double with every decade after the age of 55 years. The increasing prevalence of CVD in individuals over the age of 50 may be a consequence of lifestyle changes on CV health. Urbanisation and westernisation have also resulted in the increasing incidence of risk factors such as being overweight/obesity, cigarette smoking, alcohol consumption and unhealthy diets. Managing these risk factors can significantly reduce the occurrence of CVD in these individuals however, a large percentage of individuals do not address these. As a result, the effects of unmanaged risk factors manifest later in life.

5.2.6.2 GENDER

The gender distribution of the subsample (25.3%) is represented under Section 4.4.5.2. The majority of the subsample were females (54.2%) followed by males (45.8%). This differs from the gender distribution in the total sample where the majority were males, as well as the expected gender distribution of CVD in the general population. According to the World Heart Federation, (2016), males are at greater risk of developing CVD than pre-menopausal females as a result of the cardioprotective effects of oestrogen. However, when the age of the subsample is considered, it is evident that the majority of CVD patients were over the age of 50 which is considered the post-menopausal age in females. In addition, females

were observed to have a non-statistically significant higher mean age (52.5 years) than the males (50.0 years) in the subsample. This may account for the discrepancy in the results of the current study.

In addition, the higher prevalence CVD risk factors including physical inactivity, diet high in carbohydrates and fats; and the use of non-cardiac prescription (anti-diabetics, thyroid agents, anti-depressants, anti-epileptics, and anti-anxiety) and over-the-counter medication (NSAIDs and corticosteroids) observed in females, could account for the gender distribution of CVD demonstrated in the current study.

5.2.6.3 RACE/ETHNICITY

The race/ethnicity distribution of the subsample is represented under Section 4.4.5.3 and reveals that race was recorded in only 11.2% of the subsample. The majority of the subsample was Indian (5.1%) followed by Black African (4.2%) and White (1.3%). The race distribution in the subsample is similar to that of the total sample but deviate from the expected race distribution in SA. According to Norman *et al*. (2006), the highest mortality rates for CVDs in SA are found in the Indian population, followed by the Coloured population, while the White and Black African population have the lowest rates.

This discrepancy between the race distribution of the subsample and the SA population could be attributed to the characteristics identified in each race group. The findings of the current study suggest that the highest mean weight was recorded in the White population. The current study further demonstrates that the Black African population had the second highest mean weight and highest mean BMI, which supports the evidence of the increasing prevalence of major risk factors both in urban and rural settings in Africa (Walker *et al.,* 1997). In SA, the rapid migration of Black Africans to urban centres has led to increased poverty, obesity, HTN, and hypercholesterolaemia (Thorogood *et al.,* 2007). Dietary changes together with lifestyle and occupational changes among adults, reinforced by extensive labour migration to urban centres, foster the epidemic of CVD (Conner *et al.,* 2005).

However, race was not documented in 88.8% of the subsample which renders this variable statistically insignificant and unreliable. The reasons for the lack of documentation of this variable have been discussed under Section 5.2.3.3 of this chapter.

5.2.6.4 HEIGHT, WEIGHT AND BMI

Height and weight were utilised to calculate the BMI of each patient. BMI was then grouped into five categories as shown in Table 4.28. Majority of the patients were OB (65 collectively) followed by OW (61). The high incidence of OW and OB in the subsample is shocking as OW and OB are considered major risks for both CVD and DM (World Heart Federation, 2016). The results of the current study suggest that a relatively large percentage of patients who present to the DUT CDC are OW or OB. It is imperative for chiropractic interns to not only identify and modify this risk factor, but to also be aware of other CV risk factors that may contribute to obesity thereby increasing the risk of development of other diseases associated with obesity such as DM and LBP.

Mean height, weight and BMI of the two genders and the subsample as a whole are represented under Section 4.4.5.4, and indicate that the mean weight of the subsample was 79.0Kg and the mean BMI was 28.8. In addition, there was a statistically significant difference in the distribution of the mean height and weight between male and female. Males where shown to have a higher mean height (p=<0.001) and weight (p=0.001). In addition, a significant difference in the BMI between the genders (p=0.037) were also observed as females were shown to have a higher mean BMI than the male gender. The higher mean weight could be attributed to the higher incidence of certain CV risk factors documented in the males who presented to the DUT CDC. It is important to note that BMI is an over exaggeration of body mass as the type of body mass (muscle mass versus fat mass) is not quantified in this study. A high BMI may be attributed to greater proportion of muscle mass, which reduces the risk of CVD.

The height and weight were not documented in 33 (15.4%) and 19 (8.3%) files, respectively. DUT CDC paperwork has a designated section for documenting height and weight, in addition to calculating the patient's BMI. Thus, this information should be recorded in every patient file at the initial visit to the DUT CDC. However, the results of this study suggest that this is not the situation. It is possible that a number of patients do not know what their current weight or height is. If this is the case, tools are available to interns to assess and measure these demographics themselves, thus there is no rationale for not recording this information. Regardless of the above, this information was not documented in a number of files. This may be deduced to the intern's perception of the significance of recording and measuring these demographics or interns may be purposefully evading weight measurements to maintain patient comfort as the patient would have to be asked to step outside of the consultation room to have their weight measured by the intern.

5.2.7 PREVALENCE OF CVD RISK FACTORS AT THE DUT CDC BETWEEN 9 JUNE 2015 AND 9 JUNE 2016

5.2.7.1 NON-MODIFIABLE RISK FACTORS

5.2.7.1.1 ADVANCING AGE

The total sample ranged from 5 weeks to 86 years of age. The mean age was 37.87 years (SD 16.53 years). The age group distribution of the total sample is represented under section 4.4.2.1, and shows that the majority were young, in the 20-29 year age group (32.4%) followed by the 30-39 year age group (16.5%). The presentation of this age group to the DUT CDC is expected, considering the location of the clinic. However, these results are extremely important as CVD is no longer considered to be a disease of the elderly. At present, CVD affects individuals of working age, with more than half of deaths occurring in individuals under the age of 65 years (Heart and Stroke Foundation of South Africa, 2016). In addition, the age of the subsample who demonstrated a history of CVD ranged from 12 to 86 years, highlighting the shift in the demographics of CVD patients. This growing problem is largely attributed to our lifestyles involving unhealthy diets, excessive cigarette smoking and alcohol consumption; and the lack of physical activity (World Heart Federation, 2017). The results of the current study demonstrate that a significant amount of patients who present to the DUT CDC are young and are at risk for CVD. This emphasises the importance of the awareness of these risk factors particularly in this age group and the commencement of lifestyle management and disease prevention strategies early in life to prevent CVD later in life.

In addition, over a quarter of the total sample (27.8%) were over 50 years of age and older (50-89). While merely growing older is considered a risk factor for CVD, it has been demonstrated that SA individuals over the age of 50 years, have a higher CV risk than younger individuals (Heart and Stroke Foundation of South Africa, 2016). The results of the current study supports this finding of the Heart and Stroke Foundation of South Africa, (2016), as the majority of CVD patients were in 50-59 year age group (27.6%) followed by the 60-69 year age group (22.4%). Collectively 63.6% of CVD patients were 50 years of age and older (50-89), highlighting the prevalence of CVD in this age group.

Maredza *et al.* (2011), predicted CVD to become the leading contributor to overall morbidity and mortality in individuals over 50-years of age, which concurs with the World Heart Federation (2017). The increasing prevalence of CVD in individuals over the age of 50 may also be a consequence of lifestyle changes on CV health. Managing these risk factors in

both young and older patients can significantly reduce the incidence of CVD however, a large percentage of patients do not address them.

Furthermore, Ndetan *et al.* (2010) retrospectively reviewed 200 clinic files (100 from each of the two chiropractic teaching clinics in the US) to determine whether patients received health promotion advice when a file indicated a need for health promotion or a red-flag condition that could be helped with positive behavioural changes. Barely 50% of the patients in the sample received any advice on how to live healthier, suggesting that chiropractic interns may also not be addressing CVD risk factors present in patients presenting to chiropractic teaching clinics. Although the last mentioned study is limited to only two teaching clinics, the findings raise serious concerns, should these findings in any way be representative of chiropractic teaching institutions as a whole (Ndetan *et al*., 2010).

5.2.7.1.2 GENDER

The gender distribution of the total sample is represented under Section 4.4.2.2 and illustrates that the majority of the sample were males (53.5%). The results of this study suggest that the majority of patients seeking treatment at the DUT CDC were males, which is significant in view of the fact that males are at greater risk of developing CVD than pre-menopausal females (World Heart Federation, 2016).

In contrast to the total sample, the majority of the subsample were females (54.2%). However, when the ages of both samples are considered, it is evident that the majority of CVD patients were over the age of 50 years which is considered the post-menopausal age in females, while the females in the total sample were younger with a mean age of 39.6. These results support those of the World Heart Federation (2016), and suggest that all males presenting to the DUT CDC are at risk of developing CVD. It is thus imperative for chiropractic interns to identify and modify other lifestyle factors in males to prevent or reduce the incidence of CVD in this gender.

5.2.7.1.3 RACE/ETHNICITY

The majority of the sample in which race was recorded were Indian (4.5%) followed by Black African (4.4%). As race was not documented in 87.7% of the sample, these results are considered statistically invalid. However, should these results be indicative of the race distribution at the DUT CDC, then caution should be exercised by interns at the DUT CDC as the highest mortality rates for CVD in SA are found in Indian individuals, followed by the Coloured, White and Black African individuals (Norman *et al.,* 2006).

A survey of the CV risk factor profile of SA Indians revealed that the degree of change in CV risk factor prevalence in this population, over the past two decades, has been of epidemic proportions (Prakaschandra *et al.,* 2016). This cross-sectional study of randomly selected adults aged between 15 and 64 years of age from the suburb of Phoenix in Durban, KwaZulu-Natal measured demographic, anthropometric and biochemical variables in all participants. The mean age of the sample was 45.5 years, 47.5% were hypertensive, 20.1% had DM, 32.4% had total body obesity (high BMI) and 73.1% had an increased waist circumference. In addition, high prevalence of total body obesity (32.1%), increased waist circumference (31.3%) and insulin resistance (28.2%) were documented in the youngest age group. Over 50% of the males and 14.6% of females were current smokers and diabetic dyslipidaemia was found in 4.4% of the sample. In multivariate analysis, age, triglycerides and waist circumference measurement were significant independent risk factors associated with DM and, together with fasting glucose, also predicted HTN. Thus, timely recognition and awareness of the higher prevalence of CV risk factors in Indian patients is imperative for chiropractic interns and chiropractors, as the Indian race has been demonstrated to have a higher risk of CVD development. It is important to note that all races are at risk of CVD development as a result of their lifestyles, albeit some races have been demonstrated to have a higher CV risk.

5.2.7.1.4 FAMILY HISTORY OF CVD

Overall 603 (71.1%) of the total sample had a family history of CVD. A large percentage had a family history of multiple CVDs (15.1%). Of the 603 with a family history of CVD, 17.9% had HTN and 10.7% had peripheral vascular disease (PVD). Eighty two (9.7%) files had a history of unspecified heart disease. These findings indicate that a large percentage of patients who present to the DUT CDC at their initial visit, have a family history of CVD. It is important to note that certain individuals are at higher risk for CVD development as a result of their genetic makeup. This genetic predisposition puts an individual at higher risk of disease despite environmental factors or lifestyle choices (Steyn *et al.,* 1996). CVD with either an inherited predisposition or cause is associated with HTN, congenital heart defects and with several rare inherited connective tissue disorders (Centre for Genetics Education, 2012).

It is important to note that genetics may not be the only factor influencing the family history of CVD. Behavioural factors associated with the norms and traditions/culture of the family unit should be explored as eating behaviour is often passed on from between family members and generations.

The distribution of family history of CVD in the subsample of CVD (n=214) is similar to that in the total sample (N=848). 24.8% reported various combinations of CVD, which was the most frequently reported, followed by HTN (22.0%) and PVD (14.1%). These results support the strong association between a family history of CVD and the incidence of CVD, emphasising the importance of limiting the effects of lifestyle on CV health in these patients. However, chiropractic interns may not be advising these patients on health promotion as suggested by Ndetan *et al.* (2010). The authors established that among patients showing a family history of CVD (67 of 200) and DM (46 of 200) in their files, 12 (18%) and 26 (57%) received health promotion advice on diet and nutrition, respectively. When the risks of CVD, HTN, DM, and current overweight (OW) or obesity (OB) were combined to form a risk category for general CVD, 97 patients were observed to be at risk. Of the 97, 17.5% received advice on health promotion. However, the 97 participants with increased CVD risk were more likely to receive advice on health promotion when compared to those without CVD risk (Ndetan *et al.,* 2010).

5.2.7.2 MODIFIABLE RISK FACTORS

5.2.7.2.1 OVERWEIGHT AND OBESITY

While the majority of total sample were of normal weight (35.5%); a larger percentage had were either OW or OB (47.0% collectively). Of this 47.0%, 26.1% were OW; 17.7% were OB while only 3.3% were morbidly OB. The high incidence of OB in the total sample is alarming as OB is considered a major risk for CVD. In addition, it predisposes an individual to DM which is also a risk factor for CVD (World Heart Federation, 2016). The results of the current study suggest that a relatively large percentage of patients who present to the DUT CDC are OW or OB. It is imperative for chiropractic interns to not only identify and modify this risk factor, but to also be aware of other CV risk factors that may contribute to obesity thereby further increasing the risk of CVD development.

Mean height, weight and BMI of the two genders and sample as a whole are represented under Section 4.4.6.2.1, and reveals equally statistically significant variations in the height and weight between the two genders (p=<0.001). Males were found to have a higher mean height and weight. The higher mean weight could be attributed to the higher incidence of other CV risk factors documented in the males who presented to the DUT CDC. Females were observed to have a higher mean BMI which may be influenced by ethnic belief systems regarding body image. The SA Black culture emphasises larger body sizes which may contribute the higher prevalence of OW and OB observed in the female gender (Melnyk and Weinstein 1994; Puoane *et al.,* 2005).

BMI could not be calculated in 14.2% of files as the height and weight were omitted in 111 (13.1%) and 74 (8.7%) files, respectively. The suggested reasons for these results have been noted under Section 5.2.6.3.

5.2.7.2.2 PHYSICAL INACTIVITY

The level of physical activity of patients recorded at the initial visit is represented under Section 4.4.6.2.2 and reveals that a greater part of the total sample did not engage in any form of physical activity (33.5%). In addition, a statistically significant discrepancy was noted in the level of physical activity between male and females (p=<0.001). Females who presented to the DUT CDC tended to be less physically active compared to males. These results suggest that almost a quarter of patients who present to the DUT CDC are physical inactive, particularly females. Physical inactivity increases the risk of CHD and CVAs by 50% (World Heart Federation, 2016). Therefore it is imperative to encourage patients to engage in some form of physical activity to reduce the risk of CVD.

Exercise was simply documented as YES in 20.0% of the sample with no specification with regard to the type of physical activity. The type of physical activity was unknown in only 1.5% of the sample, where exercise was recorded as yes but the type of exercise was unclear. In 44.8% of the sample, the type of exercise was specified. Cardio (32.7%) was the most frequent type of physical activity documented followed by weight training (12.1%). These patients are reducing their risk of CVD as it has been repeatedly shown that; increased physical activity decreases the relative risk of developing CVD (Buttar *et al.,* 2005). This once more emphasises the impact of physical inactivity on CV health.

While physical activity forms a component of every individual's life, it is the degree of physical exertion that differs amongst individuals. In terms of defining physical activity, there are four areas of interest that is, intensity, mode, duration and frequency (Buttar *et al.,* 2005). As these aspects of physical activity were not documented, it is difficult to determine the exact level of physical activity of the patients that seek treatment at the DUT CDC.

5.2.7.2.3 BLOOD PRESSURE ABNORMALITIES

Blood pressure (BP) readings recorded at the initial visit are represented under Section 4.4.6.2.3 and were classified into six categories. Majority of the total sample was categorised as normotensive (58.7%). These results may be misleading as hypertensive patients who may be adhering to the management plan as recommended by their healthcare provider (this includes the use of anti-hypertensive medication), are expected to have normal or slightly raised BP. This may be ascribed to the effects of anti-hypertensives on BP. This is

alluded to by the incidence of CV medication which is represented under Section 4.4.8.1, and suggests that the use of CV medication exceeds the 214 (25.2%) clinic files with a documented diagnosed CVD. This suggests that a number of patients may possibly not have reported a diagnosed CVD for which they were being treated at the time of their first visit to the DUT CDC. It is also possible that patients may have not reported a history of HTN due to the effects of anti-hypertensives on their blood pressure. Anti-hypertensives lower BP and as a result, the patient may consider themselves as normotensive or pre-hypertensive thus discontinue the use of or not reporting the use of anti-hypertensives.

Overall 40.3% had known BP abnormalities. Of the 342 with BP abnormalities, 67.8% were pre-hypertensive and 20% had Grade I hypertension (HTN). In the total sample 36.8% were pre-hypertensive followed by normotensive (35.4%) and Grade I HTN (18.9%). This concurs with the findings of the Heart and Stroke Foundation of South Africa (2016), who reported that 75% of individuals with HTN are unaware that they have it. HTN is considered a silent killer as it is asymptomatic until the disease progressed to advanced stages. A MI or CVA may be the first sign of underlying disease (WHO, 2013a).

The results of this study suggest that, a significant number of patients who seek treatment at the DUT CDC have undiagnosed and untreated HTN, which suggests a higher prevalence of CVD than previously noted in the sample. Patients may also assume that anti-hypertensive medication returns BP to normal and it therefore is no longer a problem.

There are many suggested reasons for this high incidence of undiagnosed/unrecognised HTN. Firstly, HTN disproportionally affects poor individuals residing in urban settings, as lifestyle changes are made through urbanisation of the rural areas (Mayosi *et al.,* 2009). These individuals may be unable to afford medical care, have poor diets and have become physically inactive leading to poor health. Secondly, there may be a lack of good infrastructure to educate individuals on lifestyle modification (Mayosi *et al.,* 2009). Hence, it is imperative for the low levels of education in poor communities are addressed and ensure availability of adequate medical care for NCDs. This is reflected within SA as there is a quadruple burden of disease. HIV/AIDS is extremely prevalent and many of the medical resources have been immersed into education and awareness of HIV/AIDS, leaving individuals uneducated on NCDs induced by their choice of lifestyle (Econex, 2009).

Untreated HTN may overburden the heart and blood vessels thus resulting in aneurysms; ATH or weakening of arteries throughout the body especially those in the heart, brain, kidneys, and lower extremities which may result in a MI; CVA; kidney failure; heart failure or

rupture or haemorrhage of the blood vessels in the eyes, which may result in visual changes and blindness (Steyn, 2007; WHO, 2013a; World Heart Federation, 2017).

This risk factor can be prevented and successfully treated but only if the diagnosis is confirmed by a healthcare provider and the patient adheres to the recommended management plan (World Heart Federation, 2016). HTN is manageable by living healthily and utilising anti-hypertensive medication (Steyn, 2007). Thus, timely recognition by the intern and referral to the patient's general practitioner to prescribe antihypertensive medication; is necessary to prevent the adverse consequences of HTN. It is also important for the intern to address lifestyle modification and emphasise the importance of adhering to the management plan as recommended by the World Heart Federation (2016). However, no documented attempts to deliver health promotion advice was noted in the sample which concurs with Ndetan *et al.* (2010), who suggest that a large percentage of patients who seek treatment at chiropractic teaching clinics do not receive advice on how to live healthy. The authors assessed the documented attempts to provide health promotion advice to patients at two chiropractic teaching clinics in the US, by retrospectively reviewing 200 patient files (100 from each of the two clinics) to assess whether health promotion advice was given to patients when a file indicated a need for health promotion or a red-flag condition that could be helped with positive behavioural changes. Of the 23 patients who were hypertensive (HTN) (12 from Campus 1 and 11 from campus 2), only five received health promotion advice. Eleven patients were found to have red-flag risk factors related to HTN, such as a personal medical history of HTN and a BP reading of >120/80mmHg, five of which received health promotion advice. Of those with a history of HTN, but were not diagnosed with HTN at the time, 5/14 received advice (Ndetan et al., 2010).

A statistically significant variation in BP abnormalities between the two genders (p=0.001) were observed. BP abnormalities were more frequently recorded in males who presented to the DUT CDC. This is in keeping with the findings by the World Heart Federation (2016) who demonstrated that males are at greater risk of developing CVD than pre-menopausal females. A number of CV risk factors were found to be more prevalent in males, thus accounting for the higher prevalence of HTN in males. According to the WHO (2013a), these risk factors may show up in individuals as HTN and include alcohol use (p=<0.001), current (p=0.137) and previous tobacco use (p=0.095), being OW and OB (p=<0.001) and physical inactivity (p=<0.001).

BP could not be recorded in eight (0.9%) clinic files. This was as a result of the lack of availability of paediatric or larger BP cuffs at the DUT CDC. These patients were either too

small (e.g. paediatric patients) or too large (e.g. overweight/obese patients) to have their BP measured with a standard BP cuff with which interns are equipped.

5.2.7.2.4 TOBACCO USE

Current and previous tobacco use is represented under Section 4.4.6.2.5 and illustrate that the majority of the total sample, were non-smokers followed by those who have not previously smoked. However, passive smoking which is also considered a risk factor for CVD is often not addressed when patients are asked about their smoking status, which is evident from the lack of documentation of this information in the files that were analysed in this study. Interns may possibly be omitting this information as a result of a lack of knowledge of the effects of passive smoking. Another possible explanation is the lack of a demarcated section to document exposure to tobacco in DUT CDC paperwork, which is something that the DUT CDC should address, as passive smoking exposes an individual to similar disease risks as those who smoke tobacco (Peto *et al.,* 1992; Peto, 1994; Ezzati *et al.*, 2004).

Overall, 18.3% were currently smoking. Cigarette smoking or the use of any other tobacco products has been proven to be fatal to an individual's health. Tobacco use results in premature mortality as a result of various diseases. Most deaths are as a result of CVD (MI and CVA) (Peto, 1994; Ezzati *et al.,* 2004). Smoking cessation should be addressed by every chiropractic intern and chiropractor. However, no documented attempts were identified in the files of patients who presented to the DUT CDC in this one year period with regards to smoking cessation advice. This is in keeping with the findings of Hawk *et al.* (2005), who found that approximately 40% of patients who sought treatment at nine different chiropractic teaching clinics, had been advised to refrain from smoking and even less were equipped with information on how to do so successfully. Another study asked graduating interns at a chiropractic teaching clinic about their intention to perform health promotion measures in practice and specifically asked about a number of health promotion behaviours. While the majority of interns (>85%) said they planned on using health promotion in practice, interns were more likely to say they would advise "all" patients on exercise, for example, rather than on stress or smoking (Evans *et al.,* 2009).

Over seventeen percent of the total sample has previously smoked at the initial visit to the DUT CDC. Cessation of tobacco use can significantly reduce the risk of CVD, irrespective of the duration of smoking (World Heart Federation, 2016). However, the highly addictive characteristics of nicotine and a lack of alternative nicotine products make it challenging for individuals who have the desire to quit (Farsalinos *et al.,* 2014). However, with the

introduction of alternative and much safer sources of nicotine, smokers have the ability to reduce smoking-related diseases, including CVD. With the increasing use and awareness of alternative nicotine devices such as electronic cigarettes (ECs) much focus has been placed on the safety and appropriateness of its use. The Division of Pharmaceutical Analysis of the United States Food and Drug Administration (FDA), (2009) findings suggested that ECs expose users to toxins and carcinogens similar to those associated with cigarette smoking (Farsalinos *et al.,* 2014). Thus electronic nicotine delivery devices, including ECs, should not be promoted as a safe alternative to cigarette smoking as recommendation by WHO study group (2009).

In addition, other smoked forms of tobacco such as cigars, bidis, kreteks and water pipes have become highly popularity and are often mistakenly perceived as less hazardous than cigarettes, when in truth their health burden is similar (O'Connor, 2011). Literature on the effects of water pipes is less persuasive than that for cigarettes or smokeless tobacco (WHO Study Group on Tobacco Product Regulation, 2005), but it indicates that its use is associated with cancer, CVD, lung function, infectious diseases and reproductive effects (Akl *et al.,* 2010; England *et al.,* 2010; Raad *et al.,* 2011). Thus, it is important to identify all types of tobacco use in patients who present to the DUT CDC as well as in private practice. However, cigarette smoking was the only form of tobacco use noted in the files of patients who presented to the DUT CDC. Interns, akin to the general public, may perceive these products to be less hazardous than cigarette smoking and may thus not enquire about the use other tobacco products.

5.2.7.2.5 ALCOHOL USE

A large percentage of the total sample was documented to not use alcohol (53.3%). However, almost half of the sample was currently consuming alcohol (46.3%). The effects of alcohol consumption on the heart and CV system, has been shown to be both beneficial and detrimental. The chronic abuse of alcohol is evidently associated with numerous harmful effects, such as HTN, HF, bleeding disorders, atrial fibrillation, cardiomyopathies and haemorrhagic CVA (Hines *et al*., 2001; Watson *et al*., 2003). As previously mentioned, alcohol consumption may also be cardioprotective. It has long been suspected that the moderate consumption of alcohol may be beneficial to CV health by protecting against morbidity and mortality associated with CHD and possibly thrombotic CVAs (Watson *et al*., 2003). A review of numerous studies on the moderate alcohol consumption and CHD, demonstrated that the mechanisms by which alcohol affects the CV system, as well as many other organ systems, are complex. These mechanisms in include the effects of alcohol on HDL levels, genetic factors and the alcoholic beverage type consumed (Hines *et a*l., 2001).

Based on a review of the literature regarding alcohol consumption and CVD development (Hines *et al*., 2001; Watson *et al*., 2003), it is evident that there are various factors which influence the impact of an individual's health, and these should be considered when identifying patients that are at risk of developing CVD as a result of alcohol use. Thus, the results of this study provide no clear indication as to the number of patients who are at risk of CVD, as the type of alcoholic beverage, the quantity and frequency of alcohol consumption; and the duration of alcohol use could not documented in the sample, as this information was not recorded in the files that were analysed. A possible explanation for this finding is layout of DUT CDC paperwork. Although it includes an opening to document alcohol use, it is labelled simply as alcohol. This leaves this risk factor open to interpretation of the intern. Firstly, interns may interpret this as a closed ended question, thus providing either YES or NO answers. They may be under the impression that simply consuming alcohol is a risk factor for CVD and thus disregard the other factors that will determine the patient's propensity to develop CVD. Secondly, interns may well address the other factors associated with alcohol use but the patient may not be forthcoming with this information.

A significant variation in alcohol use between male and female patients (p=<0.001) were demonstrated, in that males were more likely to consume alcohol. The results of the current study suggests the males who present to the DUT CDC are more likely to use alcohol and that chiropractic interns and practitioners should focus more on patient education regarding healthy quantities and duration of alcohol use in all patients but, in particular males.

5.2.7.2.6 DIET

The diet preferences of the total sample is represented under Section 4.4.6.2.6 and reveals that 10.8% were consuming diets that were high in fat and 7.4% high in carbohydrates. These results are supported by the findings of nutritional surveys conducted in SA (Ndaba, 1985; Steyn *et al.*, 2001; Steyn *et al.*, 2006; Sun *et al.*, 2007). They have revealed that individuals living in urban areas frequently consume a food high in fat, refined carbohydrates and added sugar. When compared to individuals residing in rural areas, this diet may be regarded as less healthy. A poor intake of fruit and vegetables with resultant low fibre intake, high intake of plant and animal fat, including trans fatty acids, insufficient intake of milk and other dairy products, overall increases in the calorie/kilojoule intake, which lead to increasing OW or OB, and high and increasing alcohol intake were the unfavourable trends that have often been identified in these diets (Ndaba, 1985; Steyn *et al.*, 2001; Steyn *et al.*, 2006; Sun *et al.*, 2007). A high saturated fat diet increases the risk of heart disease and CVA and is anticipated to result in approximately 31% of CAD and 11% of CVAs worldwide (World Heart

Federation, 2016). In addition, high levels of dietary sodium are associated with HTN and adverse CV health (Brown *et al.,* 2009).

A healthy diet has the ability to prevent and control CVD as it can influence modifiable risk factors such as DM, HTN and OB. Diet also tends to differ between cultures and families and may contribute to this predisposition to CVD. Most risk factors act by promoting ATH. Vascular inflammation is influenced by a high calorie intake (observed in OB and insulin resistance), alcohol, numerous vitamins, dietary antioxidants, and n-3 polyunsaturated fatty acids (PUFAs). Thus, it is imperative to educate patients on the effects of unhealthy diet and offer advice on how to eat healthier. It was observed that there were limited documented attempts to equip at risk patients with advice on healthy eating. It is possible that interns may be offering patient's advice on diet modification without documenting it, which is impossible to determine; or interns may not comprehend the value of dietary recommendations. This is another area for future studies that would be useful to aid both patient management as well as intern education about the necessity as well as the health effects of these actions on their patients.

The above is especially true in that, despite the importance of lifestyle modification, implementing and insuring adherence to dietary changes may be exceptionally difficult when managing a patient with CVD (De Caterina *et al.,* 2006). Thus, it is important to set realistic goals to ensure that the patient adheres to the recommendations, and to educate the patient on the effects of poor diet choices on CV health.

In a large percentage of the total sample diet specifications did not seem to be noted. This was documented as unspecified which constitutes 71.5% of the total sample. Thus, these results are not a true reflection of the diet preferences of the patients who present to the DUT CDC. However, this study does act as a source of information for a future study, where the influence of traditional/familial norms of eating patterns should be compared to that of genetic factors on patient presentation. They may be as important, if not more important, as genetic factors in patients presenting with CVD and MSDs.

5.2.7.2.7 DIABETES MELLITUS

In total, only 9.8% of the total sample had diabetes mellitus (DM). Of the 78 who had DM, 74.4% had unspecified DM followed by 18% who had Type 2 DM (DMT2). Notwithstanding, the low prevalence of DM in the total sample, identification of this risk factor and, lifestyle modification and education is however important as DM has been identified as a major risk factor for CVD. However, the aetiology of the high rates of CV morbidity and mortality in DM

is not completely clear (The DECODE Study Group, 1999; Muhlestein *et al.,* 2003; Nelson *et al.,* 2005; Thrainsdottir *et al.,* 2005).

DMT2, which was the second most frequent type of DM documented in the total sample, is a major risk factor for CAD and CVA. DMT2 amplify an individual's risk of developing CVD two-fold compared to an individual who does not have CVD. Thus, timely recognition is imperative so as to commence medical treatment of the condition as well as behaviour modification to reduce the effects of DM on CV health, as uncontrolled DM can result in the development of CVD at an earlier age than in other individuals and its effects will be more devastating (World Heart Federation, 2016).

A number of patients were recorded to have a combination of DM and other endocrine diseases. The most frequent combination was unspecified DM and hypothyroidism (0.4%). It is equally important to identify the presence of co-morbidities as such metabolic disorders which may also increase an individual's susceptibility to developing CVDs (Buttar *et al.,* 2005).

5.2.7.2.8 CONNECTIVE TISSUE DISEASE

In the total sample only 1.1% had a pre-existing connective tissue disease. Rheumatoid arthritis (RA) (0.8%) was the most frequently reported connective tissue disease, while systemic lupus erythematosus (SLE); ankylosing spondylitis (AS) and mixed connective tissue diseases were equally prevalent (0.1%). CVD risk is increased in a number of connective tissue diseases such as SLE, RA, systemic vasculitis and antiphospholipid syndrome. When compared to the general population, CVD risk factors are more prevalent in some of these individuals (e.g. smoking in RA and hypertension in SLE). However, these factors do not fully explain that enhanced risk (Husain *et al.*, 2010).

The reason for this accelerated process is thought to be multifaceted. Connective tissue diseases are usually characterised by chronic inflammation; as well as the use of immunosuppressive medications (e.g. corticosteroids). Immunosuppressive medication may exacerbate traditional risk factor profiles thereby contributing to CVD. This association is particularly strong in individuals with SLE. However, from a population impact, the small but significant association between RA and CHD is more relevant (Husain *et al.*, 2010).

Thus, it is important for interns and practitioners managing these conditions to be aware of the CV risk associated with these conditions; and to examine and manage these patients accordingly. For example, SLE is viewed as a CHD equivalent condition. Therefore, the

objective is rigorous control of traditional risk factors including lifestyle modification, treating cholesterol and BP to healthy levels and supporting the patient towards smoking cessation and weight reduction as suggested by Wajed *et al.* (2004).

5.2.7.2.9 HYPERCHOLESTEROLAEMIA

Seventy-four (74) files had a history of hypercholesterolaemia only. High total blood cholesterol which includes high levels of triglycerides and LDL or low levels of HDL cholesterol is referred to as hypercholesterolaemia. Hypercholesterolaemia increases the risk of CHD and CVA (World Heart Federation, 2016).

Maintaining a healthy blood lipid profile is important in minimising plaque and thrombus formation in arterial blood vessels which result in CVA and CHD (Buttar *et al.,* 2005). As previously mentioned, the majority of the total sample in which diet was specified, reported a diet high in fat which concurs with the findings of the Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, (2001), who revealed that hypercholesterolaemia in most individuals, is caused by an unhealthy lifestyle, such as the excessive consumption of fat or oily food. Changing to a healthy diet, exercising and the use of lipid- lowering medication referred to as statins, can modify an individual's blood lipid profile thereby reducing the risk of CVD (World Heart Federation, 2016).

While up to 92 patients had a history of PVDs, only six had a combination of hypercholesterolaemia and other PVDs. As the information stated in Table 4.49 indicates, there was a statistically significant difference (p=0.004) in the frequency of PVDs between the two genders. PVDs were more frequently reported in females.

5.2.7.2.10 USE OF SPECIFIC MEDICATION

A large variety of both prescription and OTC medications that may induce CVD in previously healthy individuals or exacerbate pre-existing CVD, were documented in the total sample. Of the 426 patients who reported the use non-cardiac medication, the most frequently used medications were non-steroidal anti-inflammatories (NSAIDs) [12.5%], analgesics (9.4%), anti-diabetics (7.3%) and corticosteroids (3.5%). Trends suggest that gender affected the use of non-cardiac medication. More females reported the use of NSAIDs, OCP, thyroid agents, corticosteroids and unspecified analgesics. A higher prevalence and increased incidence (Woznicki, 2014) of musculoskeletal pain has been identified in the female gender. Females have also been shown to report more musculoskeletal pain and discomfort in multiple body regions than males (Silva *et al.,* 2016). This is attributed to gonadal hormones

such as oestrogen, which lowers the pain threshold and makes females more sensitive to pain. This may result in more frequent visits by females, to their healthcare provider. In traditional medicine, general practitioners (GP) are often the first port of call for MSCs (Hagen *et al.,* 2000; Savigny *et al.,* 2009; Kinge *et al.,* 2015). Their management involves prescribing medication, providing lifestyle advice and referrals to other healthcare providers (Williams *et al.,* 2010). Thus, the use of non-cardiac medication may stem from prescriptions by the GP or through respondents seeking self-medication by obtaining OTC medication at a pharmacy.

It is important to note that all the medications listed in Table 4.50 have been identified as prescription and OTC medications that may increase the risk of/exacerbate pre-existing CVD. The high total of this table is attributable to the use of multiple prescription and/or OTC medications by a large number of patients, thereby increasing the risk of CVD development. A number of these medications may induce heart failure (HF) in patients without concurrent CVD or may precipitate the occurrence of HF in individuals with pre-existing left ventricular impairment. Although, drug-induced HF may play a role in only a minority of individuals presenting with HF, it should be regarded as a potentially preventable cause of this type of CVD (Feenstra *et al*., 1999). Furthermore, the awareness of interns and practitioners of the potential adverse effects on CV function by numerous classes of medications, in both previously healthy individuals and those with pre-existing CVD, may contribute to timely diagnosis and prevention of drug-induced CVDs particularly HF.

Collectively, 4.4% of the total sample was currently using hormones in the form of the OCP [2.2%]; HRT [1.5%]; intramuscular contraceptive injection (0.5%), fertility treatment (0.1%) and androgen therapy (0.1%). Hormones such as OCP and HRT may increase the risk of CVD in healthy individuals (Buttar *et al.,* 2005; World Heart Federation, 2016). It is imperative for interns and practitioners to educate patients on the CV risks associated with the long term use of hormones in addition to identifying and modifying other risk factors that may further increase the patient's CV risk.

5.2.7.2.11 MENTAL WELLNESS

Psychological wellness was documented in 21.5% of the total sample. Of the 182, the most frequently reported psychological disorder was depression (34%) followed by anxiety (32.4%) and stress (26.4%). A chronically stressful lifestyle, social isolation, anxiety and depression have all been associated with an increased risk of CVD (World Heart Federation, 2016). Several prospective studies on healthy individuals have demonstrated the predictive role of depression or depressive symptoms in the development of CHD (Rugulies, 2002;

Wulsin *et al.,* 2003; Barth *et al.,* 2004). The risk of developing CHD was found to be 60% higher in depressed individuals.

According to Rozanski *et al. (*1999), depression is associated with poor health behaviour, maladaptive coping style, social isolation, and chronic life stress. Modifiable risk factors such as cigarette smoking, lack of exercise, an unhealthy diet, and the failure to adhere to medical recommendations mediate the relationship of depressive disorders with CHD (DiMatteo *et al.,* 2000; Ziegelstein *et al.,* 2000). This highlights the value of identifying and modifying traditional risk factors consequently preventing the adverse effects of lifestyle on overall health.

CVD prevention in patients with psychological disorders should not be limited to lifestyle modification, as a perceived lack of emotional support and social isolation have also been associated with CHD and depression (Kaplan *et al.,* 1993; Segrin, 2000). Psychosocial stressors are recognized predictors of depression in patients with CHD in addition to the prognosis of CHD in these patients (Krishnan *et al.,* 1998; Hemmingway *et al.,* 1999). It is evident that CVD prevention in this population encompasses both physical and emotional wellbeing. It is imperative for interns to be aware of these relationships, as the results of this study suggest that nearly a quarter of patients who seek treatment at the DUT CDC had a form of psychological disorder.

5.2.8 PREVALENCE OF NON-MODIFIABLE AND MODIFIABLE RISK FACTORS IN CVD PATIENTS WHO PRESENTED TO THE DUT CDC

5.2.8.1 NON-MODIFIABLE RISK FACTORS

Age, gender and race which have been recognized as non-modifiable risk factors for CVD, have been discussed under Section 5.2.6 as demographics of CVD patients who presented to the DUT CDC between 9 June 2015 and 9 June 2016. While these risk factors cannot be modified, it is imperative too that they are identified as these risk factors in combination with other lifestyle factors, may affect the disease prognosis and the patient's overall health.

5.2.8.1.1 FAMILY HISTORY OF CVD

Of the subsample (n=214) 89.7% had a family history of CVD. A large percentage had a family history of multiple CVDs (24.8%). Of the 192 with a family history of CVD, 22.0% had hypertension (HTN) and 14.1% had PVD. In 23 (10.7%) files the type of CVD was not specified, these were documented as unspecified heart disease. These findings indicate that a large percentage of CVD patients who present to the DUT CDC at their initial visit, have a

family history of CVD. These results support those Steyn *et al.* (1996), who suggested that certain individuals have a genetic/traditional/familial predisposition which puts an individual at higher risk of CVD despite environmental factors or lifestyle choices. CVD with either an inherited predisposition or cause is associated with HTN, congenital heart defects and with several rare inherited connective tissue disorders (Centre for Genetics Education, 2012).

The distribution of family history of CVD in the subsample of CVD patients (n=214) is similar to that in the total sample (N=848). A total of 24.8% reported various combinations of CVD, which was the most frequently reported, followed by HTN (22.0%) and PVD (14.1%). These results support the strong association between a family history of CVD and the incidence of CVD, emphasising the importance of limiting the effects of lifestyle/traditional/familial activities around food/exercise and lifestyle on CV health particularly in patients with pre-existing CVD. However, chiropractic interns may not be advising these patients on health promotion as previously demonstrated by Ndetan *et al.* (2010).

5.2.8.2 MODIFIABLE RISK FACTORS

5.2.8.2.1 OVERWEIGHT AND OBESITY

These risk factors have been discussed previously in Section 5.2.5.5, and revealed that the majority of the patients who presented to the DUT CDC with a diagnosed CVD, were OB (30.0%) followed by being OW (28.5%). A previous discussion in Section 5.2.7.2.1 highlighted the strong association between being OW and OB; and CVD. In view of this association, the results of the current study are disturbing, as it suggests that over half of patients who present to the DUT CDC with a diagnosed CVD, are OW or OB. The high prevalence of this risk factor in this sample may be attributed to a lack of patient compliance to recommendations by their healthcare provider. It is also possible that the patient was never educated or advised on the benefits of weight loss.

Mean weight in the subsample was 79.0 kg and the mean body mass index (BMI) was 28.8. A statistically significant difference in the weight distribution between male and female (p=0.001) was identified. Similarly, a significant difference in the BMI between the two genders were noted as females were shown to have a higher mean BMI (p=0.037) than the male gender. The higher mean weight could be attributed to the higher incidence of certain CV risk factors documented in the males who presented to the DUT CDC. However, as the type of body mass (muscle mass versus fat mass) was not quantified in this study the BMI could be over exaggerated. Thus, patients could have a high BMI primarily due to a greater proportion of muscle mass, which reduces their risk of CVD.

5.2.8.2.2 PHYSICAL INACTIVITY

The level of physical activity of CVD patients recorded at the initial visit is represented under Section 4.4.7.2.2, and shows that a greater part of CVD patients did not engage in any form of physical activity (50.7%). Although a lack statistically significant variation in the level of physical activity among male and females (p=0.121) was observed, the females who presented to the DUT CDC tended to be less physically active compared to males. The results of this study suggest that over 50% of CVD patients who present to the DUT CDC were physically inactive, which raises concern. As previously mentioned, the incidence of CVDs is directly affected by the level of exercise (Buttar *et al.,* 2005). Thus, a lack of exercise in patients with an existing CVD, may affect the disease prognosis. It may result in the development of other co-morbid pathologies that are also associated with this risk factor thus having a negative impact on the patient's overall health. Therefore, it is imperative to encourage patients with CVD to engage in exercise to reduce the duration of the disease; and improve their prognosis and overall health.

Exercise was simply documented as YES in 17.3% of the subsample with no specification with regard to the type of physical activity. The type of physical activity was unknown in only 1.4%, where exercise was recorded as yes but the type of exercise was unclear. In 30.4% of the subsample, the type of exercise was specified. Cardio (23.9%) was the most frequent type of physical activity documented followed by weight training (6.5%). While just over a quarter of the subsample were documented to engage in physical activity thus reducing the effects of physical inactivity on CV health, in addition to improving their prognosis, the majority of the sample did not address this risk factor. This is particularly concerning as it implies that these patients may not have been educated on the benefits of exercise on CV health; advised to engage in physical activity (moderated by the stage of the CVD) by their healthcare provider or they may have been advised to do so, yet failed to comprehend the value of this intervention.

The exact level of physical activity of the patients that seek treatment at the DUT CDC could not be determined as the various aspects of physical activity were not documented in the files that were analysed.

5.2.8.2.3 BLOOD PRESSURE ABNORMALITIES

The blood pressure (BP) recordings of the patients who demonstrated a history of CVD are represented under Section 4.4.7.2.3, and reveals that less than 40% of the subsample were normotensive (35.4%). Collectively, the majority of the patients with a diagnosed CVD (63.3%) were hypertensive with 36.8% of the subsample categorised as pre-hypertensive,

18.9% as Grade I HTN, 3.8% as grade 2 and 3.8% as grade 2I. When these results are compared to the number of patients who reported HTN as a diagnosed CVD at their initial visit to the DUT CDC, the prevalence of HTN is almost four times higher. Nearly 12% of the sample reported to have been diagnosed with HTN only and 13.8% of the subsample had a combination of HTN and other CVDs.

It is probable that patients with CVD may be unaware of co-morbid pathologies such as HTN, as HTN is known to be asymptomatic and was therefore not reported (See discussion in Section 5.2.7.2.3). Furthermore, non-compliance to anti-hypertensive medication and lifestyle modification advice provided by a healthcare provider may also account for this frightening result. If the latter is true, chiropractic interns and chiropractors must be able to identify patients who are not compliant and educate them on the increased risk of disease progression and mortality as a result of their behaviour.

A non-statistically significant gender variation in BP (p=0.417) was noted, although more females had normal BP reading than males. This discrepancy may be attributed to numerous reasons. Firstly, a higher prevalence of HTN has been reported in the male gender in the general population (Heart and Stroke Foundation of South Africa, 2006). The results of the current study concur with the expected gender distribution of HTN (Steyn, 2007). Moreover, a higher prevalence of certain risk factors has been documented in the male CVD patients who presented to the DUT CDC. Lastly, females tend to be more compliant when it comes to taking medication. Thus the continued use of anti-hypertensives by females may explain the higher prevalence of normal BP.

5.2.8.2.4 TOBACCO USE

Current and previous tobacco use is represented under Section 4.4.7.2.4, and demonstrate that the majority of CVD patients who present to the DUT CDC (n=214), are non-smokers (87.4%) followed by those who have not previously smoked (83.6%). However, passive smoking or exposure to tobacco smoke along with the use of other types of tobacco products such as cigars, bidis, kreteks, electronic cigarettes (ECs) and water pipes were not documented in the files that were analysed in this study. As mentioned previously, this may be attributed to the layout of the DUT CDC paperwork; the interns' lack of knowledge of the effects of passive smoking or the interns' and the general public's misconception of these products as less hazardous than cigarette smoking. Thus, the intern may not enquire about the use of other tobacco products, thereby omitting this information in the patient's history. It is imperative that the DUT CDC addresses the layout of clinic paperwork, as passive smoking and the use of other tobacco products expose an individual to similar disease risks

as those who smoke tobacco (Peto *et al.,* 1992; Peto, 1994; Ezzati *et al.*, 2004; WHO Study Group on Tobacco Product Regulation, 2005; United States FDA, 2009; Akl *et al.,* 2010; England *et al.,* 2010; O'Connor, 2011; Raad *et al.,* 2011; Farsalinos *et al.,* 2014).

Twelve percent were currently smoking at the initial visit to the DUT CDC. Cross tabulations of smoking status between male and female, yielded statistically insignificant results (p=0.252 for current smokers and p=0.260 for ex-smokers), although more males were recorded to be current smokers in addition to ex-smokers. Cigarette smoking or the use of any other tobacco products has been proven to have adverse effects on an individual's health as it results in pre-mature mortality as a result of various diseases (with most deaths as a result of CVD) (Peto, 1994; Ezzati *et al.,* 2004). Continued use of tobacco products following the diagnosis of a CVD can have detrimental effects of an individual's CV health and prognosis. Smoking cessation should be addressed by every chiropractic intern and chiropractor particularly in patients with pre-existing CVD.

In contrast, 15.9% of the subsample has previously smoked at the initial visit to the DUT CDC. While cessation of tobacco use can significantly reduce the risk of CVD, irrespective of the duration of smoking (World Heart Federation, 2016), these results suggest that a relatively small percentage of CVD have been advised on smoking cessation by their healthcare provider. Complete cessation of smoking offers the best prognosis for smokers particularly in patients with CVD. However, no documented attempts were identified in the files of patients who presented to the DUT CDC between 9 June 2015 and 9 June 2016 with regards to smoking cessation advice, which concurs with the findings of Hawk *et al.* (2005), who found that less than 50% of patients who presented to chiropractic teaching clinics had been advised on smoking cessation. A smaller percentage of these patients were equipped with specific information on how to do so successfully which might be expected since the majority of chiropractic interns were more likely to say they would advise "all" patients on exercise, for example, rather than on stress or smoking (Evans *et al.,* 2009).

5.2.8.2.5 ALCOHOL USE

A large percentage of the subsample was documented to not use alcohol (62.1%). However, almost a quarter of the subsample was currently consuming alcohol (37.9%). The effects of alcohol consumption on the heart and CV system, has been shown to be both beneficial and detrimental with the chronic abuse of alcohol being associated with negative effects on both CV and overall health (Hines *et al*., 2001; Watson *et al*., 2003), while moderate alcohol consumption may be cardioprotective (Watson *et al*., 2003).

Hines *et al*. (2001) and Watson *et al*. (2003) suggest that there are various factors which influence the impact of alcohol on an individual's overall and CV health. These include the type of alcoholic beverage, the quantity and frequency of alcohol consumption; and the duration of alcohol use, and should be considered when identifying patients that are at risk of developing CVD as a result of alcohol use. Thus, the results of this study provide no clear indication as to the number of CVD patients who are may be exacerbating their condition as this information was not recorded in the files that were analysed. Possible explanations for this finding have been discussed previously (see Section 5.2.7.2.5).

A significant variation in alcohol use between male and female patients (p=0.001) were demonstrated, in that males were more likely to consume alcohol, which concurs with the Global Status Report on Alcohol and Health (Country Profiles: South Africa) released by the WHO (2011), which reported a higher rate of alcohol consumption in SA males. The results of the current study suggests that males with pre-existing CVD who present to the DUT CDC are more likely to use alcohol and that chiropractic interns and practitioners should focus more on patient education regarding healthy quantities and duration of alcohol use in all patients but, in particular males. In addition, the DUT CDC should amend the clinic paperwork to account for the various aspects of alcohol consumption so as to provide a more accurate representation of the patients who are at risk of developing CVD as a result of excessive alcohol consumption.

5.2.8.2.6 DIET

The diet preferences of the subsample are represented under Section 4.4.7.2.6. Majority of the CVD patients reported a diet that was high in carbohydrates (13.6%) and 4.2% was high in fat. A diet high in saturated fat enhances the risk of CVD and is estimated to result in approximately 31% of CAD and 11% of CVAs worldwide (World Heart Federation, 2016). Similarly, nutritional surveys conducted in SA by Ndaba (1995); Steyn *et al.* (2001); Steyn *et al.* (2006) and Sun *et al.* (2007), identified undesirable trends in SA diets. Nonetheless, the undeniable association between CVD and unhealthy diet, it is evident from the results of this study that 17.8% of CVD patients who present to the DUT CDC are consuming foods that may have detrimental effects on an previously compromised CV system.

It is imperative to note the high prevalence of carbohydrate-based diets. The results of this study suggest that the majority of CVD patients (13.6%) who present to the DUT CDC reported consuming a diet high in carbohydrates. This suggests that a high level of carbohydrate consumption is a better predictor of CVD and other non-CVD diseases than a high fat intake. This has been alluded to by the Prospective Urban Rural Epidemiology

(PURE) study group (2017), who collected self-reported dietary data from 135 335 participants in 18 low, middle and high income countries, and grouped them according to the amount of carbohydrate, fat, and protein they consumed. After following the participants' health over a seven year period, researchers found that participants with the highest intake of dietary fat were 23% less likely to have died from CVD than those with the lowest consumption of fat. Conversely, for carbohydrates, participants with the highest intake were 28% more likely to have died than participants with the lowest intake. The main conclusion of this study is that a carbohydrate-rich diet was correlated with a higher risk of total mortality, whereas total fat and individual types of fat were related to lower total mortality. This is contrasting to what has been promoted publically as the total fat, saturated and unsaturated fats were insignificantly correlated with risk of MI and CVD mortality (PURE study group, 2017). Although this a large scale cross sectional epidemiological study, it is however not possible to demonstrate any causal relationships.

While dietary changes can affect the majority of modifiable risk factors for CVD, it is evident that implementing relevant and successful dietary changes is the greatest challenge in the prevention of CVD as suggested by De Caterina *et al.* (2006). Thus, the results of this study may be ascribed to a lack of compliance by CVD patients to dietary advice provided by their healthcare provider, or failure of the healthcare provider to equip the patient with the necessary tools to successfully modify this factor or both. Thus, it is important to set realistic goals to ensure that the patient adheres to the recommendations, to educate the patient on the effects of poor diet choices on CV health and offer advice on how to eat healthier to reduce the risk of mortality as a result of CVD. Although this study did not set out to look at documented evidence for implementation of advice, the lack of documenting diet preferences has been discussed previously in Section 5.2.7.2.6.

In a large percentage of the subsample diet specifications were not noted. This was documented as unspecified which constitutes 70.6% of the subsample. Thus, these results are not a true reflection of the diet preferences of CVD patients who present to the DUT CDC. In addition, there is a statistically insignificant difference in the dietary preferences between male and females (p=0.105), although females tended to consume more foods which are high in fats and carbohydrates.

5.2.8.2.7 DIABETES MELLITUS

In total, 22.0% of the subsample had DM which is comparatively higher than the 9.8% of the total sample who reported to have DM. These results support the association between DM and CVD as suggested by the World Heart Federation (2016). Of the 47 who had DM,

17.3% had unspecified DM followed by 3.7% who had Type 2 DM (DMT2). DM, particularly uncontrolled DM may have various harmful effects on CV health (World Heart Federation, 2016). Vascular disorders include retinopathy and nephropathy, PVD, CVA, and CHD. DM may also result in both systolic and diastolic HF if the heart is affected (The DECODE Study Group, 1999; Muhlestein *et al.,* 2003; Thrainsdottir *et al.,* 2005). Thus, timely identification of this risk factor, in addition to providing lifestyle modification and education, particularly in the case of DMT2 which was the second most frequently reported type of DM, are important aspects in the management of patients who are affected by both conditions.

A number of patients were recorded to have a combination of DM and other endocrine diseases. The most frequent combination was unspecified DM and hypothyroidism (0.9%) which is also higher than the prevalent endocrine disorders noted in the total sample (0.4%). This concurs with Buttar *et al.* (2005), who reported co-morbidities as such metabolic disorders to increase an individual's susceptibility to developing CVDs.

In addition, a comparison of the prevalence of endocrine disorders between male and female yielded statistically insignificant results (p=0,438), as endocrine disorders were nearly equally reported by both genders.

5.2.8.2.8 CONNECTIVE TISSUE DISORDERS

In the subsample only 2.4% had a pre-existing connective disease, which was comparatively higher than the prevalence of connective tissue disease in the total sample (1.1%). RA (1.9%) was the most frequently reported connective tissue disease. The frequency and specific types of connective tissue diseases documented in the sample are represented under Section 4.4.7.2.8. The higher prevalence of connective tissue disease in the subsample versus the total sample concurs with the findings of Husain *et al.* (2010), who reported an increased association between connective diseases such SLE, RA, systemic vasculitis and antiphospholipid syndrome and clinical CVD. This association is particularly strong in individuals with SLE. However, from a population impact, the small but significant association between RA and CHD is more relevant (Husain *et al.*, 2010).

As mentioned previously, this association may be attributed to higher prevalence of traditional CV risk factors in a number of these individuals compared to the general population (e.g. smoking in RA and HTN in SLE); chronic inflammation which is characteristic of connective tissue diseases; or the requirement for immunosuppressive therapy such as corticosteroids which may exacerbate traditional risk factor profiles and may also contribute to ATH (Husain *et al.*, 2010).

The results of the current study suggest that a small percentage of CVD who present to the DUT CDC also have co-morbidities such as connective tissue disorders. Thus, it is important for interns of practitioners managing these patients to be aware of the effects of connective tissue disease on CV health in patients with concomitant CVD; and to screen and manage these patients accordingly. According to Wajed *et al.* (2004), the management should encompass rigorous control of traditional risk factors including lifestyle modification, treating cholesterol and BP to strict targets and supporting the patient towards smoking cessation and weight reduction.

5.2.8.2.9 HYPERCHOLESTEROLAEMIA

While up to 40.7% of CVD patients had a history of PVDs, only 2.3% had a combination of hypercholesterolaemia and other PVDs. The majority of CVD patients had a history of hypercholesterolaemia only (24.3%). The results of this study suggest that almost a quarter of CVD patients who present to the DUT CDC have been diagnosed with high total blood cholesterol levels. Maintaining a balanced blood lipid profile has been shown by Buttar *et al.* (2005), to be clinically essential in minimising the formation of plaques and thrombi in arterial blood vessels which result in CVA and CHD. This may suggest that patients with hypercholesterolaemia may not be adhering to recommendations by their healthcare provider which consist of the continuous use of lipid lowering drugs (statins), exercising and consuming a diet that is low in fat (World Heart Federation, 2016). The latter is supported by previously reported findings, where the majority of CVD patients reported a diet high in fat. This concurs with the findings of the Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection (2001), who revealed that hypercholesterolaemia in most individuals, is due to an unhealthy lifestyle, such as the excessive consumption of fat or oily food.

While up to 2.3% had a combination of PVD, a statistically insignificant difference (p=0.125) in the frequency of PVDs between the two genders was noted, although PVDs were more frequently reported in females.

5.2.8.2.10 USE OF SPECIFIC MEDICATION

The frequency of the use of non-cardiac medication reported by CVD patients are represented under Section 4.4.7.2.9, and shows that a large variety of both prescription and OTC medications that may induce CVD in previously healthy individuals or exacerbate pre-existing CVD, were reported in the subsample. Of the 178 CVD patients who reported using these medications, the most frequently used medications were NSAIDs (19.2%) followed by anti-diabetics (18.2%) and unspecified analgesics (12.1%). The high frequency of the use of

these medications, is attributable to the use of more than one type of prescription and/or OTC medications by a large number of CVD patients which may have adverse effects on a previously healthy and diseased CV system. This coincides with the statement released by the American Heart Association (2016) who identified these medications as risk factors for the development of CVD.

It is important to note that a number of the medications identified by the American Heart Association (2016), include the use of anti-hypertensive medications which have been documented under Section 5.2.9, and may induce heart HF in patients without concurrent CVD or may precipitate the occurrence of HF in individuals with pre-existing left ventricular impairment. Although, drug-induced HF may play a role in only a minority of individuals presenting with HF, it should be regarded as a potentially preventable cause of this type of CVD (Feenstra *et al*., 1999). Furthermore, the awareness of interns and practitioners of the potential adverse effects on CV function by numerous classes of medications, in both previously healthy individuals and those with pre-existing CVD, may contribute to a timely diagnosis and prevention of drug-induced CVDs particularly HF. Thus, it is important as a healthcare provider to be aware of the various medications that patients may be using as well as possible drug interactions between cardiac and non-cardiac medications. Additionally, patients with pre-existing CVD should be educated on the effects of seeming harmless prescription and OTC medication which are used for the treatment of pain.

Collectively, 5.7% of the subsample was currently using hormones in the form of the OCP (2.8%); HRT (2.3%); intramuscular contraceptive injection (0.5%) and androgen therapy (0.5%). The use of hormones by CVD patients is relatively higher than that of the total sample (4.4%). This supports the findings by Buttar *et al.* (2005) and the World Heart Federation (2016), who suggest hormones such as OCP and HRT to increase the risk of CVD in healthy individuals. It is imperative for interns and practitioners to educate patients on the CV risks associated with the long term use of hormones in addition to identifying and modifying other risk factors that may enhance the patient's CV risk.

5.2.8.2.11 MENTAL WELLNESS

The state of psychological wellness was documented in only 26.6% of the subsample. Of the 57, the most frequently reported social factor was depression (9.4%) followed by anxiety (8.4%) and stress (6.5%). Other less frequently reported social factors are listed in Table 4.67. These findings support the proven association between mental wellness and the development of CVD, as over a quarter of patients who have been diagnosed with a CVD reported suffering from depression, anxiety or stress (Kaplan *et al.,* 1993; Krishnan *et al.,*

1998; Hemmingway *et al.,* 1999; DiMatteo *et el.,* 2000; Segrin, 2000; Ziegelstein *et al.,* 2000; Rugulies, 2002; Wulsin *et al.,* 2003; Barth *et al.,* 2004; World Heart Federation, 2016).

It is possible that these conditions were possibly overlooked by the patient's healthcare provider. The patient may have not reported experiencing symptoms of depression, anxiety or stress to their healthcare provider due their perception of the seriousness of their condition or a lack of knowledge on the effect of these conditions on their health. Additionally, patients may be reluctant to report these conditions for the fear of being criticised. Another possible reason for the prevalence of psychological conditions in this sample is a lack of compliance to their prescribed medication to manage these conditions.

The presence of these conditions in both CVD and non-CVD patients, highlights the importance of holistic treatment and management of all patients, as promoted by the chiropractic profession. All patients who present to chiropractic interns and practitioners should be assessed to identify the presence of psychological disorders and non-compliance to medication, as the presence of the above in both healthy and diseased patients may have various adverse effects on their general health, particularly their CV health.

5.2.9 THE USE AND TYPE OF CVD MEDICATION UTILISED BY PATIENTS WHO PRESENTED TO THE AT THE DUT CDC BETWEEN 9 JUNE 2015 AND 9 JUNE 2016

5.2.9.1 INCIDENCE OF CVD MEDICATION AT THE DUT CDC

A total of 240 (28.3%) patients in the total sample (N=848) reported the use of cardiac medication, which is represented under Section 4.4.8.1. Based on these results, it is evident that the use of cardiac medication exceeds the 214 (25.2%) patients who reported a diagnosed CVD. It stands to reason that a number of patients may have been utilizing more than one type of cardiac medication. This is alluded to by the presence of more than one type of CVD reported by a number of patients who presented to the DUT CDC with a diagnosed CVD. In addition, multiple CV medications are often warranted for the medical treatment of a single CVD. Some of the major types of commonly prescribed CV medications used to improve and treat the symptoms of CVD include (American Heart Association, 2012): anticoagulants, anti-platelet agents, angiotensin- converting enzyme (ACE) inhibitors, angiotensin 2 receptor inhibitors, *beta* blockers, calcium channel blockers, diuretics, vasodilators and statins which have all been reported by the sample.

It is important to note that a percentage of the total sample were observed to use CV medication but did not report a diagnosed CVD at their initial visit to the DUT CDC. Patients

may assume because they are utilising medications prescribed for their CVD, they no longer have a disease. The patient's perception of the importance of reporting the presence of co-morbidities may also account for this result. This alludes to patients' perception and lack of knowledge of the scope of chiropractic. Patients may recognise that chiropractors treat MSCs but may perceive them as purely musculoskeletal specialists not recognising the holistic nature and philosophy of the chiropractic profession, which is to enhance health through health promotion and prevent disease and injury (Egan, 2006). Thus patients may only report on what they consider important.

These findings may also be explained by the lack of documentation by the chiropractic intern despite a designated section in the DUT CDC paperwork. Chiropractic interns may well ask patients questions on their medical history but fail to document it in the patient's file, or they may not address patients' medical history. The latter would be very alarming considering the philosophy of the chiropractic profession (Egan, 2006).

5.2.9.2 TYPES OF CVD MEDICATION UTILISED BY PATIENTS WHO PRESENTED TO THE DUT CDC

The types of CV medication used by the patients who presented to the DUT CDC is represented under Section 4.4.8.2 and reveals that when multiple medication use is considered, overall 129 (15.2%) of the sample (N=848) were documented to use cardiac medication. Forty-six (5.5%) reported the use of one type of CVD medication. The most common single CVD medication used was unspecified anti-hypertensives (3.7%), followed by lipid lowering drugs (1.0%) and anticoagulants (0.2%). These results are expected considering that these medications are used for the medical treatment of HTN; hypercholesterolaemia; and other PVDs (e.g. DVT, PE), MI and CVD, respectively. Of the 214 patients who presented to the DUT CDC with a previously diagnosed CVD, HTN was the most frequently reported type of CVD followed by hypercholesterolaemia and other PVDs.

A large percentage of the total sample, were using a combination of CVD medication in addition to anti-diabetic medication. The most frequently identified combination was unspecified anti-hypertensives and anti-diabetics (1.3%) followed by unspecified anti-hypertensives and cholesterol-lowering drugs (1.1%), and anti-diabetics and cholesterol-lowering drugs (0.8%). These findings suggests that patients who present to the DUT CDC often present with co-morbid conditions which includes but is not limited to CVD and DM which coincides with results of several retrospective analysis of 7 478 files at the DUT CDC over an eleven year period (Jaman, 2007; Kandhai, 2007; Venketsamy, 2007).

The females who presented to the DUT CDC more frequently reported the use of CVD medication than males. Albeit this variation was statistically insignificant (*p* value was >0.05 for all types of CV medications compared), it may be attributed to the higher prevalence of CVD documented in the female gender.

The results of the current study emphasise the importance of the awareness of the use of the types of medication utilised to treat co-morbid conditions and the effects of these medications on all body systems, as the medication(s) which CVD patients have been prescribed may induce or exacerbate MSDs. This is supported by the findings of Conaghan *et al.* (2005); Beattie *et al. (*2005); Bruckert *et al*. (2005); Hagen *et al.* (2005) and Bannwarth (2007). Knowledge of the relationship between MSDs and CVDs and CV medication would allow for "optimal management of patients (i.e. avoids unnecessary investigations), early discontinuation of the offending agent, adequate treatment monitoring and/or intervention with appropriate prevention measures", as stated by Bannwarth (2007).

5.2.9.3 THE LENGTH OF TIME OF THE USE OF CVD MEDICATION IDENTIFIED AT THE DUT CDC

The length of time of the use of CVD medication at the DUT CDC is represented under Section 4.4.8.3. Nearly all patients who reported the duration of the use of medication were using CVD medication chronically. Unspecified anti-hypertensives (6.1%) and anti-hypertensives as a whole (9.4%) were taken for the longest length of time followed by cholesterol lowering drugs (5.1%). As previously stated in Section 5.2.9.2, the above-mentioned medications are prescribed for the medical treatment of HTN and PVD, respectively. These conditions along with other CVDs constitute the major contributor among NCDs (Boutayeb and Boutayeb, 2005). NCDs are mostly chronic in nature thus accounting for the frequency of chronic duration of CVD medication in the sample. Risk factors such as tobacco smoking, unhealthy diet, physical inactivity, and excessive alcohol use are directly implicated as causal factors for the chronicity of NCDs including CVD. The previously mentioned modifiable risk factors are underpinned by multiple factors including psycho-social, cultural, ethnic, and socioeconomic attributes of populations, society, and local communities, which are frequently overlooked (Ackland *et al.,* 2003). Thus, the management of CVD, which generally involves medical treatment and lifestyle modification, is complex as the prevalence of CVD is multi-factorial with many of these contributing factors being overlooked by the patient or their healthcare provider resulting in the development of the condition into chronic.

The length of time of the use of unspecified anti-hypertensives was the best documented among all cardiac medications. HTN was the most prevalent type of CVD reported by the sample which may account for this result. Furthermore, patients who are afflicted by chronic diseases are required to utilise certain medications for a prolonged period of time, and are more likely to remember and report the length of time of use of medication.

In the greater part of the total sample (N=848), the length of time for which various CVD medications were utilised, was omitted, thus these results should be considered statistically unreliable. These findings could be explained by interns' lack of knowledge of effects of prolonged use of medication, particularly cardiac medication. It is also probable that the patients who present to the DUT CDC may not be able to recall the length of time of use of medication. This may be a result of non-compliance to medical treatment due to their lack of perception of the seriousness of their condition; the patient's inability to recall this information due to the effects of age on memory; or the patient's inability recall the time of commencement of medical treatment due to lengthy use of the medication. Notwithstanding the findings of this study, it is imperative for interns and chiropractors to note the type and duration of medication used by patients, particularly in the presence of co-morbid conditions.

5.2.10 ASSOCIATIONS BETWEEN RISK FACTORS AND CVD IN PATIENTS WHO PRESENTED WITH BOTH CVD AND MSCs

5.2.10.1 MULTIARIABLE LOGISTIC REGRESSION ANALYSIS OF RISK FACTORS FOR CVD

Following adjustment for confounders/influencing factors in the multivariable logistic regression analysis, most of the risk factors and medications lost their significance. These results may perhaps have been influenced by the quantity of data regarding CV risk factors and the use of cardiac and non-cardiac medication omitted in the total sample. Firstly, the exact level of physical activity of the patients who sought treatment at the DUT CDC could not be determined as the DUT CDC paperwork did not allow for the various aspects of physical activity to be documented in the files that were analysed (Buttar *et al*., 2005). Secondly, in the greater part of the sample, the length of time for which various medications were utilised, was omitted. The effects of various medications on both the CV and musculoskeletal systems have been are directly related to the duration of use of the medication and the effects are usually reversible after discontinuation of the offending agent (Beattie *et al*., 2005). As this variable was considered statistically unreliable, it is impossible to accurately identify all drug classes which may have increased the risk of CVD in the

patients who presented to the DUT CDC. Thus better reporting and documentation of these risk factors may have influenced the results of this study.

In spite of this, the results stated in Section 4.4.9.2 along with those of Jaman (2007), Kandhai (2007) and Venketsamy (2007), suggest that patients who seek treatment at the DUT CDC may present with both MSDs and CVD. Moreover, this study suggests that an association exists between the presence of CVD and the presence of MSDs in the same patient as proposed by Kauppila *et al.* (1993), Penttinen (1994) Conaghan *et al.* (2005), Shiri *et al.* (2007) and Grimby-Ekman *et al.* (2015). It is evident from the aforementioned studies, that the relationship between CVD and MSDs is multifactorial and may involve numerous pathophysiological mechanisms which have been discussed in Section 2.5.
In this study, the correlation between CVD and MSDs may be attributed to the interaction of cardiac and non-cardiac medication, and the risk factors identified in the subsample:

Increasing/older age (p=<0.001), smoking (p=0.054), HTN (p=0.043) and family history of CVD (p=0.006) have been significantly associated with CVD in patients who presented to the DUT CDC. These risk factors have all been identified in literature as risk factors for both CVD and MSDs (Vallfors, 1985; Heliövaara *et al.,* 1991; Hoogendoorn *et al.,* 2000; Linton, 2000; Carroll *et al.,* 2003; Mirtz *et al.,* 2005; Ryall *et al.* 2007; Heneweer *et al.,* 2010*;* Roffey *et al.,* 2010a; Roffey *et al.,* 2010b; Plesh *et al.* 2011). Thus, it is plausible that the incidence and interaction of mutual risk factors in an individual could increase their risk of developing both CVD and MSDs. Both conditions may develop concomitantly or one may precede the other due to the presence of other risk factors which may increase their risk of developing that specific condition (Woolf, 2000; World Heart Federation, 2017).

Anti-hypertensives (p=<0.001) and thyroid agents (p=0.078) were significantly associated with the prevalence of CVD in patients with concomitant MSDs. These findings suggest that patients, who present to the DUT CDC with a previously diagnosed CVD, are utilising cardiac and/or non-cardiac medication. The use of cardiac medication is expected as anti-hypertensives are utilised to treat HTN (Steyn, 2007; American Heart Association, 2016). Thus, the correlation between CVD and the use of OTC or prescription medication may account for this outcome. This is supported by the American Heart Association (2016) who identified anti-hypertensives as one of the many cardiac drugs which may induce or exacerbate CVD. Furthermore, the use of cardiac and/or non-cardiac medication may also increase an individual's risk of developing MSDs (Bannwarth, 2002, Bannwarth, 2007; Meier *et al.,* 2011). This alludes to the hypothesis of drug-induced MSDs. It has been demonstrated that various drug-classes including anti-hypertensives and thyroid agents,

may induce MSDs (Bannwarth, 2002, Bannwarth, 2007; Meier *et al.,* 2011). Alternatively, cardiac and non-cardiac medications are known to have musculoskeletal side-effects. It is plausible that musculoskeletal side-effects of cardiac and non-cardiac medications are often overlooked or mistreated as purely musculoskeletal in origin which may explain the correlation between CVD and MSD.

In terms of site of the primary MSCs, patients with CVD were 7.1 times more likely to present with SI joint/pelvic pain (p=0.005). It would seem feasible that pain at this region may be attributed to LBP which is defined as pain located below the costal margin and above the inferior gluteal folds (Waddel, 2004). This may be ascribed to the statistically significant association identified between risk factors such as increasing age and smoking, and CVD. These particular risk factors have also been associated with the occurrence of LBP (Woolfe *et al,* 2003). Furthermore, Kaupilla *et al*. (1993) and Shiri *et al.* (2007) established that an association between the risk factors for CVD (particularly smoking) and LBP exists. Smoking which is a major risk factor for atherosclerosis (ATH) significantly accelerates blood vessel damage by promoting plaque formation. ATH is the most common aetiology of CVD resulting in obstruction of blood flow in the lumbar arteries (Kumar *et al.,* 2007; World Heart Federation, 2017). This may account for the tendency of CVD patients to present with MSCs located in the SI joint/pelvis.

The shoulder/brachium, head and thoracic spine/chest/ribs MSCs were also found to be associated with having CVD. This association may be attributed to pain referral from the heart, major blood vessels (aortic, carotid, vertebral and/or temporal artery) or lack of blood flow to the cranium; to the shoulder/brachium, head or thoracic spine/chest (Bloomfield *et al.*, 2006). It is also important to note the percentage of MSCs that radiated down the left arm in CVD patients which is one of the first signs of underlying CVD such as CHD and MI (WHO, 2013a). ATH is a precursor for the development CVDs such as grade 1 HTN. The alteration of blood flow to these regions may result in secondary changes in the muscle function/ability to function and/the inability of the joints to heal which may lead to increased degenerative changes). Thus, it is plausible that patients with CVD may present with shoulder/brachium, head and thoracic spine/chest/ribs MSCs that may be associated with pain referred from the CV system which may be overlooked as MSDs (Bloomfield *et al.*, 2006).

It is evident from the discussion above, that numerous risk factors were demonstrated to significantly influence the presentation of MSCs between CVD and non-CVD groups. Thus, it is imperative for chiropractic interns and practitioners to identify and modify risk factors associated with both CVD and MSDs. As the aim of chiropractic therapy is health promotion

and disease prevention, management should start with lifestyle modification to prevent the incidence of disease, thereby eliminating the need for medication. With that being said, musculoskeletal side-effects of cardiac and non-cardiac medications are often overlooked or mistreated as purely musculoskeletal in origin. This is contrasting to the holistic nature of chiropractic and may result in the development of chronicity of both CVD and MSDs as the cause of the complaint is not addressed; and the drug classes identified have been implicated to induce both conditions.

Moreover, it is imperative for both chiropractic interns and practitioners to be aware of drug-induced MSDs to avoid undertaking unwarranted investigations, and allow for optimal management of patients by identifying and appropriately managing the use of the offending agent. Additionally, chiropractors should educate patients on the side-effects and health risks associated with the chronic use of these medications. Patients should be encouraged to adequately monitor their treatment and seek medical care to amend the dose or type of medication prescribed by their healthcare provider should the effects become intolerable. As a result of the above it therefore becomes possible for the practitioner to be able to more effectively address both the MSDs and the CVDs through primary prevention strategies (Baird, 2011), as the current study has shown them to be related to one another. This would result in more effective and holistic treatment for the patient with the result that there is an increase in the life span and the quality of life for patients suffering from one or both of the conditions; without the unnecessary expense of secondary and tertiary prevention measures (Omran, 2001; Ulwin *et al.*, 2006; Alwan *et al.*, 2009; Baird, 2011).

5.2.11 SUMMARY

This study set out to ascertain whether a relationship between CVD and MSD exists. Based on the results illustrated in Chapter Four, it is evident that an association exists between CVD and the presenting MSD. The current study can only speculate on causality based on known mechanisms described in literature however reverse causality may exist (viz. a lack of exercise, presence of MSCs may actually predispose to the CVDs). A longitudinal study should be undertaken to determine this causality and confirm the associations found in this study.

CHAPTER SIX

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The patients who sought treatment at the Durban University of Technology Chiropractic Day Clinic (DUT CDC) between 9 June 2015 and 9 June 2016, have been described in terms of their demographics, presenting musculoskeletal complaints (MSCs), history of cardiovascular diseases (CVD) and any risk factors associated with the development of CVD. By doing so, this study has attempted to provide a demographic and CVD profile of the patients presenting to chiropractic teaching clinics in SA.

6.2 CONCLUSION

To review the outcomes this study has set out to achieve, the conclusion will discuss the results under of each the study objectives.

6.2.1 OBJECTIVE ONE: TO DETERMINE THE NATURE OF ANY MUSCULOSKELETAL DISORDERS THAT THE PATIENT HAS PRESENTED WITH

The demographic profile of the patients that had presented to DUT CDC (as generated in this study) seemed to suggest that patients were predominantly Indian males, with a mean age of 37.87 years. Notwithstanding this, patients' ages ranged from five weeks to 86 years of age, with the majority in the 20-29 year age group.

The findings of this study showed that the majority of patients who presented to the DUT CDC between 9 June 2015 and 9 June 2016 sought treatment for a MSC, with less than a quarter presenting with a secondary MSC. The most frequently reported site for both primary and secondary MSCs was the lumbar spine/abdomen followed by the cervical spine. The majority of MSCs were of chronic duration, sharp character, no associated site of radiation and of moderate severity. While the nature of MSCs of patients who were previously diagnosed with a CVD were similar to that of non-CVD patients, insignificantly higher frequencies were noted in terms of chronic duration, radiation of pain and site of radiation, in addition to severe pain intensity.

6.2.2 OBJECTIVE TWO: TO DETERMINE THE DUAL PREVALENCE OF CARDIOVASCULAR DISEASE AMONG THE AFOREMENTIONED PATIENTS PRESENTING AT THE DUT CDC

In the 1-year period from 9 June 2015 to 9 June 2016, the prevalence of CVD was 25.2%. Despite the relatively lower prevalence of CVD at the DUT CDC compared to the expected prevalence of CVD in the general population of South Africa (SA), the presence of one or more risk factors related to the occurrence of CVD was documented in a large percentage of patients who presented to the DUT CDC (CVD and non-CVD patients). It is important to note that the prevalence of CVD determined by this study is not representative of the true prevalence of CVD at the DUT CDC. Firstly, a significant percentage of the files that were analysed were excluded (viz. research files, incomplete paperwork and files in which the initial visit was documented outside of the study timeframe). Secondly, the results of this study suggest that a larger percentage of patients did not report a diagnosed CVD at their initial visit or it may have been omitted by chiropractic interns.

6.2.3 OBJECTIVE THREE: TO IDENTIFY ANY DIAGNOSED CARDIOVASCULAR DISEASE (E.G. CARDIAC, VASCULAR)

The majority of CVD patients were diagnosed with hypertension (HTN) and peripheral vascular diseases (PVDs) including hypercholesterolaemia or varicose veins. While HTN is the most prevalent type of CVD in SA, it is also the most deadly due its silent nature as most individuals are unaware that they have it. Similarly, a significant number of patients who presented to the DUT CDC were observed to have undiagnosed or untreated HTN as the quantity of patients with BP abnormalities exceeded the number of patients who had a diagnosed CVD. This suggests a higher prevalence of HTN then previously noted.

6.2.4 OBJECTIVE FOUR: TO IDENTIFY ANY RISK FACTORS PREDISPOSING THE PATIENTS TO CARDIOVASCULAR DISEASE

The risk factors assessed in this study included non-modifiable risk factors namely advancing age; gender; race/ethnicity and family history of CVD; and modifiable risk factors namely being overweight (OW) or obese (OB); physical inactivity; blood pressure (BP) abnormalities; tobacco use; alcohol use; high fat and carbohydrate diet; diabetes mellitus (DM); connective tissue disease; hypercholesterolaemia; use of cardiac and non-cardiac medication and mental wellness. A number of risk factors present in the study's patients were significantly associated with the development of CVD. Thus, it is imperative to identify and modify these risk factors to reduce their effects on the CV system and other body systems, as a number of these risk factors have been associated with the development of other diseases, including MSDs. This can be achieved by means of educational, nutritional and activity based interventions. They should also be advised to cease harmful use of alcohol and tobacco; and avoid second-hand tobacco smoke.

In spite of this, a number of modifiable risk factors were also identified in cardiac patients. The majority of cardiac patients were OW/OB, physically inactive, hypertensive, consuming a diet high in carbohydrates, had a high total blood cholesterol (hypercholesterolaemia) and were utilising multiple non-cardiac medications. The primary goal in the management of a patient with CVD is to prevent recurrence and progression of the condition, and ultimately death. The high incidence of risk factors in the CVD patients that presented to the DUT CDC suggests that they may not have been attended to by the patient or their healthcare provider. Similarly, this study suggests that these risk factors may have been overlooked by the chiropractic interns at the DUT CDC (although this assumption requires further investigation). This study may not be representative of all patients who present to chiropractors, but it does highlight the importance the awareness of high prevalence of risk factors in patients that may seek chiropractic treatment, which if unaddressed may lead to premature morbidity and mortality.

6.2.5 OBJECTIVE FIVE: TO IDENTIFY ANY MEDICATIONS THAT THE PATIENT HAS BEEN PRESCRIBED FOR THEIR CARDIOVASCULAR DISEASE AND THE LENGTH OF TIME FOR WHICH THIS MEDICATION HAS BEEN TAKEN

Overall over a quarter of patients reported the use of cardiac medication with the majority having been prescribed multiple medications which included anti-diabetics. Anti-hypertensives, cholesterol-lowering and anti-coagulants were the most frequently reported singular medication reported. The length of time for which various CVD medications were utilised, was omitted in a greater part of the clinic files. However, nearly all patients who reported the duration of the use of medication were using CVD medication chronically.

6.2.6 OBJECTIVE SIX: TO DETERMINE IF AN ASSOCIATION EXISTS BETWEEN THE PREVALENCE OF AND RISK FACTORS FOR THE CARDIOVASCULAR DISEASE, THE PRESCRIBED MEDICATION AND THE PRESENTING MUSCULOSKELETAL COMPLAINTS NOTED

With regards to CVD and the presenting MSCs, a number of CV risk factors were demonstrated to influence the presentation of MSCs between CVD and non-CVD patients. However, once the effects of confounder variables were accounted for, there was a lack of statistical significance between a number of CV risk factors and the MSCs between CVD and non-CVD groups. Thus the use of prescription and over-the-counter medications particularly anti-hypertensives and thyroid agents, were shown to have a greater likelihood of being associated with CVD in patients who presented with MSDs. Additionally, patients in the CVD group had a greater likelihood of presenting with risk factors such as increasing age, smoking, HTN and family history of CVD. CVD patients were also more likely to present

with MSCs located in the SI joint/pelvis, thoracic spine/chest/ribs, head and shoulder/brachium.

The results of this study suggest that CVD patients who presented to the DUT CDC with certain risk factors, and utilising prescription or over-the- counter cardiac and/or non-cardiac medication, have a greater likelihood of presenting with MSDs of this nature. CVD patients are proposed to have a particular presentation of MSDs localised to the SI joint/pelvis, shoulder/brachium, head or thoracic spine/chest/ribs. The implication of this study is that it is possible that CVD patients, who frequently seek treatment at chiropractic teaching clinics and private practice, may present musculoskeletal side-effects associated with the use of cardiac and non-cardiac medications which may be misinterpreted as musculoskeletal in origin. It is imperative for chiropractic interns and practitioners to be aware of this association as it affects how these patients are currently treated and managed this affecting their prognosis.

This study suggests that very little attention is being placed on CVD prevention. It is thus vital for the chiropractic profession to modify the management of both cardiac and non-cardiac patients who seek chiropractic treatment, particularly at chiropractic teaching clinics. More emphasis should be placed on the management of the patient's lifestyle as it forms an integral part of the management of the patient in order to prevent or improve the effects of the lifestyle that the patient has on their long term health.

The next section addresses the research questions of the study.

6.3 RESEARCH QUESTIONS

6.3.1 RESEARCH QUESTION 1: WHAT IS THE PREVALENCE OF CARDIOVASCULAR DISEASE AMONGST PATIENTS WHO PRESENTED TO THE DUT CDC FROM 9TH JUNE 2015 –9TH JUNE 2016?

In this 1-year period, the prevalence of CVD at the DUT CDC was 25.2%. Since the current prevalence of CVD in the SA population is unavailable, the prevalence of CVD at the DUT CDC cannot be compared to that of the SA population. However, these results coincide with similar results achieved by Jaman (2007), Kandhai (2007), Prasad *et al*. (2013) and Venketsamy (2007), who demonstrated that patients with CVD frequently present to chiropractic teaching clinics and chiropractors. The result of the current study in addition to the above mentioned studies conducted at the DUT CDC emphasise the importance of the awareness of the prevalence of CVD in the general population.

6.3.2 RESEARCH QUESTION 2: WHAT ARE THE RISK FACTORS FOR PRESENTING WITH CARDIOVASCULAR DISEASE IN PATIENTS ATTENDING DUT CDC FROM 9TH JUNE 2015 –9TH JUNE 2016?

Patients who presented to the DUT CDC with CVD had a greater likelihood of being older (OR 1.1; *p*=<0.001) than non-CVD patients. They were 2.1 times more likely to have a family history of CVD (*p*=0.006), 2.5 times more likely to present with Grade 1 HTN (*p*=0.043). Smoking (OR 2.5; *p*=0.054) and the use of anti-hypertensive (OR 7.1; *p*=<0.001) medication was also shown to be significantly associated with having CVD. CVD patients were seven times more likely to utilise anti-hypertensive medication than non-CVD patients who sought treatment at the DUT CDC. These are expected as a correlation between the aforementioned risk factors and CVD has already been established (Steyn, 2007; Centre for Genetics Education, 2012; WHO, 2013a; World Heart Federation, 2017).

6.4 LIMITATIONS

With this study having been a retrospective, data mining study by design, several selected risk factors for CVD, for example metabolic syndrome and socioeconomic status could not be measured in this study.

The specificity of the data recorded in the clinical records was not consistent; as a result the risk for CVD due to alcohol consumption and smoking could not be determined (insufficient documentation of the frequency of alcohol consumption and the type of alcoholic beverage consumed as well as the type of smoking / frequency of smoking, respectively).

The sample size in this study was relatively small, implying that the data generated is likely to be context specific and unlikely to be generalizable (even though trends and patterns may be similar to that presented in some literature).

It is imperative to take into account the effect of language on the reporting of information as only one word for pain exists in the isiZulu language. Due to the limited knowledge on the race/ethnicity of the sample assessed, this research can only suggest that the effect of this needs to be considered in a future study.

6.5 RECOMMENDATIONS

6.5.1 RECOMMENDATIONS FOR FUTURE RESEARCH

- Clinical/experimental studies should be conducted to determine whether the selected risk factors and the use of these medications that predispose CVD patients who

present to the DUT CDC to the development of MSDs, are independently associated with these conditions. This study was designed as a cross-sectional epidemiological study, thus only evaluated the clinical presentation of both CVD and non-CVD patients who presented to the DUT CDC.

- Similar studies on CVD patients who seek treatment at the DUT CDC should be undertaken to determine the disease prevention and health promotion practices of chiropractic interns. This will reveal a more accurate representation of the documented attempts of interns to deliver lifestyle modification advice to patients.

- Prospective studies utilising a structured data collection tool should be undertaken. Interns will be required to complete all the relevant information at the patients' initial visit to the DUT CDC. This will allow for more accurate data collection.

- Qualitative research designs to evaluate patients' perceptions of the importance in reporting specific data to chiropractic interns should be undertaken.

- Qualitative studies should focus on the chiropractic intern's perception of health promotion and disease prevention activities (recorded or unrecorded) in terms of their management practices.

- Research should be conducted to determine the accuracy of reporting risk factors versus the recording or perceived importance of risk factors for the patient versus the intern in the management of non-MSCs.

- Research practice management protocols for patients is required, particularly as in upper body MSCs were shown to be associated with CVD, which may mimic the presentation of CVDs. This presents the need to assess risk-management protocols within the chiropractic practice.

- Causal relationships between the use of medication by CVD patients and the incidence of MSCs should be identified to determine whether medication initiates, exaggerates or ameliorates the pre-existing MSC.

6.5.2 RECOMMENDATIONS FOR THE DURBAN UNIVERSITY OF TECHNOLOGY CHIROPRACTIC DAY CLINIC

Recommendations for the DUT CDC include:

- Reinforcing training in the area of disease prevention and health promotion.
- Emphasising the need for increased accuracy in the recording of patient data to provide more accurate information on the practice of disease prevention and health promotion.

6.5.3 RECOMMENDATIONS FOR THE CHIROPRACTIC PROFESSION

Recommendations for the chiropractic profession include:

- Risk management strategies need to be considered in patients with a high index for CVD, especially when presenting with upper body pain.

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APPENDIX 1:

The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic.

PRE-EXPERT GROUP DATA SHEET

Does this file have any record of cardiovascular disease (CVD)			YES		NO	
Gender			Male		Female	
Age:			**Date of birth:**			
Presenting musculoskeletal compliant:						
Site/location		Headache	C/spine	T/spine	L/spine	SI Joint
Hip	Knee	Foot and Ankle	Shoulder	Elbow	Hand and Wrist	Other
Onset	Acute (1 month)	Acute on chronic	Sub-acute (1-3 months)		Chronic (>3 months)	
Character	Dull	Sharp	Tearing	Constricting	Crushing	Other
Radiation:	Neck	Jaw	Back	Right arm	Left arm	Other
Associated signs and symptoms: nausea, vomiting, sweating, dizziness, headaches, mental changes, palpitations, dyspnoea, orthopnoea, paroxysmal dyspnoea, chest pain, wheezing, haemoptysis, abdominal discomfort, oliguria, intermittent claudication, limb ischeamia						
Severity recorded at initial visit (based on NPR Scale): 1 2 3 4 5 6 7 8 9 10						
If hypertensive:	Grade I(140-159/90-99mmHg)		Grade 2 (160-179/100-109mmHg)		Grade 2I (>180/>110mmHg)	
Family history of CVD	YES (Specify)		NO		UNKNOWN	
Hypercholesterolaemia	YES		NO		UNKNOWN	
Diabetes	YES (Specify)		NO		UNKNOWN	
Exercise type:						
Alcohol	YES		NO		UNKNOWN	
Smoking	YES	NO	Started: Stopped: Duration: No. Of pack years (20 cigarettes per 1 year)			
Weight:			**Height:**			
Medication Type:	Digoxin		Cholesterol- lowering		Vasodilators	
	Beta blockers		Alpha blockers		Central agonist	
	Antiplatelets		Diuretics		Alpha- 2 receptor agonists	
	Anticoagulants		Calcium channel blockers		Peripheral adrenergic inhibitors	
	Angiotensin 2 receptor blockers		OTHER:		UNKNOWN	
Duration:	Acute (1 month)		Subacute (1-3 months)		Chronic (>3 months)	
REVIEW OF SYSTEMS: Identify symptoms of possible side-effects of CVD medication (circle appropriate symptom)						
General: fatigue/lethargy, insomnia, weight gain, skin rash, fever, anaemia, nausea, vomiting						
Hair and head: excessive hair growth, headaches *Eyes*: visual disturbance (blurred or yellow vision)						
Ear, nose and throat: vertigo, tinnitus, congestion						
Neurological: dizziness, loss of taste, dryness of the mouth, weakness, depression, postural/orthostatic hypotension						
Cardio- respiratory: palpitations, tachycardia, bradycardia, symptoms of asthma, chronic dry hacking cough						
Musculoskeletal: joint pain, muscle stiffness/cramping, muscle pain/tenderness, muscle weakness						
Peripheral vascular: peripheral cyanosis, leg cramps						
Genitourinary: constipation, swollen ankles, symptoms of kidney damage, dyspepsia, diarrhoea, abdominal pain, melaena						
Reproductive: impotence, breast enlargement						

APPENDIX 2:

The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic.

FINAL DATA SHEET

1. DEMOGRAPHICS						
1.1 Does this file have record of cardiovascular disease (CVD) at the first visit to the Durban University of Technology Chiropractic Day Clinic			YES		NO	
1.2 Gender			Male		Female	
1.3 Age:			**Date of birth:**			
1.5 Weight:		MISSING	**1.4 Race:**		UNKOWN	
1.6 Height :		MISSING	**1.7 BMI= weight/ height2 = =**		UNABLE TO CALCULATE	
2. PRESENTING MUSCULOSKELETAL COMPLAINT/S:						
2.1 PRIMARY MUSCULOSKELETAL COMPLAINT:						
2.1.1 Site/location		Head	C/Spine / Neck	T/Spine / Chest / Ribs	L/Spine / Abdomen	SI Joint / Pelvis
Hip / Thigh	Knee / Leg	Foot And Ankle	Shoulder / Brachium	Elbow / Forearm	Hand and Wrist	Other:
2.1.2 Onset of complaint	Acute	Acute on chronic	Sub-acute		Chronic	
2.1.3 Character of complaint	Aching	Boring	Burning	Constricting	Crushing	Dull
	Nagging	Piercing	Tearing	Tingling	Throbbing	Tuggi ng
	Sharp	Shooting	Splitting	Stabbing	Squeezing	
	Other					
2.1.4 Radiation of complaint			YES		NO	
2.1.4.1 Site of radiation	Jaw	Left arm	Left leg	Low back	Neck	
	Pelvis	Right arm	Right leg	Thoracic	Other	
2.1.5 Severity of complaint recorded at initial visit			Mild	Moderate	Severe	
2.2 SECONDARY MUSCULOSKELETAL COMPLAINT (if applicable):						
2.2.1 Site/location		Head	C/Spine/Neck	T/Spine / Chest / Ribs	L/Spine / Abdomen	SI Joint/ Pelvis
Hip/Thigh	Knee/Leg	Foot/Ankle	Shoulder / Brachium	Elbow / Forearm	Hand and Wrist	Other :
2.2.2 Onset of complaint	Acute	Acute on chronic	Sub-acute		Chronic	
2.2.3 Character of complaint	Aching	Boring	Burning	Constricting	Crushing	Dull
	Nagging	Piercing	Tearing	Tingling	Throbbing	Tuggin g
	Sharp	Shooting	Splitting	Stabbing	Squeezing	
	Other					
2.2.4 Radiation of complaint			Yes		No	
2.2.4.1 Site of radiation	Jaw	Left arm	Left leg	Low back	Neck	
	Pelvis	Right arm	Right leg	Thoracic	Other	
2.2.5 Severity of complaint recorded at initial visit			Mild	Moderate	Severe	

3. CARDIOVASCULAR DISEASE RISK FACTORS					
3.1 Blood pressure (mmHg)					
3.1.1 If hypertensive	Grade I(140-159/90-99mmHg)		Grade 2 (160-179/100-109mmHg)	Grade 2I (>180/>110mmHg)	
	Hypotensive (70-90/40- 60mmHg)		Normotensive (>90- <120/>60- <80mmHg)	Prehypertensive (120-139/80-89mmHg)	
3.2 History of CVD					
3.2.1 Peripheral vascular (e.g. Hypercholesterolaemia	YES	Specify		NO	NOT APPLICABLE
3.2.2 Cardiac	YES	Specify		NO	NOT APPLICABLE
3.2.3 Haematological	YES	Specify		NO	NOT APPLICABLE
3.2.4 Endocrine	YES	Specify		NO	NOT APPLICABLE
3.2.5 Other (e.g. congenital, connective tissue disorder)	YES	Specify		NO	NOT APPLICABLE
3.3 Family history of CVD					
3.3.1 Peripheral vascular	YES	Specify		NO	NOT APPLICABLE
3.3.2 Cardiac	YES	Specify		NO	NOT APPLICABLE
3.3.3 Haematological	YES	Specify		NO	NOT APPLICABLE
3.3.4 Endocrine (e.g. Diabetes mellitus)	YES	Specify		NO	NOT APPLICABLE
3.3.5 Other (e.g. congenital, connective tissue disorder)	YES	Specify		NO	NOT APPLICABLE
3.4 History of other:					

3.5 Exercise	YES	NO	Cardio	Weight training
3.6 Alcohol	YES	NO	UNKNOWN	

3.7 Smoking	**3.7.1 Currently**	YES	NO
	3.7.2 Previously	YES	NO

3.8 Diet	Vegan	Vegetarian	High carbohydrate	High fat	High protein	Unspecified	Missing
	Diet supplementation:						

4. CARDIAC MEDICATIONS					
Medication Type:	Yes	No	Duration (acute)	Duration (sub-acute)	Duration (chronic)
4.1 Alpha- 2 receptor agonists					
4.2 Alpha blockers					
4.3 Antiplatelets					
4.4 Anticoagulants					
4.5 Angiotensin 2 receptor blockers					
4.6 Beta blockers					
4.7 Calcium channel blockers					
4.8 Central agonist					
4.9 Cholesterol- lowering (Statins)					
4.10 Digoxin					
4.11 Diuretics					
4.12 Peripheral adrenergic inhibitors					
4.13 Vasodilators					
4.14 Recreational/ performance enhancing					
4.15 OTHER:					
OTHER:					
OTHER:					
OTHER:					
UNKNOWN					

5. REVIEW OF SYSTEMS: Identify signs and symptoms associated with MSDs, CVD and other conditions (circle appropriate symptom)									
5.1 General:	Anaemia	Fatigue / lethargy	Fever	Insomnia	Nausea	Skin rash	Vomiting	Weight gain	Other:
5.2 Skin									
5.3 Hair and head:	Excessive hair growth		Headaches						Other:
5.4 Eyes:	Blurred vision		Double vision		Yellow vision				Other:
5.5 ENT:	Congestion		Tinnitus		Vertigo				Other:
5.6 CNS / PNS	Dizziness	Depression	Dryness of the mouth		Loss of taste	Postural / orthostatic hypotension	Weakness		Other:
	Mental changes						Numbness		
5.7 CVS	Bradycardia		Chest pain		Chronic cough	Hacking Cough			Other:
	Sweating	Productive Cough	Palpitations		Symptoms of asthma	Tachycardia			
5.8 Respiratory	Dyspnoea	Haemoptysis	Orthopnoea		Paroxysmal dyspnoea	Wheezing			Other:
5.9 MSK	Cramping	Joint pain	Muscle pain		Muscle stiffness	Muscle weakness			Other:
	Tenderness								
5.10 PVS	Leg cramps		Peripheral cyanosis	Intermittent claudication		Limb ischaemia			Other:
5.11 GIT/GUT	Abdominal pain/discomfort		Constipation	Diarrhoea		Dyspepsia			Other:
	Melaena		Swollen ankles	Symptoms of kidney damage		Oliguria			
5.12 Re-productive	Breast enlargement		Impotence						Other:

APPENDIX 3:

Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2900
Fax: 031 373 2407
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

18 November 2015

IREC Reference Number: **REC 127/15**

Ms L Fillis
11 Raylene
60 Ritson Road
Berea
4000

Dear Ms Fillis

The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic

I am pleased to inform you that Provisional Approval has been granted to your proposal REC 127/15 subject to:

- Piloting of the data collection tool

Full approval is subject to meeting the above condition.

The Proposal has been allocated the following Ethical Clearance number **IREC 135/15**. Please use this number in all communication with this office.

Approval has been granted for a period of two years, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Please note that you may continue with validity testing and piloting of the data collection tool. Research on the proposed project may not proceed until IREC reviews and approves the final document. If there are no changes to the data collection tool, kindly notify the IREC in writing.

APPENDIX 4:

Dear Patient/s

Please note: A research study titled:

<u>The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic</u>,

is currently being conducted on patient files at the Durban University of Technology Chiropractic Day Clinic over the next month.

Kindly notify the reception should you wish to not have your file included in the study.

If you wish to ask any questions,
Please contact
Lynn Fillis:
083 271 3655

APPENDIX 5:

REQUEST FOR PERMISSION TO USE THE DURBAN UNIVERSITY OF TECHNOLOGY CHIROPRACTIC DAY CLINIC FOR RESEARCH PURPOSES

To: Dr Charmaine Korporaal

Clinic Director of the Faculty of Health Sciences Clinic

I hereby request permission for the use of Durban University of Technology Chiropractic Day Clinic for the research study titled: The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic. In view of the fact that this study involves the analysis and collection of data from the clinic files of patients who presented to the Durban University of Technology Chiropractic Day Clinic, permission to access these files for research purposes is also requested.

Thank you for your time.

Kind regards

_____ _____

Miss Lynn Fillis Date

Student number: 20818915

APPENDIX 6:

To : Prof Puckree
Chair : RHDC

Prof Adam
Chair : IREC

From : Dr Charmaine Korporaal
Clinic Director : FoHS Clinic

Date : 07.05.2015

Re : Request for permission to use the Chiropractic Day Clinic for research purposes

---

Permission is hereby granted to:

Ms Lynn Fillis (Student Number: 20818915)

Research title: "The prevalence of and risk factors for CVD in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic".

It is requested that Ms Fillis submit a copy of her RHDC / IREC approved proposal to the Clinic Administrators before she starts with her research in order that any special procedures with regards to her research can be implemented prior to the commencement of her seeing patients.

Thank you for your time.
Kind regards

Dr Charmaine Korporaal
Clinic Director : FoHS Clinic

Cc: Mrs Pat van den Berg : Chiropractic Day Clinic
Dr L O'Connor : Supervisor and Research co-ordinator
Dr G Harpham : Supervisor

APPENDIX 7:

STATEMENT OF CONFIDENTIALITY: RESEARCHER

RESEARCH TITLE: The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic.

NAME OF RESEARCHER: Lynn Fillis
RESEARCHER'S QUALIFICATION: BTech: Chiropractic
RESEARCHER'S CONTACT DETAILS: 083 271 3652: lynnfillis341@gmail.com

PURPOSE OF THE RESEARCH:
The purpose of this study is to investigate the prevalence of and associated risk factors for CVD in patients who presented with musculoskeletal complaints to the DUT CDC. It aims to establish the presence of any associations between the presence of the CVD, the prescribed medication and the presenting MSD (type, severity and duration) noted.

OUTLINE STUDY PROCEDURE:
Expert group and pilot study:
Following IREC approval, the data sheet will be validation by means of an expert group. The expert group will consist of the researcher, the research assistant, the research supervisor, co-supervisor, a clinician at the CDC, a qualified chiropractor and two chiropractic interns. A pre-pilot data sheet will then be developed, which be tested on five patient files (which will be excluded from the main study).
The pilot study will also serve as a training session for both the researcher and the research assistant to set a standard for the approach to data collection.

Data collection:
The researcher will book a clinic room for data collection prior to commencement of the data collection process. On each day of data collection, both the researcher and the research assistant will report to the DUT CDC reception staff to collect the files. The researcher and research assistant will manually extract every file from the archives of DUT CDC from one year preceding IREC approval. The researcher will then sign out the files selected for that day on a sheet containing the relevant file numbers and take them to a clinic room. The files will be analysed to exclude the files that do not meet the inclusion criteria. These file numbers will be documented on a spreadsheet.
The sample that meets criteria will be equally divided between the researcher and research assistant. The files will be analysed to gather information regarding demographics, presence of CVD/ non-CVD, presenting MSC, region of main complaint, risk factors of CVD, type and duration of medication; and the prevalence of CVD at the DUT CDC. This information will be coded for recording documented on a data sheet. At the end of each day the researcher will return the files to reception where she will sign them in. Data collection will occur over 31 days (to be confirmed by pilot study).

Write up:
This involves the analysis and interpretation of the data following statistical analysis and the completion of the written mini-dissertation.

RESEARCHER'S RESPONSIBILITIES:
I, the chiropractic student researcher understand that the following statements elucidate my role in the study titled:

The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic.

- To seek consent in writing from the Chiropractic Day Clinic Director to access medical records within the clinic.
- Analyse half of the total number of patient files to exclude the files that do not meet the inclusion criteria of this study.
- Analyse the above mentioned files to gather information regarding demographics, presence of cardiovascular disease (CVD)/ non-CVD, presenting MSC, region of main complaint, risk factors of CVD, type and duration of medication; and the prevalence of CVD at the CDC.
- Document and code this information on a data sheet for the first two files and then enter data directly into an Excel spreadsheet.
- To exchange the files of patients whom I have previous treated or am acquainted with, with the research assistant to limit reporter bias.

CONFIDENTIALITY:

- Limit access to those to whom it is essential for the provision of health care (the researcher and research assistant, supervisors and the Clinic Director).
- To code file numbers on data collection sheet to ensure patient anonymity.
- To safely store the spreadsheet containing the file numbers and respective codes after the completion of the study.
- To store information derived from medical records for research purposes securely within the archives and, as far as possible, ensures subjects involved are unidentifiable to third parties.

These guidelines will be followed by the Chiropractic student researcher at all times.

Ms. L Fillis _____
(Chiropractic student researcher)

Date _____

APPENDIX 8:

LETTER OF INFORMATION:
RESEARCH ASSISTANT

Title of the Research Study: The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic.

Researcher: Lynn Fillis (B.Tech: Chiropractic)

Supervisors: Dr. Graeme Harpham (M.Tech: Chiropractic)
Dr. Charmaine Korporaal (M.Tech: Chiropractic, CCFC,CCSP,ICCSD)

Brief Introduction and Purpose of the Study:
Cardiovascular disease (CVD) is a major contributor to death in South Africa (Statistics South Africa, 2013). The Centres for Disease Control and Prevention (2001) indicated that arthritis and back pain are the first and second leading causes of disability followed by CVD (Ulwin, 2006; Alwan, 2009). Studies conducted at the Durban University of Technology (DUT) Chiropractic Day Clinic (CDC), indicated that patients who present with cervical and lumbo-sacral complaints may also present with hypertension (HTN) and angina (Jaman, 2007; Venketsamy, 2007). By contrast Hagen et al., (2005) indicated that there is no relationship between the presentation of musculoskeletal complaints and conditions that could be classified as cardiovascular disease. Therefore, ambiguity exists in the literature in relation to whether a relationship between the presence of CVD and the presence of musculoskeletal disorder (MSD) complaints in the same patients. In addition, Hagen et al., (2005) indicated that the relationship between these two types of complaints may be facilitated by a common factor (e.g. diabetes mellitus), an independent factor (e.g. person's weight or levels of activity) or may be a direct relationship. These latter relationships therefore require further investigation.
The purpose of this study is to investigate the prevalence of and associated risk factors for CVD in patients who presented with musculoskeletal complaints to the DUT CDC. It aims to establish the presence of any associations between the presence of the CVD, the prescribed medication and the presenting MSD (type, severity and duration) noted.

Outline of the Procedures:
Following IREC approval, the data sheet will be validated by means of an expert group. As the research assistant you are expected to participate in the expert group which will also include the researcher, the research supervisor, co-supervisor, a clinician at the CDC, a qualified chiropractor and two chiropractic interns. A pre-pilot data sheet will then be developed, which be tested on five patient files (which will be excluded from the main study).
The pilot study will also serve as a training session for both the researcher and the research assistant to set a standard for the approach to data collection.

The researcher will book a clinic room for data collection prior to commencement of the data collection process. On each day of data collection, both the researcher and the research assistant will report to the DUT CDC reception staff to collect the files. The researcher and research assistant will manually extract every file from the archives of DUT CDC from one year preceding IREC approval. The researcher will then sign out the files selected for that day on a sheet containing the relevant file numbers and take them to a clinic room. The files will be analysed to exclude the

files that do not meet the inclusion criteria. These file numbers will be documented on a spreadsheet.

- The sample that meets criteria will be equally divided between the researcher and research assistant. The files will be analysed to gather information regarding demographics, presence of CVD/ non-CVD, presenting MSC, region of main complaint, risk factors of CVD, type and duration of medication; and the prevalence of CVD at the DUT CDC. This information will be coded for recording documented on a data sheet for the first two files and then enter data directly into an Excel spreadsheet.
- The files of patients whom have previously treated by or are acquainted with the researcher/research assistant will be exchanged between them to limit reporter bias.

At the end of each day the researcher will return the files to reception where she will sign them in. Data collection will occur over 31 days (to be confirmed by pilot study).

Risks or Discomforts to the Participant: There will be no risks or discomforts to you should you choose to participate.

Benefits: Participation as a research assistant will allow you to accumulate hours towards your internship portfolio.

Reason/s why the Participant May Be Withdrawn from the Study: There will be no adverse consequences for the research assistant should you choose to withdraw from the study after agreeing to participate.

Remuneration: There will be no monetary or other type of remuneration. Your participation is voluntary.

Costs of the Study: There will be no research related costs should you choose to participate.

Confidentiality: As a research assistant you are expected to undertake the following steps to maintain patient confidentiality throughout the process of the study:

- Sign a Letter of information and Consent to ensure patient confidentiality at all times.
- Limit access to those to whom it is essential for the provision of health care (the researcher and research assistant, supervisors and the Clinic Director).
- To code file numbers on data collection sheet to ensure patient anonymity.
- Once the data has been captured, submit the spreadsheet containing the sampled file numbers to the researcher who will keep it safe in storage, thus denying access to third parties.

Research-related Injury: There will be no research related injury as a result of your participation.

Persons to Contact in the Event of Any Problems or Queries:
(Supervisor and details) Please contact the researcher (0832713652), my supervisors Dr. G Harpham (031 3123167) and Dr. C Korporaal (031 373 2611)or the Institutional Research Ethics administrator on 031 373 2900. Complaints can be reported to the DVC: TIP, Prof F. Otieno on 031 373 2382 or dvctip@dut.ac.za.

CONSENT

Statement of Agreement to Participate in the Research Study:

I hereby confirm that I have been informed by the researcher, _____ (name of researcher), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,

I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.

I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.

In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.

I may, at any stage, without prejudice, withdraw my consent and participation in the study.

I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____	_____	_____	_____
Full Name of Research assistant	**Date**	**Time**	**Signature Right**

I, _____ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_____	_____	_____
Full Name of Researcher	**Date**	**Signature**

_____	_____	_____
Full Name of Witness (If applicable)	**Date**	**Signature**

_____	_____	_____
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

APPENDIX 9:
CHIROPRACTIC PROGRAMME
Chiropractic Day Clinic
CONFIDENTIAL PATIENT INFORMATION

Date:	Title:
Male / Female:	Initials:
Surname:	I.D. number:
First name:	Marital status:
Birthdate:	Medical aid:
Occupation:	M/A number:
Med doctor:	Last visit:
Chiropractor:	Last visit:
Postal address:	Residential address:
Tel - work:	Tel - home:
Cell number:	
Employer:	
Employer's address:	

NB: Please ensure that you supply your Medical Aid No for refund purposes

FINANCIAL INFORMATION

The current fee schedule of the Chiropractic Day Clinic is:

Student (5th Year Students)		**Student (6th Year Students)**	
Initial visit:	**R 90.00**	Initial visit:	
Subsequent visits	**R 60.00**	Subsequent visits	**R 80.00**

All consumables (e.g. needles) : Prices are available on request at the reception desk.
PTO for more information and in order to sign for consent.

Medical Aid schemes pay in varying degrees for coverage of Chiropractic Services. This coverage is therefore medical aid dependant and we request that you check with your medical aid in this respect. **The DUT Chiropractic Day Clinic is contracted out of medical aid**, which means that we run on a **strictly cash only basis**, whereby you are requested to pay cash in advance of services rendered. You will be sent a monthly statement which you must submit to your medical aid for them to refund you directly. This statement will be sent out at the **end of each month.**
Charges are **not** applicable to **research patients**

Medico-Legal Reports:
As the Chiropractic Day Clinic is a teaching facility we are not in a position to generate any reports required for medico-legal purposes**,** claims that relate to injury on duty (IOD) or workman's compensation

Report of findings:
It is imperative that the student treating you explains fully your diagnosed condition, both as an educational requirement for the student but also, **and more importantly**, such that you are able to make an informed decision about the type of treatment that you wish to receive.

Treatment options:
It is imperative that the student explains all treatment options that are available for you based on the diagnosed condition/(s) that was/were given to you in respect of the above.

Risks/Benefits:
The student must explain to your satisfaction/understanding all risks and benefits in relation to treatment of your reported diagnosis/condition(s).

As a Patient at this, the Chiropractic Day Clinic, I understand that I am attending an educational facility and I give my permission to allow observation, and if necessary the video recording of supervised examination and treatment by Doctors of Chiropractic and Students. In addition I, as the patient note, that information generated through my attendance of the clinic, may be used for research purposes (either through my direct participation in the research or alternatively through data collected in my patient file).

By signing this form I agree that

a) I understand and take full financial responsibility for consultations.
b) I understand that I cannot request records for medico legal reasons.
c) I understand that should I be on medical aid, that my diagnosis and treatment information will be shared for the purposes of medical aid reimbursing me according to that which I am contractually bound in terms of my medical cover (and that only a written request or instruction from myself will be accepted in terms of discontinuing this practice by my health care provider – the Chiropractic Day Clinic).
d) Should I need to be referred that my medical information (pertinent to my condition) will be shared with the doctor / specialist to whom I have been referred.
e) I understand that with my attendance at the Chiropractic Day Clinic, that my medical information will be discussed between the student responsible for my care and the supervising clinician who is responsible for overall oversight of my care.

Date:		**Patient Signature:**	
Parent/legal guardian signature: (in the case of patient's who are under the age of 12 years and those requiring assistance between the ages of 12-18 years)			
Relationship of guardian to the minor:			
Date:		**Student Signature:**	
Date:		**Clinician Signature:**	

By signing this section of the form I agree that (to be completed after you have been assessed and prior to your treatment / referral):

a) The student has discussed with me to my satisfaction, and I fully understand, my / my minor child's diagnosed condition(s) that I have.
b) The student has discussed with me to my satisfaction, and I fully understand all treatment and/or non treatment options and their relative successes and/or failures as applicable to the diagnosed condition(s).
c) I am making an informed decision with regard to, and will submit to / consent to my minor child being submitted to, the treatment protocol as explained.

Based on the above I therefore give consent for the treatment of my named complaint by signing the form hereunder:

Date:		**Patient Signature:**	
Parent/legal guardian signature: (in the case of patient's who are under the age of 12 years and those requiring assistance between the ages of 12-18 years)			
Relationship of guardian to the minor:			
Date:		**Student Signature:**	
Date:		**Clinician Signature:**	

APPENDIX 10:

LETTER OF INFORMATION: EXPERT GROUP

Dear expert group participant
Welcome to the focus and thank you for your participation.

Title of the Research Study: The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic.

Researcher: Miss Lynn Fillis, B.Tech: Chiropractic
Supervisors: Dr. Graeme Harpham (M.Tech: Chiropractic)
Dr. Charmaine Korporaal (M.Tech: Chiropractic, CCFC,CCSP,ICCSD)

Brief Introduction and Purpose of the Study:
Cardiovascular disease (CVD) is a major contributor to death in South Africa (Statistics South Africa, 2013). The Centres for Disease Control and Prevention (2001) indicated that arthritis and back pain are the first and second leading causes of disability followed by CVD (Ulwin, 2006; Alwan, 2009).Studies conducted at the Durban University of Technology (DUT) Chiropractic Day Clinic (CDC), indicated that patients who present with cervical and lumbo-sacral complaints may also present with hypertension (HTN) and angina (Jaman, 2007; Venketsamy, 2007). By contrast Hagen et al., (2005) indicated that there is no relationship between the presentation of musculoskeletal complaints and conditions that could be classified as cardiovascular disease. Therefore, ambiguity exists in the literature in relation to whether a relationship between the presence of CVD and the presence of musculoskeletal disorder (MSD) complaints in the same patients. In addition, Hagen et al., (2005) indicated that the relationship between these two types of complaints may be facilitated by a common factor (e.g. diabetes mellitus), an independent factor (e.g. person's weight or levels of activity) or may be a direct relationship. These latter relationships therefore require further investigation.
The purpose of this study is to investigate the prevalence of and associated risk factors for CVD in patients who presented with musculoskeletal complaints to the DUT CDC. It aims to establish the presence of any associations between the presence of the CVD, the prescribed medication and the presenting MSD (type, severity and duration) noted.

Outline of the Procedures: Data will be collected from patient files of patients who presented to the Durban University of Technology (DUT) Chiropractic Day Clinic (CDC).
Following IREC approval, the data sheet will be validated by means of an expert group. The expert group will consist of the researcher, the research assistant, the research supervisor, co-supervisor, a clinician at the CDC, a qualified chiropractor and two chiropractic interns. A pre-pilot data sheet will then be developed, which be tested on five patient files (which will be excluded from the main study).
The pilot study will also serve as a training session for both the researcher and the research assistant to set a standard for the approach to data collection.

The researcher will book a clinic room for data collection prior to commencement of the data collection process. On each day of data collection, both the researcher and the research assistant will report to the DUT CDC reception staff to collect the files. The researcher and research assistant will manually extract every file from the archives of DUT CDC from one year preceding IREC approval. The researcher will then sign out the files selected for that day on a sheet containing the relevant file numbers and take them to a clinic room. The files will be analysed to exclude the files that do not meet the inclusion criteria. These file numbers will be documented on a spreadsheet.
The sample that meets criteria will be equally divided between the researcher and research assistant. The files will be analysed to gather information regarding

demographics, presence of CVD/ non-CVD, presenting MSC, region of main complaint, risk factors of CVD, type and duration of medication; and the prevalence of CVD at the DUT CDC. This information will be coded for recording documented on a data sheet. At the end of each day the researcher will return the files to reception where she will sign them in. Data collection will occur over 31 days (to be confirmed by pilot study).
Risks or Discomforts to the Participant: There will be no risks or discomfort to you should you chose to participate.

Benefits: Expert group participants will not benefit in any from this study.

Reason/s why the Participant May Be Withdrawn from the Study: There will be no adverse consequences should you choose to withdraw from the expert group. You are free to withdraw from this study at any time without providing any reasons.

Remuneration: There will be no monetary or other type of remuneration. Expert group participation is voluntary.

Costs of the Study: There will be no costs to you should you agree to participate.

Confidentiality: The following steps will be undertaken to maintain confidentiality throughout the process of the study.

- All information contained in the research documents and any information discussed during the focus group meeting will be kept private and confidential. This is especially binding to any information that may identify any of the participants in the research process.
- The returned data sheets will be coded and kept anonymous in the research process.
- None of the information shall be communicated to any other individual or organisation outside of this specific focus group as to the decisions of this focus group.
- The information from this focus group will be made public in terms of a journal publication, which will in no way identify any participants of this research.

Research-related Injury: There will be no research related injury as a result of your participation.

Persons to Contact in the Event of Any Problems or Queries:
(Supervisor and details) Please contact the researcher (0832713652), my supervisors Dr G. Harpham (031 3123167) and Dr C Korporaal (031 373 2611)or the Institutional Research Ethics administrator on 031 373 2900. Complaints can be reported to the DVC: TIP, Prof F. Otieno on 031 373 2382 or dvctip@dut.ac.za.

Yours sincerely
Lynn Fillis

CONSENT

Statement of Agreement to Participate in the Research Study:

I hereby confirm that I have been informed by the researcher, _____ (name of researcher), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,

I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.

I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.

In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.

I may, at any stage, without prejudice, withdraw my consent and participation in the study.

I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____ _____ _____ _____

Full Name of Participant **Date** **Time** **Signature / Right Thumbprint**

I, _____ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_____ _____ _____

Full Name of Researcher **Date** **Signature**

_____ _____ _____

Full Name of Witness (If applicable) **Date** **Signature**

_____ _____

_____

Full Name of Legal Guardian (If applicable) **Date** **Signature**

APPENDIX 11:

CONFIDENTIALITY STATEMENT: EXPERT GROUP

IMPORTANT NOTICE:

THIS FORM IS TO BE READ AND FILLED IN BY EVERY MEMBER PARTICIPATING IN THE EXPERT GROUP, BEFORE THE EXPERT GROUP MEETING CONVENES.

1. All information contained in the research documents and any information discussed during the expert group meeting will be kept private and confidential. This is especially binding to any information that may identify any of the participants in the research process.

2. The returned data sheets will be kept anonymous in the research process.

3. None of the information shall be communicated to any other individual or organisation outside of this specific expert group as to the decisions of this expert group.

4. The information from this expert group will be made public in terms of a journal publication, which will in no way identify any participants of this research.

Once this form has been read and agreed to, please fill in the appropriate information below and sign to acknowledge agreement.

Please PRINT in block letters:

Expert Group Member: _____

Signature_____

Witness Name: _____

Signature: _____

Researchers Name: _____

Signature: _____

Supervisors Name: _____

Signature: _____

APPENDIX 12:

CODE OF CONDUCT FORM

EXPERT GROUP

IMPORTANT:
THIS FORM NEEDS TO BE COMPLETED BY EVERY MEMBER OF THE EXPERT GROUP PRIOR TO THE COMMENCEMENT OF THE EXPERT GROUP MEETING.

As a member of this committee I agree to abide by the following conditions:
1. All information contained in the research documents and any information discussed during the focus group meeting will be kept private and confidential.

This is especially binding to any information that may identify any of the participants in the research process.

2. None of the information or decisions made in this focus group shall be communicated to any other individual or organisation outside of this specific focus group.

3. The information from this focus group will be made public as part of a journal publication, which will in no way identify any participants of this research.

MEMBER REPRESENTS	MEMBER'S NAME	CONTACT DETAILS	SIGNATURE

APPENDIX 13:

The prevalence of and risk factors for cardiovascular disease in patients seeking treatment at the Durban University of Technology Chiropractic Day Clinic

PRE-PILOT DATA SHEET

1. DEMOGRAPHICS						
1.1 Does this file have record of cardiovascular disease (CVD) at the first visit to the Durban University of Technology Chiropractic Day Clinic			YES		NO	
1.2 Gender			Male		Female	
1.3 Age:			**Date of birth:**		**1.4 Race:**	
1.5 Weight:			**BMI= weight/ height2**			
1.6 Height :			**=**			
			=			
2. PRESENTING MUSCULOSKELETAL COMPLAINT/S:						
2.1 PRIMARY MUSCULOSKELETAL COMPLAINT:						
2.1.1 Site/location		Head	C/Spine / Neck	T/Spine / Chest/Ribs	L/Spine / Abdomen	SI Joint / Pelvis
Hip / Thigh	Knee / Leg	Foot And Ankle	Shoulder / Brachium	Elbow / Forearm	Hand and Wrist	Other:
2.1.2 Onset of complaint	Acute	Acute on chronic	Sub-acute		Chronic	
2.1.3 Character of complaint	Aching	Boring	Burning	Constricting	Crushing	Dull
	Nagging	Piercing	Tearing	Tingling	Throbbing	Tugging
	Sharp	Shooting	Splitting	Stabbing	Squeezing	Other
2.1.4 Radiation of complaint			Yes		No	
2.1.4.1 Site of radiation	Jaw	Left arm	Left leg	Low back	Neck	
	Pelvis	Right arm	Right leg	Thoracic	Other	
2.1.5 Severity of complaint recorded at initial visit			Mild	Moderate	Severe	
2.2 SECONDARY MUSCULOSKELETAL COMPLAINT:						
2.2.1 Site/location		Head	C/Spine/Neck	T/Spine/Chest/Ribs	L/Spine/Abdomen	SI Joint/ Pelvis
Hip/Thigh	Knee/Leg	Foot/Ankle	Shoulder/Brachium	Elbow/Forearm	Hand and Wrist	Other :
2.2.2 Onset of complaint	Acute	Acute on chronic	Sub-acute		Chronic	
2.2.3 Character of complaint	Dull	Sharp	Tearing	Constricting	Crushing	Other
2.2.4 Radiation of complaint			Yes		No	
2.2.4.1 Site of radiation	Jaw	Left arm	Left leg	Low back	Neck	
	Pelvis	Right arm	Right leg	Thoracic	Other	
2.2.5 Severity of complaint recorded at initial visit			Mild	Moderate	Severe	
3. CARDIOVASCULAR DISEASE RISK FACTORS						
3.1 If hypertensive	Grade I(140-159/90-99mmHg)		Grade 2 (160-179/100-109mmHg)		Grade 2I (>180/>110mmHg)	
	Hypotensive		Normotensive		Prehypertensive	
3.2 History of CVD						
3.2.1 Peripheral vascular (e.g. Hypercholesterolaemia	YES	Specify		NO	NOT APPLICABLE	
3.2.2 Cardiac	YES	Specify		NO	NOT APPLICABLE	
3.2.3 Haematological	YES	Specify		NO	NOT APPLICABLE	
3.2.4 Endocrine	YES	Specify		NO	NOT APPLICABLE	
3.3 Family history of CVD						

3.3.1 Peripheral vascular	YES	Specify			NO	NOT APPLICABLE	
3.3.2 Cardiac	YES	Specify			NO	NOT APPLICABLE	
3.3.3 Haematological	YES	Specify			NO	NOT APPLICABLE	
3.3.4 Endocrine (e.g. Diabetes mellitus)	YES	Specify			NO	NOT APPLICABLE	
3.5 History of other:							
3.6 Exercise	YES	NO			Cardio	Weight training	
3.7 Alcohol	YES		NO			UNKNOWN	
3.8 Smoking	**3.8.1 Currently**	YES	NO				
	3.8.2 Previously	YES	NO				
3.9 Diet	Vegan	Vegetarian	High carbohydrate	High fat	High protein	Unspecified	Missing
	Diet supplementation:						

4. CARDIAC MEDICATIONS					
Medication Type:	Yes	No	Duration (acute)	Duration (sub-acute)	Duration (chronic)
4.1 Alpha- 2 receptor agonists					
4.2 Alpha blockers					
4.3 Antiplatelets					
4.4 Anticoagulants					
4.5 Angiotensin 2 receptor blockers					
4.6 Beta blockers					
4.7 Calcium channel blockers					
4.8 Central agonist					
4.9 Cholesterol- lowering (Statins)					
4.10 Digoxin					
4.11 Diuretics					
4.12 Peripheral adrenergic inhibitors					
4.13 Vasodilators					
4.14 Recreational/ performance enhancing					
4.15 OTHER:					
OTHER:					
OTHER:					
OTHER:					
UNKNOWN					

5. REVIEW OF SYSTEMS: Identify signs and symptoms associated with MSDs, CVD and other conditions (circle appropriate symptom)

5.1 General:	Anaemia	Fatigue / lethargy	Fever	Insomnia	Nausea	Skin rash	Vomiting	Weight gain	Other:
5.2 Hair and head:	Excessive hair growth		Headaches						Other:
5.3 Eyes:	Blurred vision		Double vision		Yellow vision				Other:
5.4 ENT:	Congestion		Tinnitus		Vertigo				Other:
5.5 CNS / PNS	Dizziness	Depression	Dryness of the mouth		Loss of taste	Postural / orthostatic hypotension		Weakness	Other:
									Mental changes
5.6 CVS	Bradycardia		Chest pain		Chronic cough		Hacking Cough		Other:
	Sweating	Productive Cough	Palpitations		Symptoms of asthma		Tachycardia		
5.7 Respiratory	Dyspnoea	Haemoptysis	Orthopnoea		Paroxysmal dyspnoea		Wheezing		Other:
5.8 MSK	Cramping	Joint pain	Muscle pain		Muscle stiffness		Muscle weakness		Other:
	Tenderness								
5.9 PVS	Leg cramps		Peripheral cyanosis		Intermittent claudication		Limb ischaemia		Other:
5.10 GIT/GUT	Abdominal pain/discomfort		Constipation		Diarrhoea		Dyspepsia		Other:
	Melaena		Swollen ankles		Symptoms of kidney damage			Oliguria	
5.11 Re-productive	Breast enlargement		Impotence						Other: