

**THE ATTITUDE TOWARD AND THE PRESCRIPTION OF A LOW
CARBOHYDRATE, HIGH FAT DIET BY KWAZULU-NATAL
CLINICAL DIETICIANS**

By

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ABSTRACT

Aim: To determine the attitude toward and the prescription of a low carbohydrate, high fat (LCHF) diet by KwaZulu-Natal clinical dietitians working in government or private practice.

Objectives: The study set out to determine the following objectives: (i) dietitians' attitudes toward a LCHF diet, (ii) the prescription of this diet in practice and concerns regarding the diet; (iii) to determine if there is a relationship between the socio-demographic characteristics, areas of work and professional interest as well as research involvement of dietitians and the prescription of a LCHF diet in practice; and to (iv) assess whether dietitians would be willing to adapt their practice methods and attitude after hearing a presentation on the LCHF diet.

Method: The email addresses for 155 clinical dietitians, working in either government or private practice, were obtained from a data base. The dietitians were emailed a link to a four-part online questionnaire regarding their area of work, main professional interests, practice methods, prescription or non-prescription of a LCHF diet and research involvement.

Results: The response rate to the questionnaire was 58% (n=90). The majority of the subjects were female (n=87, 97%) and had qualified at the University of KwaZulu-Natal (n=67, 74%). Patients with non-communicable diseases were the most common condition counselled by the subjects (71.3%). The latter was also the main area of interest for subjects in private practice. Upon analysis of the section pertaining to research involvement, it was found that the majority of subjects scored poorly in the questions related to the most basic of research involvement skills, with an average score of 40%. Overall, there was a negative attitude toward the prescription of the LCHF diet. Only 17% (n=15) of the subjects had prescribed the LCHF diet in practice and it had been prescribed rarely. The most common condition that the diet was prescribed for was weight loss. Subjects working in private practice were more likely to prescribe a LCHF diet for their patients compared to those working in government. More than 80% of the sample reported that they had never prescribed the diet. The most common reason provided was that it was felt there was a lack of supportive evidence for its use.

Discussion: The finding that private practicing dietitians are more likely to prescribe a LCHF diet to patients may be because this type of patient is more likely to be able to afford and sustain a LCHF diet compared to the type of patients seen by subjects working in the government sector. These patients are also more likely to be aware of the LCHF diet compared to government health patients. Very few dietitians prescribed a LCHF diet; this may be a reflection of the dietitians

practicing evidence evidence-based nutrition and/or it could be related to harm-avoidance. The very low level of research involvement and skill observed in the study is a concern and should be used as a basis for further investigation.

Conclusion and recommendations: The low score obtained by subjects in basic research involvement could be interpreted that more emphasis should be placed on this area in undergraduate training and in the continuing professional development of qualified dietitians. More studies need to be done on the long-term safety and efficacy of a LCHF diet for the prevention and management of NCDs. Dietetic authorities should consider a country-wide advertising campaign to encourage the public to consult a Registered Dietitian before following a LCHF diet.

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CHAPTER 1: INTRODUCTION TO THE PROBLEM AND ITS SETTING

1.1 Motivation for and importance of the study

Although infectious diseases such as Human Immunodeficiency Virus (HIV) and Tuberculosis (TB) continue to be a large public health problem in South Africa, non-communicable diseases (NCDs) such as cardiovascular disease and diabetes are rapidly becoming major epidemics (National Department of Health 2013). Data from the South African National Health and Nutrition Examination Survey (SANHANES-1) released in 2013 reported an increase in the prevalence of NCDs amongst the population in comparison to the South African Demographic and Health Survey (SADHS) conducted ten years previously (Shisana, Labadarios, Rehle, Simbayi, Zuma, Dhansay, Reddy, Parker, Hoosain, Naidoo, Hongoro, Mchiza, Steyn, Dwane, Makoae, Malukele, Ramlagan, Zungu, Evans, Jacobs, Faber 2013; DOH/MRC 2007).

According to the World Health Organisation (WHO), NCDs are responsible for sixty percent of all global deaths (WHO 2008). They are largely preventable, and therefore deaths that are related to them are too. NCDs are characterised by the fact that the modification of certain lifestyle factors, including nutritional intake, can prevent their onset. As a result, South African nutrition guidelines are of utmost importance. This was emphasised by the South African Health Minister in the most recent Strategic Plan for the Prevention and Control of NCDs document (National Department of Health 2013).

The Seven Countries Study conducted in the late 1950s was a revolutionary study that defined the relationship between saturated fat, serum cholesterol levels and cardiovascular disease (Keys 1970). It showed that a high intake of saturated fats led to an increase in serum cholesterol levels, and that elevated serum cholesterol levels was one of the independent risk factors for cardiovascular disease. Study subjects were followed up for five years. The results from this study, combined with further studies, led to global nutrition policies (Mancini & Stamler 2004).

In 1977 the first “Dietary Goals for Americans” were developed. These goals were based on what is now known as a prudent diet and recommended that Americans increase their carbohydrate intake and decrease their fat intake, specifically limiting the intake of saturated fat and cholesterol (Hite, Feinman, Guzman, Satin, Schoenfeld & Wood 2010). A prudent diet can be defined as a diet that is low in saturated fat and cholesterol, with the majority of energy being provided by wholegrain carbohydrates (Kelley, Kelley, Roberts and Haskell 2011; WHO 2003).

International nutrition guidelines, including those specific to South Africa, have not deviated much since the first prudent dietary guidelines were released in 1977. In 2012, The South African Department of Health released the latest version of the South African Food Based Dietary Guidelines (FBDGs) to be used for nutrition education in schools, clinics, hospitals and other community based settings (National Department of Health 2012). These guidelines were designed to promote healthy eating habits amongst South Africans, and to prevent as well as manage obesity and diseases of lifestyle. One of the FBDGs emphasises the importance of choosing starchy foods as the main part of most meals. Another focuses on fat by recommending that the public should use fat sparingly and to preferably use vegetable fats instead of animal fats (National Department of Health 2012).

Despite the dietary guidelines referred to above, low carbohydrate diets have been popular as a weight loss tool for many years. A well-known example of one of these diets is the Atkins diet, designed by Dr Robert Atkins. Atkins began prescribing the diet for his patients in 1963. It was first published into books for public use in 1979, and it has remained one of the most popular weight loss diets to date (Foster, Wyatt, Hill, Makris, Rosenbaum, Brill, Stein, Mohammed, Miller, Rader, Zemel, Wadden, Tenhave, Newcomb & Klein 2010).

Certain scientists have never been satisfied with the evidence that supports a prudent diet as a “heart-healthy diet”. An example is Hite *et al* (2010) who have shown a disapproval of the American Dietary Guidelines, stating that certain concerns that were raised when the guidelines were developed over 30 years ago were never addressed. These researchers questioned the restriction of fat and proposed that it was in fact carbohydrates that should

have been restricted. Hite *et al* (2010) further suggested that the prudent diet recommendations were based on insufficient and weak scientific evidence and were not appropriate to prevent NCDs.

In South Africa, a medical doctor and Professor, Timothy Noakes, recently published his disapproval of the evidence supporting a prudent diet and has claimed that a low carbohydrate, high fat (LCHF) diet is more effective in treating those who are overweight or obese, and/or have dyslipidaemia, pre-diabetes or diabetes (Noakes 2013). The above author has also stated that what would be considered to be a high saturated fat intake is not as dangerous as previously thought and that serum cholesterol levels were not as important a risk factor for cardiovascular disease (Noakes & Vlismas 2012, p130). Noakes has voiced this opinion in the form of books, press releases, magazine and newspaper articles and public and academic presentations (Noakes 2012). In doing so a large public following and interest in the LCHF diet has ensued. Noakes has also proposed that the conventional low fat prudent diet is ineffective in promoting weight loss and like Hite *et al* (2010) has suggested that it is in fact carbohydrates, and not fats, that are the cause of the physiological changes which lead to obesity, diabetes, insulin resistance and cardiovascular disease (Noakes & Vlismas 2012, p130).

The proposals that Noakes has made have created a large rift amongst the South African medical community. While his views were welcomed by a few, they were refuted by many, particularly dietitians and cardiologists. An example of this is an open letter written by a group of cardiologists and academics from the University of Cape Town, available on the Heart and Stroke Foundation website. The letter warned Noakes of the dangers of advising the public on following a LCHF diet (Appendix A, p98). The fact that the letter was freely available to the public, and not published in a professional journal, perhaps indicated how important the authors thought it was to correct what they alleged to be misinformation being disseminated by Noakes.

A systematic review and meta-analysis comparing a LCHF diet to an isoenergetic balanced weight loss diet was published in July 2014, possibly as a result of the interest shown by

health professionals in the LCHF diet. The results indicated that there was little to no difference between the two diets in terms of weight loss and cardiovascular risk over a period of two years. Following the release of the systematic review and meta-analysis, a joint statement was released by the Health Professionals Council of South Africa (HPCSA), the Association for Dietetics of South Africa (ADSA), The Chronic Disease Initiative for Africa, The Heart and Stroke Foundation South Africa and the Nutrition Society of South Africa (Appendix B, p100). The purpose of this statement was to explain to the public that a LCHF diet was not a more effective weight loss diet than a prudent diet and that the long term safety of a LCHF diet was unknown. In addition, it was strongly recommended that South Africans continue to follow a diet based on the FBDGs.

Lending significance to the current study is the fact that the interest in a LCHF diet is not limited to South Africa. A similar statement to Appendix B was released by Dietitians NZ, the New Zealand equivalent of ADSA (Appendix C, p103). Their statement declared that the LCHF is dangerous due to its saturated fat content and that there was no long term evidence regarding weight loss. The statement further recommended that New Zealanders should follow their national dietary guidelines, which are very similar to South Africa's. In response to the Dietitians NZ statement, a group of researchers, including dietitians, from the Auckland University of Technology (AUT) in New Zealand released their own statement (Appendix D, p105) which claimed to include evidence indicating that a LCHF diet was not harmful and that its benefits were at least equal to those of a prudent diet. Based on this the researchers felt the LCHF diet should not be disregarded by the dietetic or medical community.

Considering the conflicting dietary messages that have been presented to them, it is easy to understand why the public became confused. As Nagler (2014) observed, when the public are exposed to such conflicting messages, it is easy for them to begin to doubt even scientifically sound advice. An article in *The Journal of The Academy of Nutrition and Dietetics* examined how news stories related to nutrition and health tend to play on the emotions of the public, due to their personal nature. How these stories are presented can often cause the public to lose the ability to think critically (Gregerson 2012). The popularity of Timothy Noakes may have had this effect on the South African public. It is important, therefore, that dietitians communicate their opinion and attitude toward a LCHF diet in a way that maintains the

public's trust in them as the health professional most qualified to disseminate scientifically based nutrition advice. For this reason dieticians' attitude toward, opinion of and prescription of a LCHF diet must be investigated.

From this it can be seen that the following questions are pertinent:

- What is a prudent diet, and why is it the accepted dietary treatment for the prevention and management of NCDs?
- What is a LCHF diet and how does it differ from a prudent diet?
- What is the evidence for and against the use of a LCHF diet to prevent and manage NCDs?
- What is the current knowledge of dieticians regarding a LCHF diet, and what is their attitude toward the use of this diet?
- Do dieticians prescribe a LCHF diet for their patients?

1.2 Statement of the problem

There is an increased incidence of NCD-related deaths globally and in South Africa which may largely be due to a poor dietary intake. The public interest in a LCHF diet to prevent and treat NCDs is on the increase due to the public promotion of the diet by some health professionals. It is therefore crucial that dieticians maintain a reputation of being experts in nutrition in order to prevent members of the public from turning to unreliable sources of information. It is also important that dieticians are prepared when the public question their opinion of and attitude toward a LCHF diet. For this reason, dieticians' attitudes towards as well as their prescription or non-prescription of a LCHF diet in patient management required urgent investigation.

1.3 Objectives

The objectives of this study were:

1. To determine dieticians attitudes toward a LCHF diet, the prescription of the diet in practice and concerns regarding the diet.

2. To determine whether there is a relationship between dietitians' socio-demographic characteristics, areas of work and professional interest and research involvement and their prescription of a LCHF diet in practice.

1.4 Hypotheses

The following hypotheses were proposed:

1. Dietitians would have a negative attitude toward a LCHF diet.
2. Dietitians would not prescribe a LCHF diet for the management of NCDs.

1.5 Limitations

Due to financial and time constraints, this study was limited to dietitians practicing in the KwaZulu-Natal (KZN) province. Due to the scope of the investigation, this study only included clinical dietitians working in the government and private practice.

1.6 Definition of terms

Attitude	“Opinion or way of thinking; behaviour reflecting this” (South African Pocket Oxford Dictionary 1994, p50)
Cardiovascular disease	A collective term for a group of conditions; including ischaemic heart disease, atherosclerosis, coronary heart disease, vascular disease and heart failure (Mahan, Escott-Stump & Raymond 2012, p743).
Diabetic dyslipidaemia	Different to traditional dyslipidaemia in that it takes into account blood glucose and insulin levels, glycosylated haemoglobin, inflammatory markers and LDL particle size (Bell, Al Badarin & O’Keefe 2011).
Diet-heart hypothesis	A hypothesis which states that the intake of saturated fat and cholesterol above that which is recommended by the prudent diet guidelines, raises the serum cholesterol levels which leads to cardiovascular disease (Ravnskov 2002).

Dyslipidaemia	Can also be referred to as hypercholesterolemia. It refers to elevated serum levels of total cholesterol, low density lipoprotein and triglycerides and low levels of high density lipoprotein (Maritz 2006).
Food Based Dietary Guidelines	South African National Dietary guidelines which were designed to be used for nutrition education at schools, clinics and hospitals. They are based on a prudent diet (National Department of Health 2012).
Hyperglycaemia	Elevated blood glucose levels, often associated with diabetes (Mahan et al 2012, p679).
Insulin resistance	Also referred to as pre-diabetes. A physiological condition that occurs when cells do not respond to the effects of insulin. This leads to hyperglycaemia, or raised blood glucose levels (Mahan et al 2012, p679).
Low carbohydrate, high fat diet	While there is no formal definition of a LCHF diet, for the purposes of this investigation it was defined as a diet that provides $\geq 60\%$ of the total energy as fat, $\leq 20\%$ of the total energy as carbohydrates and the remainder of energy as protein.
Metabolic syndrome	A group of conditions or risk factors that most often occur simultaneously. These include raised fasting blood glucose levels, raised serum lipid levels, abdominal obesity and elevated blood pressure (Alberti, Eckel, Grundy, Zimmet, Cleeman, Donato, Fruchart, James, Loria & Smith 2009).
Non-communicable diseases	Also referred to as chronic diseases of lifestyle, of which the four most common include cardiovascular diseases, cancers, chronic respiratory diseases and diabetes (National Department of Health 2013).
Normoglycaemic	The presence of a normal concentration of glucose levels in the blood (Mahan et al 2012, p679).
Obesity	The state of being grossly overweight. Can be indicated by a body mass index of more than 30 kg/m^2 . Central obesity (a risk factor for disease) can be defined as a

Prudent diet	<p>waist to hip ratio of more than 1 in males and 0.8 in females (Mahan et al 2012, pp467-469).</p> <p>Also referred to as a “balanced diet”, and commonly thought to be effective in the prevention of chronic disease and obesity. The diet is low in total fat, particularly limiting the intake of saturated fat and cholesterol, while promoting monounsaturated and polyunsaturated fat. It recommends that more than half of the total calorie intake should come from carbohydrates and the remainder from protein (Kelley et al 2011).</p>
Type 2 diabetes mellitus	<p>An extended period of insulin resistance followed by hyperglycaemia at which point diabetes is diagnosed. Normally occurs in, but is not limited to, older adults and those who are overweight. It is considered a non-communicable disease (National Department of Health 2013, Mahan et al 2012, p679).</p>

1.7 Abbreviations

ADSA:	Association for Dietetics in South Africa
AUT:	Auckland University of Technology
BMI:	Body Mass Index
BP:	Blood pressure
CDL:	Chronic disease of lifestyle
CPD:	Continuing Professional Development
CVD:	Cardiovascular disease
DGAC:	Dietary Guidelines Advisory Committee
DOH:	Department of Health
FAO:	Food and Agriculture Organisation

FBDGs:	Food Based Dietary Guidelines
HDL-C:	High Density Lipoprotein Cholesterol
KZN:	KwaZulu-Natal
LCHF:	Low Carbohydrate, High Fat
LDL-C:	Low Density Lipoprotein Cholesterol
NCD:	Non-Communicable Disease
RD:	Registered Dietician
RIQ:	Research Involvement Questionnaire
SADHS:	South African Demographic and Health Survey
SANHANES-1:	South African National Health and Nutrition Examination Survey
SARACG:	South African Risk Assessment Collaborating Group
T2DM:	Type 2 diabetes mellitus
TC:	Total cholesterol
TG:	Triglycerides
WHO:	World Health Organisation

1.8 Assumptions

For the purposes of this study, the following assumptions were made:

- The sample would be representative of Kwa-Zulu-Natal dieticians.
- The undergraduate training that the subjects received would have been the same country-wide.
- All subjects would be up to date with their Continuing Professional Development (CPD) points as required by the HPCSA.
- Subjects would answer the respective questionnaires truthfully and that their answers would be free from bias.

- Both government and private practicing dietitians would be able to provide nutrition advice according to the patient's lifestyle and available resources, and not necessarily always within the boundaries of the conventional prudent diet.

1.9 Summary

The incidence of NCDs in South Africa is rapidly increasing. This is making a significant contribution to morbidity and premature mortality amongst the local population. An unhealthy diet is one of the risk factors that contribute to the development of NCDs. It is therefore vital that South Africans follow a diet that is successful in preventing the onset of NCDs.

It is accepted globally as well as locally that a prudent diet is the most effective diet in maintaining health and preventing the onset of NCDs. However, the public interest in a LCHF has recently increased due to the promotion of it by some health professionals and the media.

Dietitians strive towards maintaining a reputation of being experts in the field of nutrition, and are expected to stay abreast with developments in the field. To date no studies have been published surrounding the prescription of the LCHF diet by South African Dietitians. It is therefore of the utmost importance that the attitude of dietitians toward a LCHF diet; and whether or not it is prescribed is examined. Considering the large interest from both members of the public and health professionals regarding a LCHF diet, this investigation is both topical and relevant. It is anticipated that the results of this study will contribute towards providing updated information regarding the scope of practice and professional interest, as well as the research involvement of registered South African dietitians.

1.10 Chapter overviews

This dissertation consists of six chapters. The first covered the reasons and need for conducting the current investigation. The second chapter presented the current body of evidence regarding NCDs in South Africa, the dietary management thereof and the studies

that have investigated the benefits of a LCHF diet versus a prudent diet. The third chapter covered the methodology used in the study while the fourth chapter included the results of the study after the statistical analyses were conducted. Chapter five included a discussion of the results and chapter six concluded the dissertation with recommendations based on these results.

CHAPTER 2: REVIEW OF THE RELATED LITERATURE

While Human Immunodeficiency Virus (HIV) and Tuberculosis (TB) are still the leading causes of morbidity and mortality in South Africa, non-communicable diseases (NCDs) are rapidly on the increase. This phenomenon can be attributed to an increase in urbanisation and industrialisation, along with a health care system that is not equipped to deal with the increased number of NCD sufferers (National Department of Health 2013).

In order to provide the necessary background for the current study this chapter will cover the definition and cause of NCDs and the current prevalence of these conditions amongst South Africans. Following that, the current dietary management of NCDs will be discussed. This will be followed by an explanation of why there is a debate surrounding an emerging theory that a low carbohydrate, high fat (LCHF) diet may be appropriate for the treatment of NCDs. The training and acquisition of knowledge of health professionals responsible for the dietary management of NCDs, specifically dietitians, will also be examined. Lastly, possible factors that influence the decision of whether dietitians would prescribe a LCHF diet for the management of NCDs will be discussed.

2.1 Definition of non-communicable diseases

According to the South African Strategic Plan for the Prevention and Control of NCDs for the years 2013 to 2017 (National Department of Health 2013), NCDs are conditions which are not infectious and can be prevented through the amendment of four lifestyle areas: tobacco use, alcohol use, dietary choices and physical activity. This report clarified that there are other conditions including respiratory conditions and mental disorders that can also be defined as NCDs due to the fact that they are non-infectious. However, for the purposes of the current literature review and dissertation, NCDs will hereafter refer to cardiovascular disease (CVD) and type 2 diabetes mellitus (T2DM).

The metabolic syndrome refers to a group of conditions or risk factors that often cluster together. These conditions or risk factors can vary according to the diagnostic criteria used. Alberti *et al* (2009) authored a statement in which the various definitions of the metabolic

syndrome were harmonized. This was a joint statement between six different organisations: The International Diabetes Federation Task Force on Epidemiology and Prevention; The National Heart, Lung and Blood Institute, The American Heart Association, The World Heart Association, The International Atherosclerosis Society and the International Association for the Study of Obesity. According to this statement, an individual must display three or more of the following five risk factors in order to be diagnosed with the metabolic syndrome (Aberti *et al* 2009):

- A raised fasting blood glucose level;
- An elevated blood pressure (BP);
- A raised serum triglyceride (TG) level;
- A reduced high density lipoprotein cholesterol (HDL-C) level and
- Abdominal obesity or a high waist circumference measurement.

If one is free from CVD or T2DM, being diagnosed with the metabolic syndrome is a strong predictor for the development of these conditions. Once CVD or T2DM has developed, the metabolic syndrome is often present (Alberti *et al* 2009). The more metabolic syndrome risk factors present the higher the risk of disease progression.

2.2 The relationship between obesity, type 2 diabetes mellitus and cardiovascular disease

The cause of obesity can be multi-factorial and the interaction between factors such as genetics, environmental circumstances and psychosocial dynamics can all play a role in its development. Changes in diet and lifestyle are one of the largest contributors to the increasing prevalence of obesity. Modern day diets tend to be high in saturated fat, trans-fats and sugar. Foods high in these nutrients, coupled with a lack of or decrease in physical activity, are a predominant cause of global obesity (Mahan *et al* 2012, pp467-469).

CVD is a collective term for a group of conditions including ischaemic heart disease, atherosclerosis, coronary heart disease, vascular disease and heart failure (Mahan *et al* 2012, p743). Dyslipidaemia, or abnormal serum lipid levels, is one of the risk factors for the

development of CVD (Klug, Raal, Marais, Taskinen, Dalby, Schamroth, Rapeport, Blom, Catsicas & Webb 2012).

When T2DM and CVD occur simultaneously diabetic dyslipidaemia occurs. Diabetic dyslipidaemia is characterised by low HDL-C levels, high TG levels and the presence of small, dense low density lipoprotein cholesterol (LDL-C) (Bell *et al* 2011). Data generated by the Framingham study, which was initiated in 1948 and is still taking place presently, indicated that this pattern of dyslipidaemia is twice as likely to be seen in those with T2DM when compared to those without, while concentrations of LDL-C and total cholesterol (TC) do not differ between those with and without T2DM (Bell *et al* 2011).

In 2012 the South African Heart Association and the Lipid and Atherosclerosis Society of South Africa released a consensus statement on dyslipidaemia treatment guidelines. However, certain researchers feel that diabetic dyslipidaemia is inadequately dealt with in these guidelines, as the recommendation to physicians was to base the diagnosis of dyslipidaemia on a lipogram only. The guidelines stated that the only other tests besides a lipogram that should be done, and only under special circumstances, are C-reactive protein and lipoprotein-a. LDL-C particle size was not included (Klug *et al* 2012). In light of the above, current South African dyslipidaemia guidelines may not be sufficient for those suffering from the diabetic dyslipidaemia pattern, and there may be a need for provisions for additional markers that require testing.

Glycaemic control plays an important role in improving dyslipidaemia and lowering the prevalence of cardiac events. It is for this reason that fasting glucose; fasting insulin and glycosylated haemoglobin are recommended as part of the screening and management of diabetic dyslipidaemia. C-reactive protein is an inflammatory marker associated with both T2DM and CVD, hence its inclusion (Bell *et al* 2011).

The LDL-C particle size may also have significance. It has been observed that the small dense LDL-C particles are more atherogenic than the larger LDL-C particles and it is these

small particles that tend to be elevated in diabetic dyslipidaemia (Bell *et al* 2011). Table 2.1 summarises the difference in the markers used to diagnose traditional dyslipidaemia and diabetic dyslipidaemia:

Table 2.1 Comparison of traditional dyslipidaemia and diabetic dyslipidaemia markers

Traditional dyslipidaemia	Diabetic dyslipidaemia
Raised LDL-C level	Raised glucose and glycosylated haemoglobin (HbA1c) levels
Raised TG level	Raised insulin levels
Raised TC level	Raised TG
Lowered HDL-C level	Raised Apolipoprotein B (ApoB) level
	Raised C-reactive protein level
	Lowered HDL-C level
	Normal/raised LDL-C level, but particles are small and dense

Source: Bell *et al* (2011); Maritz (2006).

The relevance of this explanation of traditional dyslipidaemia versus diabetic dyslipidaemia is explained in Section 2.5.3. In order to emphasise the importance of scientifically-sound dietary guidelines for the South African public, the current prevalence of NCDs needs to be examined.

2.3 The global and local prevalence of non-communicable diseases

According to a WHO report, 38 million people die annually as a result of NCDs, and over 85% of these deaths occur in developing countries (WHO 2011). In order to demonstrate the increasing prevalence of NCDs in South Africa, two figures taken from the 2011 WHO NCD report are represented by Figures 2.1 and 2.2. They demonstrate the number of deaths caused by NCDs in South Africans younger than 70 years. The number of deaths per thousand is shown on the y-axis and the years are displayed in the x-axis. Each colour depicted in the graph represented a different NCD, with “other NCDs” including conditions such as autoimmunity, eye disorders, osteoporosis and mental disorders. Figure 2.1 is related to males and Figure 2.2 is related to females:

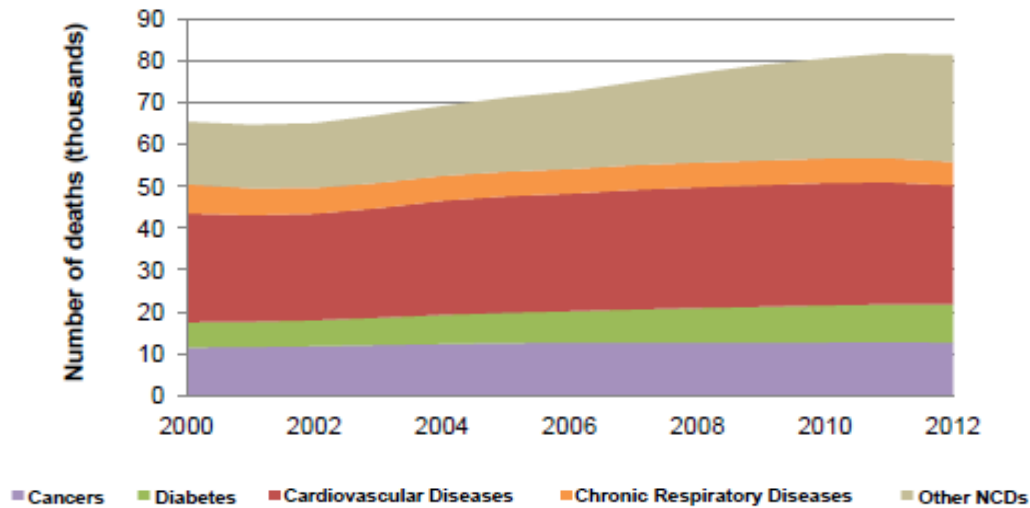


Figure 2.1 Number of deaths related to NCDs in South African males (WHO 2011)

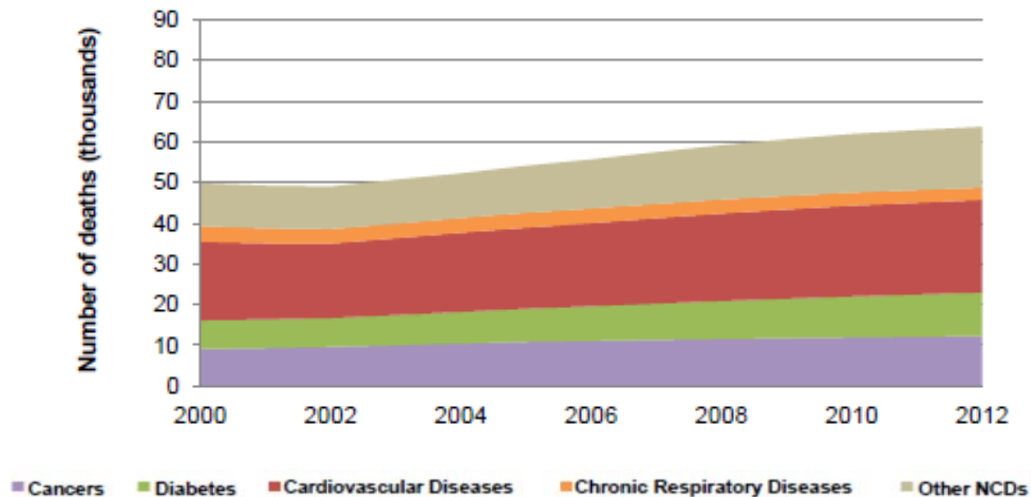


Figure 2.2 Number of deaths related to NCDs in South African females (WHO 2011)

2.3.1 Obesity

While obesity is considered more of a risk factor for the development of an NCD, rather than an NCD itself (WHO 2013), it is important to assess how the prevalence of obesity has increased globally as well as locally. According to the WHO, the global prevalence of obesity worldwide has almost doubled since 1980. In 2008, 35% of people over the age of 20 years were overweight while 11% were obese (WHO 2013).

By looking at two of the most important national health studies conducted in South Africa, it becomes evident how the prevalence of obesity has increased locally. The two studies

assessed for this purpose were the 2003 South African Demographic and Health Survey (SADHS) (DOH/MRC 2007) and the South African National Health and Nutrition Examination Survey (SANHANES-1) conducted in 2012 (Shisana *et al* 2012). Table 2.2 depicts how the anthropometric status of South Africans has deteriorated over this period of 11 years:

Table 2.2 The anthropometric status of South Africans between the years 2003 and 2012

Variable	Males		Females	
	2003	2012	2003	2012
Mean BMI	23.3 kg/m ²	23.6 kg/m ²	27 kg/m ²	28.9 kg/m ²
Overweight	21%	20.1%	27.5%	25%
Obese	8.8%	10.6%	27%	39.2%
Waist circumference (≥ 88 cm in females, ≥ 102 cm in males)	5%	9.9%	33.7%	50.5%
Waist-to-hip ratio (≥0.85 in females, ≥1 in males)	6.4%	7%	32%	47.4%

Sources: Shisana *et al* (2013); DOH/MRC (2007)

As can be seen from the above, the SANHANES-1 found that the prevalence of obesity increased in both males and females between 2003 and 2012, with the increase being more significant in females than males. Currently, almost half of South African females are obese and more than half have a waist circumference which puts them at increased risk for the development of NCDs (Shisana *et al* 2013).

The increase in the local prevalence of obesity can largely be attributed to an imbalance between energy intake and energy expenditure (Shisana *et al* 2013). Globally, and especially in South Africa, as a result of what Bourne, Lambert and Steyn (2002) have described as the nutrition transition, there has been a replacement of traditional meals with more convenient fast foods as a result of urbanisation. Fast foods are more energy dense as they tend to be

high in fat and sugar. Along with these dietary changes, there has been an increase in sedentary behaviour (WHO 2013).

2.3.2 Type 2 diabetes mellitus

As described in Section 2.2, the increased prevalence of overweight and obesity may explain the observed increase in T2DM. In the year 1980, there was an estimated 153 million cases of diabetes documented worldwide. In the year 2008, this figure had more than doubled to 347 million. In 2004, high blood glucose levels were related to all diabetes-related deaths, 22 percent of all ischaemic heart disease deaths and 16 percent of all stroke related deaths (WHO 2009).

Two studies, ten years apart, were used to document the increase in the prevalence of T2DM among Indian South Africans (Omar, Seedat, Dyer, Motala, Knight & Becker 1994; Omar, Seedat, Dyer, Rajput, Motala & Joubert 1985). Five hundred and sixty three subjects who had been tested for diabetes in the first study, that took place in 1984, were followed up in the ten years later (Omar *et al* 1994). The results of the 1994 study revealed a 0.95% annual increase in the prevalence of T2DM, with an 8.3% overall increase in prevalence when adjusted for age and gender. Subjects who were obese were found to have an almost five-fold increased greater risk of developing T2DM than those who were not obese (Motala, Pirie, Gouws, Amod & Omar 2003).

The overall prevalence of diabetes among South Africans remained unchanged from 1998 to 2003 (DOH/MRC 2007). However race-specific prevalence and prevalence in certain age groups increased, particularly, in Indians and females aged 55 to 64 years (DOH/MRC 2007). The SADHS also documented that diabetic medication made up 19% of all chronic medications prescribed to South Africans at the time.

In 2000, 5.5% of all South African deaths were attributed to diabetes (Bradshaw, Norman, Pieterse, Levitt & the SACRACG 2007). According to Statistics South Africa (2013), diabetes-related deaths increased by 3.8% between 2009 and 2010. The same report ranked

diabetes mellitus as the sixth leading cause of death in 2010, in all provinces, across all ages and genders, placing it higher than HIV. The same trend was observed in KwaZulu-Natal (KZN) while in particular for those aged 50 to 64 years and 65 years and older, it was ranked second and third respectively (Statistics South Africa 2013).

Five percent of the 12 025 SANHANES-1 subjects reported having diabetes and over 8000 of the subjects had blood tests to confirm this diagnosis. Of these, 9.5% were diagnosed with diabetes, while 18.4% were at risk of diabetes as they presented with impaired glucose and insulin levels (Shisana *et al* 2013).

2.3.3 Dyslipidemia and cardiovascular disease

In order to confirm the link between CVD and T2DM, Motala *et al* (2008) examined 1025 Zulu South Africans with and without T2DM and found significantly abnormal lipid levels in those with T2DM compared to those without. The SANHANES-1 found that TC increased with age, and that females had higher TC and LDL-C levels than males. One out of four South Africans had abnormally high TC (23.9%) and LDL-C (26.4%) and one out of two had abnormally low HDL-C levels (47.9%) (Shisana *et al* 2013).

Considering how closely linked obesity, T2DM and CVD are, in order to slow down the increasing prevalence of these conditions, they must not be treated individually, but rather holistically (Maritz 2006). The reasons for the increase in these NCDs are very likely to be multi-factorial, and include economic development, changes in cultural practices and urbanization (Vorster, Badham & Venter 2013).

In low-income and developing countries such as South Africa, the health system should focus on the four key modifiable risk factors in order to lower the incidence of NCDs. These risk factors are tobacco use, physical inactivity, the use of alcohol at harmful levels and unhealthy diets (Atun, Jaffar, Nishtar, Knaul, Barreto, Nyirenda, Banatvala & Piot 2013). For the purpose of the current study risk factor related to nutrition will be examined. In order for this

risk factor to be addressed, it is vital to ensure that the South African public receive, understand and implement scientifically sound nutrition advice.

2.4 Current advice for the dietary management and prevention of non-communicable diseases

It is globally accepted that an energy-restricted or energy-balanced prudent diet is the most appropriate dietary advice for the prevention or treatment of obesity and NCDs (WHO 2003). South African dietitians are currently taught this principle at university. In a prudent diet the following is recommended (Kelley *et al* 2011; WHO 2003):

- A total fat intake between 15 to 30 percent of total kilojoule intake, with less than ten percent being provided by saturated fat;
- A daily cholesterol consumption of 300 milligrams or less;
- Fifty to sixty percent of the total kilojoule intake should come from carbohydrates, preferably wholegrain sources;
- A daily dietary fibre intake of more than 25 grams for females and 35 grams for males.

The relationship between dietary fat intake and the effect on health began in 1933 when researcher Nikolai Anitschkow force fed high-cholesterol food to rabbits. This process induced the deposition of fatty particles in the animals' aortas, causing their death (Weinberg 2004). It is now known that the observed deaths were due to the fact that rabbits normally consume a vegetarian diet, and therefore the animals did not have the physical capabilities of metabolizing the cholesterol-laden feed (Weinberg 2004). However, Anitschkow's research sparked an interest in blood lipids and in 1950 the process of describing the serum levels of lipoproteins was discovered (Mann 1977). Three years later an article was published suggesting that heart disease in humans was caused by increased serum cholesterol levels that were related to the fat content of the diet (Keys 1953).

Based on this and similar research on the effect of fat in the diet, recommendations to adopt a low fat diet were released by the American Heart Association and the "Atherosclerosis Study

Group” in 1970 (Atherosclerosis Study Group 1970). In 1977 the “Dietary Goals for Americans” were released (Hite *et al* 2010). These goals were based on the research to show that the intake of dietary saturated fat and cholesterol raised serum cholesterol levels, thereby increasing the risk of developing heart disease. Thus, the 1977 dietary goals encouraged a diet that was low in saturated fat and cholesterol and high in grains, cereals and vegetable oils in order to maintain a healthy weight and to prevent the development of NCDs. This way of eating became known as the prudent diet, which is based on the following guidelines:

- Total energy intake needs to be restricted in order to lose weight, and energy consumed need to be equal to energy expended in order to maintain a healthy weight;
- Of the three macronutrients, fat contributes the most kilojoules per gram (37 kilojoules as opposed to 17 provided by carbohydrates and protein), and so in order to prevent weight gain or to induce weight loss fat should be restricted;
- A high intake of saturated fat can lead to an increase in serum cholesterol levels which subsequently can lead to CVD. This is known as the diet-heart hypothesis (Ravnskov 2002).

South African dietary guidelines are also based on the above and these national guidelines are known as the Food Based Dietary guidelines (FBDGs) (National Department of Health 2012). Development of the FBDGs began in 1998 when a working group was commissioned by the Nutrition Society of South Africa (Love, Maunder, Green, Ross, Smale-Lovely & Charlton 2001). As directed by the World Health Organisation (WHO) and the Food and Agriculture Organisation (FAO), the FBDGs are designed for two reasons: (i) to inform the public on how to follow a healthy prudent diet, and (ii) to provide guidelines for national food and nutrition policies as well as the food industry (Keller & Lang 2007). The FBDGs promoted the use of starchy foods as the basis of each meal, and encouraged the public to use fats sparingly.

It was recommended by the FBDGs working group that the guidelines form part of the Integrated Nutrition Programme and school curriculums and that they were used as a basis for planning the Primary School Nutrition programme. It was also recommended that the FBDGs were promoted to the general public through the use of appropriate marketing strategies. In

this way the FBDGs would be communicated to South Africans of all ages (Vorster, Love, Browne 2001). KwaZulu-Natal dieticians also received training on the FBDGs which are regularly used in hospital and community settings for counselling patients on healthy eating patterns (UKZN Dietetics Post-Graduate Diploma Book 2014; Keller & Lang 2007).

In 2010 a document based on scientific recommendations, entitled “Guidelines for Healthy Eating: Information for Nutrition Educators”, was released by the South African Department of Health (National Department of Health 2012). This report contained the updated FBDGs and instructions on how they should be used in nutrition education. These latest FBDGs have not changed substantially from the original ones as they continued to encourage the public to “make starchy foods part of most meals”, to “use fat sparingly”, and to “choose vegetable oils rather than hard fats” (National Department of Health 2012). The FBDGs were designed to advise both under-nourished and over-nourished persons, and were intended for use as a tool to “eliminate or substantially reduce” NCDs. In order to achieve this goal, the FBDGs encourage South Africans to follow a prudent diet which provides 10 – 20% of the total energy as protein, 45 – 60% as carbohydrates and 25 – 30% as fat (National Department of Health 2012).

To demonstrate the global endorsement of the prudent diet, Table 2.3 includes the latest dietary guidelines from: the United States; the WHO - one of the most recognized health authorities, as well as the South African FBDGs.

Table 2.3 Current guidelines on the recommended intake of fat and carbohydrate in relation to total energy intake

Macronutrient contribution	Dietary guidelines for Americans	WHO/FAO	South African FBDGs
Carbohydrates	45 – 65% of total energy.	55 – 75% of total energy.	45- 60% of total energy.
Fat	20 – 35% and less than 10% as saturated fats of total energy.	25 – 30% and less than 10% as saturated fat of total energy.	25 – 30% of total energy (no specific value for saturated fat but indicated to limit it/cut it out).

Sources: National Department of Health (2012); USDA & USDHSS (2010); WHO/FAO (2003)

Since the American Heart Association put forward its first dietary recommendations in 1970, consuming a diet low in fat has been associated with healthy eating throughout the world (National Department of Health 2012; Margetts 2003). It is for this reason that the recent promotion of a low carbohydrate, high fat (LCHF) diet has sparked such controversy amongst the South African public and health professionals alike.

2.5 Emerging theories for the dietary management and prevention of non-communicable diseases

Appendix E (p107) is an article from 2011 in which Timothy Noakes first published his opinion on a LCHF diet. In the article, Noakes described how he had come to the conclusion that the dietary advice that health professionals, including himself, had been giving to the public was not necessarily correct. He stated that for both himself, and what he believed to be a large part of the population, carbohydrates should not be the largest contributor to total energy intake. This was because of a condition he went on to refer to in later publications as “carbohydrate-intolerance” (Noakes & Vlismas 2012, pp128-130).

“Carbohydrate-intolerance” is related to the hormonal- or insulin-model of obesity, and has been referred to as early as 1923 (Falta 1923). This model of obesity differs from the currently accepted “energy in-energy out” model of obesity in that it takes into account the effect of the metabolism of different macronutrients. A simplified explanation of the insulin-model of obesity is that a person who for genetic reasons does not metabolise or store carbohydrates efficiently, will gain weight because the resultant insulin resistance causes adipose tissue deposition (Noakes & Vlismas 2012, pp128-130). Thus, the restriction of carbohydrates in such an individual would theoretically lower insulin levels which would in turn lower the amount of adipose tissue deposition. In a “carbohydrate-intolerant” individual, it is proposed that regular consumption of carbohydrates would cause constant hunger because of the inefficiency of metabolising carbohydrates and as a result overconsumption of kilojoules from all macronutrients is likely (Noakes & Vlismas 2012, pp128-130; Appendix E, p107).

Noakes has proposed that because a large proportion of the human population could possibly be “carbohydrate-intolerant”, current prudent dietary guidelines which recommend that the majority of the kilojoules should be consumed as carbohydrates, may have been contributing toward the increasing rates of obesity and NCDs (Noakes & Vliemas 2012, pp128-130). It has been suggested that non-diabetic hyperglycaemia is a risk factor for CVD (Levitan, Song, Ford & Liu 2004). Regular consumption of carbohydrates results in regular increases in serum glucose levels and for this reason Noakes further advises the restriction of carbohydrates (Noakes & Vliemas 2012, pp137-140).

Since the 2011 magazine article was published, Noakes has continued his promotion of a low carbohydrate diet throughout South Africa through magazine and newspaper articles, addresses to both the public and health professionals and debates with other health professionals (Noakes 2012; Noakes & Vliemas 2012). In addition to his theory on carbohydrates, Noakes has also proposed that current guidelines on saturated fat intake are unfounded as there was no clear evidence to show that a high saturated fat intake increased mortality rates (Noakes & Vliemas 2012, p130). Hence it was proposed that the advice to follow a low fat diet has been a major driver in the development of obesity and NCDs. The reason for this, according to Noakes, was that the elimination of fat from food products has resulted in the replacement of this energy with sugar and refined carbohydrates, perpetuating the insulin-model of obesity. It must be noted that Noakes and other proponents of a LCHF diet agree with the current convention that trans fats should be avoided and do not propose that trans fats be included in a LCHF diet.

In 2013, Noakes published a survey in the *South African Medical Journal* which documented case studies of 127 South African’s responses to the LCHF diet. The anecdotal case studies showed how the individuals had lost significant amounts of weight and had improved NCD markers such as glucose and lipid levels. An obvious limitation of this article was that the information was self-reported by the case study individuals and some information was unsubstantiated. It is important to note that case studies do not yield data as reliable and valid as that which a randomised control trial would and therefore the information obtained from this survey cannot be generalised to the whole South African population.

Noakes has also set up a research foundation to showcase his views on nutrition. “The Noakes Foundation” website states its purposes are the following: (i) to be “a catalyst for new research into better health and nutrition”; (ii) “to uncover, once and for all, what makes up a healthy meal”, and (iii) to “change the definition of a healthy diet” (The Noakes Foundation 2014). As a prominent public figure, Noakes has created a large public interest and adoption of what has become known in South Africa as “the LCHF diet”, the “Tim Noakes diet” or “the Banting diet”.

2.5.1 Definition of a low carbohydrate, high fat diet

It is well-accepted that a LCHF diet can be used to treat childhood epilepsy, especially when medication fails to control seizures. A Cochrane review found that a LCHF ketogenic diet is able to control epileptic seizures on an equal level to that of modern epileptic drugs (Levy, Cooper, Giri & Pulman 2012). The term ketogenic refers to the production of the ketone bodies acetoacetate and beta-hydroxybutyrate which are produced as a result of carbohydrate restriction (Adam-Perrot, Clifton & Brouns 2005).

For the purpose of this study a LCHF diet was referred to as one that provides 60% or more of the total energy from fat (all fat types excluding trans fat), 20% or less of the total energy from carbohydrates and the remainder from protein. As per Noakes’ definition of a LCHF diet it may or may not be ketogenic, depending on how much the carbohydrates are restricted (Noakes & Vlismas 2012). The majority of studies investigating the use of a LCHF diet for the management and prevention of NCDs defined the diet in a similar manner to the definition adopted for the purpose of the current dissertation. Section 2.6.3 will illustrate this.

2.5.2 A history of the low carbohydrate, high fat diet

In 1862, William Banting published the first edition *The Letter on Corpulence* (Banting 1865). The publication explained how Banting’s doctor had prescribed a LCHF diet in order to treat his morbid obesity, and how successful this prescription was. LCHF diets were thereafter referred to in academic and medical literature and were often recommended as the preferred treatment for diabetes throughout the 19th century (Osler 1978).

More recently, the Atkins diet, as mentioned in Chapter 1, has remained one of the most popular weight loss diets since its publication in the 1970s. The Atkins diet closely follows the macronutrient prescription of a LCHF diet as defined by the current study (Thiele 2003).

2.5.3 The current evidence for and against a LCHF diet

Table 2.4 summarises a selection of primary studies identified by the researcher at the time of the literature review. The studies compared a LCHF diet to a conventional prudent diet. The table includes the number of subjects involved, the type of study, the dietary interventions used, the study period, measures put in place to promote adherence, the baseline health status of the subjects, results observed and limitations to the study.

The following key refers to Table 2.4:

CHO: Carbohydrates

BP: Blood pressure

CHD: Coronary Heart Disease

HbA1c: Glycosylated haemoglobin

Sat.fat: Saturated fat

HPT: Hypertension

VLDL-C: Very low density lipoprotein

Table 2.4 Summary of studies comparing a low carbohydrate, high fat diet to a prudent diet

Study	Number of subjects	Dietary interventions	Study type and period	Adherence measures	Inclusion & exclusion of subjects	Results observed	Limitations
Foster, Wyatt, Hill, Makris, Rosenbaum, Brill, Stein, Mohammed, Miller, Rader, Zemel, Wadden, Tenhave, Newcomb & Klein (2010).	307 (99 males, 208 females).	LCHF diet: <20gram CHO for three months, thereafter increased by five grams CHO/day until stable weight maintained Other diet: energy-restricted diet, <30% fat.	Randomised parallel group control trial that ran for two years.	Group session weekly for 20 weeks, biweekly for the next 20 weeks, then every second month for the remainder of the two years. LCHF subjects instructed to follow Atkins diet guidelines.	<u>Inclusion:</u> 18 – 65 years old. BMI of 30-40kg/m ² . <u>Exclusion:</u> T2DM, lipid-lowering medication, pregnancy, lactation, serious medical illnesses, medication which could affect weight.	No significant differences in weight loss at 2 years. Greater increases in HDL-C on LCHF diet at all measured points. At 6 months better improvements in BP, TG and VLDL-C levels in LCHF group, as well as more adverse effects.	Drop-out rate was 32% for low fat diet and 42% for LCHF diet at 2 years. Patients with T2DM and dyslipidaemia excluded.
Lim, Noakes, Keogh & Clifton (2010).	104 (17 males, 87 females).	LCHF diet: 80% fat, 4% CHO Other diet: 10% fat. Both diets were isocaloric.	Randomised, parallel group control trial that ran for 15 months.	Bi-weekly consult with a dietician for 3 months, meal plans, food diaries at three, six, nine, 12 and 15 months.	<u>Inclusion:</u> One CVD risk factor, BMI between 28 and 40kg/m ² , <u>Exclusion:</u> DM, regular dining out, history of alcohol use, CHD, fluctuating exercise	No significant weight loss differences at 15 months, significant improvements in CVD markers at 3 months in LCHF group but not at 15 months.	Only 66% completed the study. Possibly poor compliance after 3 months.

Study	Number of subjects	Dietary interventions	Study type and period	Adherence measures	Inclusion & exclusion of subjects	Results observed	Limitations
Shai, Schwarzfuchs, Henkin, Shahr, Witkow, Greenberg, Golan, Fraser, Bolotin Vardi, Tangi-Rozental, Zuk-Ramot, Sarusi, Brickner, Schwartz, Sheiner, Marko, Katorza, Theiry, Fiedler, Blucher, Stumvoll, Stampfer (2008).	322 (277 males, 45 females).	LCHF diet: 20 grams CHO/day for two months, then gradual increase to max 120 grams CHO/day. Other diet: prudent diet with 2100kJ energy deficit, <30% from fat.	Randomised control trial that ran for two years.	Subgroups met with dietician at weeks one, three, five, seven and every six weeks after. Regular phone calls from dietician. Spousal support. Labelled meals at work place (subjects worked in same place).	<u>Inclusion:</u> Age between 40-65 years, BMI >27kg/m ² , presence of T2DM or CVD irrespective of age/BMI. <u>Exclusion:</u> Pregnancy, lactating, cancer and liver disease.	More weight loss on LCHF diet at 2 years, both diets improved waist circumference and blood pressure, HDL and TG. TC to HDL ratio more improved on LCHF diet but improvements in both diets. Both diets improved insulin sensitivity.	Few females compared to males. Unique situation of all subjects being in same workplace made it difficult to generalise to rest of population.
Westman, Yancy, Olsen, Dudley & Guyton (2005).	119 (28 males, 91 females).	LCHF diet: < 20 grams CHO/day. Other diet: energy restricted 30% fat.	Randomised, parallel group control trial that ran for six months.	Group meetings bi-weekly for three months, then monthly for three months.	<u>Inclusion:</u> 18 – 65 years old, BMI 30 – 60kg/m ² , LDL-C >3.36mmol/l, TG >2.26 mmol/l. <u>Exclusion:</u> Any serious medical condition.	Weight loss greater in LCHF group at 6 months. LCHF group had greater reductions in LDL-C levels, and increase in LDL particle size.	Short-term study. Subjects free of disease used. Small subject group. Data used from drop-outs.

Table 2.4 continued							
Study	Number of subjects	Dietary interventions	Study type and period	Adherence measures	Inclusion & exclusion of subjects	Results observed	Limitations
Boden, Sargrad, Homko, Mozzoli & Stein (2005).	10 (3 males, 7 females).	LCHF diet: < 20 gram CHO/day. Other diet: subjects encouraged to continue normal eating habits.	Cross-over trial: day one to seven normal diets were followed, day eight to 21 LCHF diet was followed.	Inpatient trial where all food consumed strictly controlled by hospital kitchen.	<u>Inclusion:</u> Obesity, T2DM. <u>Exclusion:</u> Other endocrine disorders, significant medical conditions, smokers.	Weight decreased in LCHF diet phase, total energy expenditure increased in LCHF diet phase, improved BG, HbA1C, TG and TC in LCHF diet phase. Patient satisfaction equal on both diets.	Very short study duration. Very small study group. Inpatient setting made it hard to apply to normal setting.

Table 2.4 continued							
Study	Number of subjects	Dietary interventions	Study type and period	Adherence measures	Inclusion & exclusion of subjects	Results observed	Limitations
McAuley Hopkins, Smith, McLay, Williams, Taylor & Mann (2004).	96 females.	LCHF diet: <20 gram CHO/day then increase by 5 gram/week until weight stable. Other diet: CHO >55%, fat < 30%, < 8% sat.fat No formal energy restriction.	Randomised, parallel group control trial that ran for 6 months.	Weekly reviews with dietary advice given for the first 16 weeks, thereafter no contact with researchers.	<u>Inclusion:</u> Females 30-70 years, BMI>27 kg/m ² , normal glucose tolerance, TC < 7mmol/l. <u>Exclusion:</u> Pregnancy, major medical conditions, formal weight loss programme, strict vegetarians.	Weight, waist circumference and TG significantly reduced on LCHF diet, greater increase in LDL-C on LCHF diet.	Possibly not enough dietary guidance provided. Dietary advice provided by researchers could introduce bias. LDL-C particle size not measured. Short study period. Only females of European descent used.
Volek, Sharman, Gomez, Judelson, Rubin, Watson, Sokmen, Silvestre, French & Kraemar (2004).	28 (15 males, 13 females).	LCHF diet: less than 10% from CHO. Other diet: 60% CHO, 25% fat, 15% protein. <10% sat.fat, <300 mg cholesterol. Both energy restricted by ±2100 kJ.	Randomised cross over trial. Males followed each diet for 50 days; females followed each diet for 30 days.	Initial and follow-up consults with dietician, recipes, sample menus, weighed food records. Urinary ketone measures when on LCHF diet.	<u>Inclusion:</u> 20 – 55 years old. Non-smokers. > 25% body fat. <u>Exclusion:</u> Post-menopausal females, >145 kg weight, DM, CVD.	Significant decrease in body fat in males and females between groups and between individuals.	Short-term study. Subjects free of disease used. Small subject group.

Table 2.4 continued							
Study	Number of subjects	Dietary interventions	Study type and period	Adherence measures	Inclusion & exclusion of subjects	Results observed	Limitations
Yancy, Olsen, Guyton, Bakst & Westman (2004).	120 (29 males, 91 females).	LCHF diet: <20 grams CHO/day then increase by five grams/week until weight stable. Other diet: <30% fat, <10% sat.fat, <300 mg cholesterol.	Randomised, parallel group control trial that ran for six months.	Consult with dietician, information hand outs, self-reporting, food records, urinary ketone levels for those on LCHF diet.	<u>Inclusion:</u> Obesity, dyslipidaemia <u>Exclusion:</u> Any serious medical condition.	Weight loss greater in LCHF group, fat mass loss similar in both groups, more improvements in CVD markers in LCHF group, more adverse effects in LCHF group.	Short study period. 76% and 57% of each group completed study. Supplements for LCHF group may have increased compliance to diet.
Brehm, Seeley, Daniels & D'Alessio (2003).	53 females.	LCHF diet: 20 gram CHO/day initially, then increase to 40-60 gram/day but staying in ketosis, fat <i>ad libitum</i> . Other diet: energy restricted, 55% CHO, 15% protein, 30% fat	Randomised parallel-group control trial that ran for 6 months.	Weekly group meetings with dietician, weekly individual session with dietician, food records. Dieticians swapped groups to prevent bias. No more contact with dieticians from three months.	<u>Inclusion:</u> At least 18 years old, BMI between 30 and 35 kg/m ² , stable weight over previous 6 months. <u>Exclusion:</u> CVD, untreated HPT, DM, hypothyroidism, pregnancy, lactation.	Weight loss and fat loss more significant in LCHF group at three and six months, no significant differences in lipids at six months between groups, significant improvements in glucose and insulin in both groups.	Short study period. Small subject group. Only females included. Subjects free of disease used.

Study	Number of subjects	Dietary interventions	Study type and period	Adherence measures	Inclusion & exclusion of subjects	Results observed	Limitations
Foster, Wyatt, Hill, McGuckin, Brill, Mohammed, Szapary, Rader, Edman & Klein (2003).	63 (20 males, 43 females).	LCHF diet: 20 gram CHO/day for first two weeks, then gradual increase until stable weight reached Other diet: energy restricted, 60% CHO, 25% fat, 15% protein.	Randomised, parallel group control trial that ran for one year.	Met with dietician individually at zero, three, six and 12 months. Provided with Atkins diet book and instructed to follow it.	<u>Inclusion:</u> Obesity. <u>Exclusion:</u> T2DM, lipid-lowering medication, pregnancy, lactation, medication which could affect weight.	No significant differences in weight loss at 12 months but higher loss in LCHF group at three and six months. Both diets improved BP and insulin sensitivity. More improvement in HDL and TG in LCHF group.	Poor adherence in both groups. High drop-out rate of 43% on low fat diet and 39% of LCHF diet.
Samaha, Iqbal, Seshadri, Chicano, Daily, McGrory, Williams, Williams, Gracely & Stern (2003).	132 (109 males, 23 females).	LCHF diet: ≤ 30 gams CHO/day Other diet: prudent diet with 2100kJ energy deficit, <30% from fat.	Randomised, parallel group control trial that ran for 6 months.	Each group attended group sessions every week for four weeks, then monthly sessions with nutritional counsellor. Hand outs and meal plans given.	<u>Inclusion:</u> Age of at least 18 years, BMI ≥ 35 kg/m ² , <u>Exclusion criteria:</u> uncontrolled BG levels, raised creatine levels, liver disease, serious medical conditions, participation in a weight loss programme, weight loss medications.	Greater weight loss in LCHF group, increased glycaemic control in diabetics in LCHF group, no significant changes in TC, HDL and LDL in either group, non-significant decrease in HBA1c in LCHF group.	Data used from drop-outs. Short study duration. Small subject group. High drop-out rate of 47% in low fat diet and 33% in LCHF diet. Poor compliance.

Table 2.4 continued							
Study	Number of subjects	Dietary interventions	Study type and period	Adherence measures	Inclusion & exclusion of subjects	Results observed	Limitations
Meckling, Gauthier, Grubb & Sanford (2002).	20 females.	Encouraged to follow and record normal diet for 1 week then LCHF diet with < 71 grams CHO/day for 8 weeks.	Clinical trial that ran for eight weeks.	Not indicated how subjects were instructed to eat when trial began, three day food records at weeks zero, two, four and six.	<u>Inclusion:</u> Age 18 – 60 years, overweight by BMI or > 30% body fat. <u>Exclusion:</u> Overt DM, medication for DM, CVD or HPT.	Energy intake reduced by 2648 kJ, average weight loss of five kg in eight weeks, improvements in BP and LDL-C, non-significant increase in HDL, no change in glucose tolerance.	Very short study period. Small subject group. Only females included. No clear indication of dietary advice given.

A meta-analysis and systematic review was published in July 2014, in which 19 trials which compared a LCHF diet to an isoenergetic balanced weight loss diet were included. Subjects included in the trials were overweight, obese and/or had T2DM. The review concluded that over a two year period, there was little to no difference in weight loss and cardiovascular risk factors between the two diets (Naude, Schoonees, Senekal, Young, Garner, Volmink 2014).

Table 2.4 substantiates the concerns of many health professionals regarding the studies conducted on LCHF diets. The studies were of a short duration, the study samples were small, the drop-out rates were high and adherence to dietary guidelines was poor. These limitations challenge the generalisability of the findings. In addition, many of the studies used disease-free subjects, making the findings difficult to interpret for people already suffering from and taking medication for NCDs. Another factor that makes the results difficult to apply is the likelihood that subjects had differences in baseline measurements including lipid profiles and fasting glucose, and this may have affected the study outcome.

Despite these limitations, the results of the studies have suggested that a LCHF diet may be generally safe, it may provide an equal or greater weight loss than a prudent diet, and it does not seem to have adverse effects on CVD risk factors. Referring back to Section 2.2 in which diabetic dyslipidemia was discussed, proponents of a LCHF diet have suggested that a major benefit of this diet as compared to a prudent diet is that it theoretically improves all the markers for this type of dyslipidemia (see Table 2.1) (Foster *et al* 2010; Lim *et al* 2010; Westman *et al* 2005; Boden *et al* 2005; McAuley *et al* 2004; Volek *et al* 2004; Yancy *et al* 2004; Brehm *et al* 2003; Foster *et al* 2003; Samaha *et al* 2003; Meckling *et al* 2002).

2.6 Health professionals responsible for the dietary treatment and prevention of non-communicable diseases

In South Africa, the health professionals responsible for providing the public with dietary advice on how to prevent and treat NCDs include medical doctors, nurses and Registered Dietitians (RDs). For the purposes of this literature review, the focus will be on RDs.

2.6.1 Academic and professional requirements for Registered Dietitians

A dietitian is someone who has acquired an undergraduate degree in Dietetics from a university that offers this qualification. There are currently nine universities in South Africa that offer an undergraduate degree in Dietetics (ADSA 2014). The term “registered” refers to the registration of the dietitian with the Health Professions Council of South Africa (HPCSA). In order to be registered as a dietitian with the HPCSA, the successful completion of the Dietetics qualification is essential, followed by a mandatory year of community service in the South African public health sector. Once community service has been completed, an application to be registered with the HPCSA is made. Following registration the RD is allowed to practice independently, within the practice regulations promulgated by the HPCSA (HPCSA 2013).

2.6.2 Regulations governing Registered Dietitians in South Africa

Regulations governing South Africans RDs include those related to ethics, scope of practice and areas of practice. Failing to adhere to any of these regulations puts an RD at risk for losing their registration with the HPCSA and thus their ability to legally practice (HPCSA 2013).

RDs are also expected to earn Continuing Professional Development points (CPDs) on an annual basis (HPCSA 2013). The purpose of this is to ensure that all RDs are kept abreast with new information in the field and are practicing using evidence based nutrition information. RDs are able to earn CPD points by attending accredited conferences, meetings or symposiums where they will be exposed to new or relevant information, and by completing questionnaires based on accredited articles providing new or relevant information. Any organisation, whether it is a university, corporate company or private business, that wants to offer RDs the opportunity to earn CPD points needs to have their content accredited by the HPCSA. This is to ensure that the content is relevant and scientifically sound. (HPCSA 2013).

The Association for Dietetics in South Africa (ADSA) is a professional association that dietetic students and RDs can voluntarily belong to. According to its website, ADSA’s

primary aims are to “serve the interests of Dietitians in South Africa and to promote the nutritional well-being of the community”. ADSA also assists RDs with earning CPD points through the attendance of regular provincial meetings. ADSA has its own codes of ethics and standards of professional practice which it expects its members to adhere to (ADSA 2014). ADSA advises that their codes and standards are practiced in conjunction with those of the HPCSA. If an ADSA member fails to adhere to any of its codes or standards of practice, members of the ADSA committee are able to liaise with the HPCSA regarding the RDs transgressions (ADSA 2014).

2.7 Factors affecting Registered Dietitians prescription of diets and patient treatment

Nutritional science is a rapidly changing field, with new ideas emerging every day. In order for health professionals to critique a new idea or concept, they need to review its credibility and relevance (Higgs, Jones, Loftus and Christensen 2008, p168). To successfully do this they should critique it against their existing knowledge base using a valid scientific method. In addition they should evaluate the new concept by conducting literature and systematic reviews. According to Higgs *et al* (2008, p168) questions that should be raised by the health professional, should include:

- “Can my knowledge of physiology explain why this concept should work?”
- “What are the possible consequences of putting this concept into practice?”
- “How do my colleagues feel about this concept, and how does it compare to the professions knowledge base?”
- “How does this concept relate to the literature available on the topic?”
- “Do my professional knowledge, ethics and practice standards allow for the use of this concept?”

RDs should currently find themselves asking the above questions considering the recent public interest in a LCHF diet as described in Section 2.6.

Various studies have been conducted in order to determine the factors that influence the use or non-use of a certain clinical guidelines by a health professional. Table 2.5 summarises some of these studies that assessed a variety of health professionals, in addition to dietitians. It must be noted that the majority of these studies reviewed were not of a high methodological quality. However, they can be used to provide insight into the factors that may influence a health professional such as an RD to prescribe or not prescribe a LCHF diet in practice.

Table 2.5 Factors influencing the use or non-use of clinical guidelines by health professionals

Factor	Explanation		Sources
Characteristic of guidelines.	<u>Increases use:</u> Easy to use. Easy to trial. Do not require specific resources. In accordance with evidence based science. Development of guidelines by end-user (for example guidelines for dieticians developed by dieticians). Guidelines take into account local circumstances.	<u>Decreases use:</u> Discordance among various sets of guidelines for same condition. Cumbersome or difficult to implement. Does not take into account local situation.	Sachs (2006). Simpson, Marrie & Majumdar (2005). Saillour-Glenisson & Michel (2003). Cabana, Rand, Powe, Wu, Wilson, Abboud & Rubin (1999). Davis & Taylor-Vaisey (1997). Grilli & Lomas (1994). Davies, Freemantle, Grimshaw, Huwitz, Long & Russell (1994).
Characteristics of professionals.	<u>Increases use:</u> Openness to innovation. Positive attitude toward guidelines. Younger age. Less experience. Research skills and involvement	<u>Decreases use:</u> Lack of awareness. Limited familiarity. Negative attitude toward guidelines. Unwillingness to change previous practice methods. Concern over legality.	Welhan <i>et al</i> (2013) Sachs (2006). Simpson <i>et al</i> (2005). Saillour-Glenisson & Michel (2003). Cabana <i>et al</i> (1999). Davis & Taylor-Vaisey (1997).
Characteristics of patients.	<u>Increases use:</u> Higher level of education. Demographics of patient.	<u>Decreases use:</u> Patient resistance. Patients with co-morbidities. Lower level of education. Demographics of patient.	Simpson <i>et al</i> (2005). Saillour-Glenisson & Michel (2003). Cabana <i>et al</i> (1999).
Environmental factors.	<u>Increases use:</u> Support from manager. Support from peers/colleagues.	<u>Decreases use:</u> Limited time. Limited staff members. Negative attitude from manager/peers/colleagues.	Sachs (2006). Simpson <i>et al</i> (2005). Saillour-Glenisson & Michel (2003). Cabana <i>et al</i> (1999).

As can be seen from Table 2.5 there are four areas which should be taken into consideration to determine the factors that may influence an RD to prescribe a LCHF diet in practice. These include: (i) the characteristics of the diet itself, (ii) the RD's attitude toward the diet; (iii) the types of patients the RD normally consults and (iv) the RD's work environment. The information in Table 2.5 was applied to the current study and is explained by the following figure:

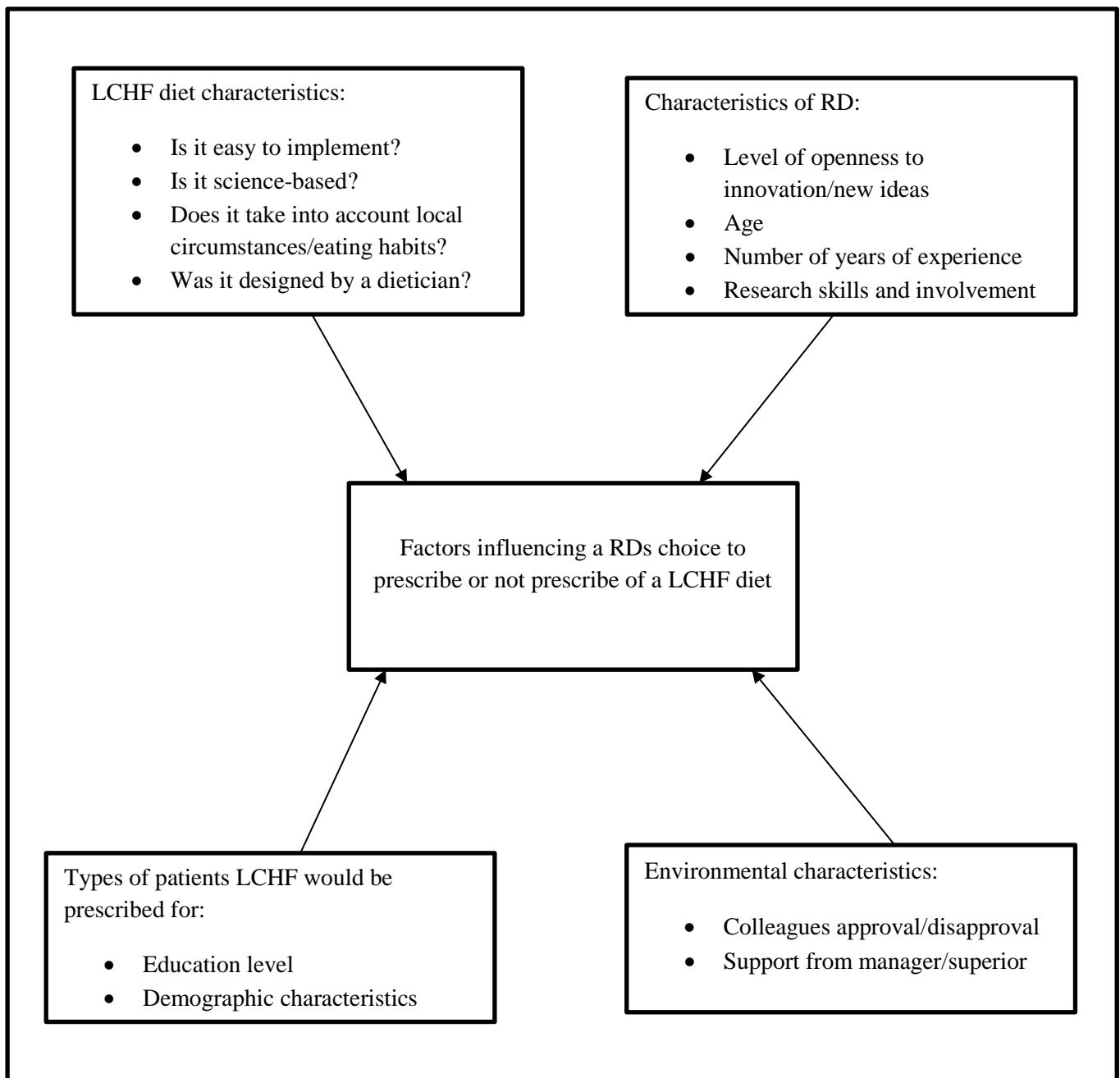


Figure 2.3 Factors that may influence the choice of RDs to prescribe or not prescribe a low carbohydrate, high fat diet

2.8 Summary

NCDs are a major public health problem globally as well as in South Africa. This has resulted in the South African health care system being under considerable strain (National Department of Health 2013). The link between high body fat levels and the development of T2DM and CVD is very clear (American Diabetes Association Position Statement 2013). Current accepted dietary intervention recommends that those with T2DM eat most of their kilojoules in the form of carbohydrates and control their blood glucose levels using medication (American Diabetes Association Position Statement 2013). Those at risk for developing or with diagnosed CVD are advised to eat a low fat diet in order to reduce their serum cholesterol levels (Ryden, Grant, Anker, Berne, Cosentino, Danchin, Deaton, Escaned, Hammes, Huikuri, Marre, Marx, Mellbin, Ostergren, Patrono, Seferovic, Uva, Taskinen, Tendera, Tuomilehto, Valensi & Zamorano 2013).

However, there is some evidence to suggest that a LCHF diet can improve the markers associated with NCDs, even without the occurrence of weight loss. This evidence still has severe limitations: it is not long term evidence, studies have mostly used very small sample sizes with high attrition rates, and the results have often been unclear. However, in South Africa, the LCHF versus the prudent diet debate continues among members of the public and many health professionals.

Considering the fact that dietitians are the health professionals responsible for the dietary management and counselling of patients with NCDs, it is of the utmost importance that they are at the fore-front of this debate. It is important therefore to understand the attitude of KwaZulu-Natal dietitians toward a LCHF diet; to determine whether any of these dietitians prescribe the diet in practice; and whether they would have a change in attitude toward the diet after hearing a presentation on its potential benefits given by a proponent of the diet. The following chapter examines the methodology which was used in order to achieve this.

CHAPTER 3: METHODODOLOGY

In this chapter the following aspects will be covered: the literature supporting the methodology used; the study design; the research instrument design; the population and sample selection, as well as statistical analysis of the data. Finally, the ethical considerations of the study are discussed.

3.1 The definition and use of questionnaires

Questionnaires are a method of survey research. Survey research methods include face-to-face interviews, telephonic interviews, postal questionnaires and self-administered questionnaires (Leedy & Ormrod 2010, pp187-189). According to Welman, Kruger and Mitchell (2005, p152), a questionnaire can be used in order to gather information relating to biographical details, behaviour patterns and opinions, convictions or attitudes toward a specific issue. This method of data collection involves obtaining the information from the subjects themselves and does not involve direct observation.

Traditionally, questionnaires have been used to survey health professionals in order to gather information relating to their personal views and attitudes toward certain topics, to assess their knowledge on a topic and to provide information to assist with service provision and planning (Braithwaite, Emery, de Lusignan & Sutton 2003).

3.1.1 Guidelines for the use of questionnaires

Data generated via questionnaires can be subject to design error and bias and so the design and administration of the questionnaire needs to be carefully thought through (Leedy & Ormrod 2010, p187). Data must be valid, reliable, un-discriminatory and unbiased, and come from a representative sample of the total population in order for the results to be generalised to the total population (McColl, Jacoby, Thomas, Soutter, Bamford, Steen, Thomas, Harvey, Garratt & Bond 2001).

It is recommended that the following guidelines should be adhered to in order to encourage both questionnaire completion, and to ensure reliability and validity of the data generated.

- Questions should be clear, focused and as short as possible, while still conveying the necessary information or meaning (Alreck & Settle 2004, p89);
- The vocabulary of the questions should be appropriate for the subject's level of education and literacy (Alreck & Settle 2004, p93);
- The use of questions requiring lengthy answers should be appropriate for the target group and included as sparingly as possible, in order to prevent subject fatigue (Leedy & Ormrod 2013, p197);
- The purpose of the questions should be explained so that the respondent is confident as to why the answer is required from them (Leedy & Ormrod 2013, p197);
- The questionnaire should be reliable, validated and the questions should not introduce bias (Leedy & Ormrod 2013 p199; Alreck & Settle 2004, p95);
- It should be ensured that questions are not leading or do not induce answers which may not necessarily be truthful or accurate (Leedy & Ormrod 2013, p197);
- A pilot study on a group of subjects' who are representative of the final study sample should be conducted to ensure validity (Leedy & Ormrod 2013, p199).

The use of a Likert scale is often seen on questionnaires regarding a subject's attitude toward something (Leedy & Ormrod 2010, p189). The Likert scale was designed by Rensis Likert and is one of the most popular types of scales in questionnaires due to its ease of use in. The Likert scale contains a group of statements, often with some negative and some positive statements toward the object in question. The respondent has to indicate their level of agreement or disagreement with the statement by choosing an answer on the scale (Welman *et al* 2005, pp156-157).

3.2 Study design

Four South African studies which also investigated the attitude, opinion, practice method, knowledge or involvement of South African dieticians were identified and used as guidance for the design of the questionnaire for the current study (Oosthuizen 2011; Najaar 2009; Viviers & Gericke 2007; Paterson, Green, Basson & Ross 2002). A number of similar international studies were also found (Collins, Bertrand, Hayes, Li, Thomas, Truby & Whelan 2013; Hirschhorn, Walji & Boon 2013; Howard, Ferguson, Wilkonson & Campbell 2013; Whelan, Copeland, Oladitan, Murrells & Gandy 2013; Judges, Knight, Graham & Goff 2012; Orazio, Murray & Campbell 2012; Heiwe, Kajermo, Tyni-Lenne, Guidetti, Samuelsson, Andersson & Wengstrom 2011; Sud, Marcon, Assor, Daneman & Mahmud 2011; Lederman, Huffman & Enrione 2009; Phul, Wharton & Heur 2009; Green, Smith & Whelan 2007; Rio & Cawadias 2007; Barr, Yarker, Levy-Milne & Chapman 2004; Thomas, Kukuruzovic, Martino, Chauhan & Elliott 2003; Harvey, Summerbell, Kirk & Hill 2002; Campbell & Crawford 2000; Williamson, Hunt, Pope & Tolman 2000; Duncan & Bergman 1999). Hence, both local and international studies were consulted for guidance regarding the sampling technique and study design to be used in this study

The main survey types used in the above-mentioned studies were self-administered questionnaires, telephone interviews and online questionnaires. Table 3.1 summarises the advantages and disadvantages of each questionnaire type. Although not used in any of the above-named authors studies, the advantages and disadvantages of face-to-face interviews were also included in Table 3.1.

Table 3.1 Advantages and disadvantages of different survey types (After Leedy & Ormrod 2010; van Gelder, Bretveld & Roeleveld 2010; Welman 2005).

Survey type	Definition	Advantages	Disadvantages
Postal questionnaire	The questionnaire is compiled, and then posted to subjects with the request to return the completed questionnaire via email, fax or post.	<ul style="list-style-type: none"> • Inexpensive. • Can reach subjects in a wide variety of locations. • Provides high possibility of anonymity. 	<ul style="list-style-type: none"> • The researcher has little control over the conditions in which the questionnaire is completed. • High possibility of questions being omitted. • Postal questionnaires tend to have the lowest response rate of all types.
Telephonic interview	The researcher asks subjects questions over the phone and the responses are recorded.	<ul style="list-style-type: none"> • Questionnaires can be completed quickly as no travelling is required. • Lower cost if compared to methods that involve travelling. • Provides the respondent with an impression of anonymity. 	<ul style="list-style-type: none"> • The respondent may be suspicious of the researcher's intentions and not answer truthfully. • Questions need to be simple and straightforward in order to ensure compliance.
Online questionnaire	Subjects are able to answer the questionnaire on the internet, and answers are stored on a database.	<ul style="list-style-type: none"> • Flexibility (in terms of questionnaire design and method of sending to the respondent). • Can be administered in a time-efficient manner. • Modern technological innovations allow the researcher greater control over responses so there is less chance of questions being left out. A question can become non-applicable where necessary and questions can be answered in correct order. • Convenient for the respondent as they can respond when they have the time and can often complete the questionnaire at a later stage if necessary. • Low administrative burden for the researcher as data can be captured more easily. 	<ul style="list-style-type: none"> • Mistrust about survey use (respondent may think the aim is to sell a product). • Privacy and security issues. • Can be perceived as "junk mail". • Internet access can vary widely in the same country leading to skewed data. • Lack of online capabilities in subjects. • Impersonal.

Table 3.1 continued			
Survey type	Definition	Advantages	Disadvantages
Face-to-face interview	The researcher asks a subject questions and records their answers. This can be structured, where a standard set of questions are asked, or semi-structured, where the researcher tailors questions in order to get clarity from the subject.	<ul style="list-style-type: none"> • The researcher is able to gain rapport with the subject and gain their co-operation. • Generally have a high response rate. 	<ul style="list-style-type: none"> • Can be time-consuming for the researcher. • May involve the researcher having to travel. • The subject may not answer truthfully if they are aware that their answers are being used as a part of research.

After reviewing the information presented in Table 3.1, it was decided that an online questionnaire (Appendix F, p108) would be used for the following reasons:

- The study population, namely Registered Dietitians (RDs), were likely to have regular access to the internet, and therefore would not have experienced difficulty in accessing the questionnaire;
- The study population were all health professionals with busy schedules. Hence an online survey would have been suited to the time constraints they experience. Thereby completing the questionnaire in their own time would have increased the likelihood of a good response rate from the subjects;
- Due to the fact that the study population resided throughout KwaZulu-Natal (KZN), a postal survey would have proven to be time consuming and may have increased the likelihood of a low response rate;
- A telephonic interview would not have suited the researcher's time and financial constraints. It may have also affected the response rate due to the risk of subjects not answering their phones.

In order to overcome the possible limitations of an online questionnaire as described in Table 3.1, an email was sent clearly explaining the purpose of the questionnaire so that the receiver would be less likely to view it as "junk mail". Proof of ethics approval and permission to conduct the study from the Department of Health were attached to the email in order to further provide the respondent with clarity about the source and purpose of the questionnaire. In addition, it was made clear to the subjects that their information would be kept private and that the site carried no security risks.

3.3 Population and sample selection

The current study was a cross-sectional descriptive survey. The study population included RDs practicing in KZN, either in private practice or working for the Department of Health (hereafter referred to as working for government). Dieticians who were in the process of completing their community service year were excluded, as it was felt that they would not have enough experience in patient management to generate reliable data in line with the aim

of the study. In addition, food service dietitians, dietitians in academia, corporate roles or those that practice in community nutrition were excluded, as the aim and purpose of the study was not in line with their scope of practice.

A list of dietitians registered with the private practicing dietitians portfolio of the Association for Dietetics in South Africa (ADSA) was obtained (Dolloway 2013) along with a list of government-employed clinical dietitians (Downs 2013). A combination of these two lists provided the researcher with 155 email addresses of eligible subjects. A link to the online questionnaire used for this phase of the data collection was emailed to these addresses.

3.4 Questionnaire development and distribution

Studies investigating dietitians' attitudes toward a certain practice or theory were used to guide the research instrument design of the current study. The questionnaire was divided into the four sections. Table 3.2 describes these sections and the objective that these sections were aimed at:

Table 3.2 Sections, objectives and variables measured in the questionnaire

Section	Objective	Variables measured
1. Socio-demographic characteristics of the subjects.	To determine if there was a relationship between the socio-demographic characteristics, areas of work and professional interest and research involvement of subjects and the prescription of a LCHF diet in practice.	Age, gender, university attended, year of qualification, post-graduate qualifications obtained, type of work, common patient types seen, years of nutrition counselling experience, main area of professionals interest.
2. Non-communicable disease management.	To determine dieticians' opinion on methods of NCD dietary management.	Management of NCDs, types of diets used in management of NCDs.
3. The use of a LCHF diet in patient management.	To determine dieticians' attitudes toward a LCHF diet, the prescription of the diet in practice and concerns regarding the diet. To determine if there was a relationship between the demographic characteristics, areas of work and professional interest and research involvement of subjects and the prescription of a LCHF diet in patient management.	Whether or not subjects had prescribed LCHF diet for patients in the past, how often a LCHF diet was prescribed by subjects, reasons for prescribing a LCHF diet, opinion of patient's response to LCHF diet, reasons for not prescribing a LCHF diet.
4. Research skills and involvement.	To determine if there was a relationship between the demographic characteristics, areas of work and professional interest and research involvement of subjects and the prescription of a LCHF diet in practice.	Research skills and involvement based on four different levels: level 1 (evidence-based practice); level 2 (collaboration in research); level 3 (leading research); level 4 (leadership in research).

While the researcher developed the questions in the first section of the questionnaire, other studies where socio-demographic data was collected, were considered in its design (Paterson *et al* 2002). Qualifications held, as well as past and current work experience was assessed in this section, as well as the clinical conditions that the RD most often dealt with.

The second section of the questionnaire focused on the management of chronic diseases of lifestyle. As noted by Barr *et al* (2004), obesity is a complex condition that can be caused by

many factors. It is therefore important to investigate dietitians' management of obesity and related conditions. Questions six, seven and eight from this section were adapted from a study by Campbell and Crawford (2000), which determined Australian dietitians' attitudes and practices toward the management of obesity. The remainder of the questions were developed and designed by the researcher for the purpose of the study. For example, proponents of the LCHF diet propose that saturated fat and cholesterol intake may not be as significant a risk factor for the development of heart disease as was previously thought, and that a prudent diet may not be the only diet recommended for the management of a type 2 diabetic. This suggested that those who have prescribed a LCHF diet may not agree with the statements in this section of the questionnaire.

The third section of the questionnaire focused on whether the subjects had prescribed a LCHF diet or not. This section provided information for objectives numbers one and two of the study. As it would seem that there are no published studies that investigated the prescription of a LCHF diet by RDs it was necessary for the researcher to develop this section of the questionnaire.

Section four of the questionnaire was related to the subject's research involvement and skills. The Research Involvement Questionnaire (RIQ) developed by Whelan *et al* (2013) was used after obtaining permission from the authors. The RIQ is made up of 24 questions. The questions are based on four levels of research involvement as described by the British Dietetic Association in a document designed to guide RDs on the required research skills and knowledge for different stages of their career (BDA 2011). Table 3.3 shows the four levels:

Table 3.3 Levels of research involvement applicable to Registered Dietitians (BDA 2009)

Level	Overall activities included	Specific activities include
Level 1	Understand interpret and apply research	<ul style="list-style-type: none"> • Understand scientific principles • Interpreting basic data analysis • Identifying research gaps in general areas of practice • Appreciating the ethical framework of research • Conducting comprehensive literature reviews to inform practice • Using findings from research in practice
Level 2	Active involvement in research	<ul style="list-style-type: none"> • Participating in research as part of a team • Interpreting advanced data analysis • Participating in research under supervision • Involvement in internal presentations • Identifying research gaps in specific areas of practice • Involvement in external presentations
Level 3	Leading research	<ul style="list-style-type: none"> • External presentations of research that RD has led • Development and management of a research budget • Managing research within governance and ethical frameworks • Leading the development and design of research • Independently formulating research questions/hypotheses • Review of research of others
Level 4	Supervision and leadership in research	<ul style="list-style-type: none"> • Education of colleagues in research methods • Extensive involvement in the review of the work of others • Developing and leading research • Supervising and being a mentor in the research of others • Influencing the research of others • Undertaking research as a major job component

The RIQ contained six questions for each level described in Table 3.3. Each question was preceded by the statement “how much are you involved in the following activity”, and the subjects had the opportunity to answer on a Likert scale with the following options: “not at

all”; “a little”; “quite a bit”; “a lot” and “a great deal”. Subjects could score a maximum of 30 points per level, and a maximum of 120 points overall. The order of the questions was random in order to prevent the possible affect that grouping the levels may have had on the subject’s answers.

The use of the RIQ to measure the subject’s research skills and involvement was decided upon because it was assumed by the researcher that all the subjects were registered with the HPCSA and were up to date in accruing the required Continuing Professional Development (CPD) points. Considering that the subjects were in clinical practice and not in an academic role, it was predicted that not many of the subjects would score highly in the questions related to levels two, three and four. However, level one activities are those which any qualified RD should be actively involved in (BDA 2009). Therefore the results of the RIQ were able to provide insight into the subject’s research skills and involvement over and beyond that of the compulsory CPD research and activities.

The questionnaire was distributed to the 155 RDs via email contact. The link that the subjects received allowed them access to a site specifically designed for the purpose of the questionnaire. Once consent (Appendix I, p118) was given by the subjects the site directed them to the start of the questionnaire.

Measures were put into place in order to facilitate compliance with the directions of the questionnaire and to minimise the risk of subjects not completing the questionnaire. For example, when a question became non-applicable, based on a subject’s previous answer, the site did not allow the subject to answer that question. Where only one response was asked for, the site would automatically delete the first response if a subject attempted to choose another. If a subject left out answers in any of the four sections, they were shown a display message warning them that they had done so before being taken to the next section. If a subject had to exit the site before completing the questionnaire, they were able to continue from where they had left off the next time they entered the site.

3.5 Validity and reliability of the research instrument

Reliability and validity are two essential and crucial aspects of all measuring instruments or data collection tools, regardless of the type (Leedy & Ormrod 2013, p89). Reliability is defined as the ability of a measuring instrument to produce the same result when used repeatedly (Leedy & Ormrod 2013, p91). Validity refers to the accuracy of an instrument by determining the degree to which it measures what it was designed to measure (Welman *et al* 2005, p106).

Random errors and measurement errors are two phenomena that can decrease the reliability of a measuring instrument. A random error is most often caused by choosing a small sample size or having insufficient representation of the entire study population. The degree of measurement error is determined by the strength or the weakness of the measuring instrument's ability to perform what it was designed to do (Welman *et al* 2005, p145).

In order to ensure reliability, it was important to provide subjects with clear and detailed instructions regarding the completion of both questionnaires. For example, the questionnaire was structured in a way that made it difficult to omit questions and impossible to answer questions not applicable to the respondent.

To ensure validity of the questionnaire, two measures were applied: a content validity test and a pilot study. A content validity test makes use of the experience of a third party who is an expert in the field to ensure that the questionnaire is comprised of appropriate content, and does not contain inappropriate content (Leedy & Ormrod 2013, p89-90). As no studies examining the use of the LCHF diet by dietitians could be located, an expert in the field of conducting research on dietetic subjects was consulted. The findings of this expert were related to the socio-demographic characteristic related questions and advice was provided on questions to avoid and include in this area.

An additional factor that contributed toward the questionnaire's reliability and validity was the use and adaption of questions from previously published studies. Specifically, questions

two, five, six, seven and eight in section three were used or adapted from Campbell and Crawford (2000) and the RIQ by Whelan *et al* (2013) was used.

The validity and reliability of the RIQ was investigated by Whelan *et al* (2013), and it was found to be a valid and reliable measuring instrument for assessing research involvement amongst dietitians. It was also found that the criterion as well as construct validity, intra-rater reliability and internal consistency of the RIQ were all strong (Whelan *et al* 2013). Criterion validity refers to the extent to which results from the RIQ agree with other measures of research involvement and skills in dietitians, while construct validity refers to the extent which the RIQ measures activities which cannot be directly observed. Intra-rater reliability refers to the extent to which an individual produces the same results when using the instrument on two separate occasions while internal consistency measures if several items which propose to measure the same thing successfully do so (Gleason, Harris, Sheen, Boushey & Bruemmer 2010). In a personal discussion with the researcher, Whelan *et al* (2003) recommended that the RIQ should not be altered in any way in order to retain the reliability and validity of the measuring instrument (Whelan *et al* 2013). This suggestion was followed.

Once the data had been collected it was entered into Statistical Package for Social Sciences (SPSS) version 21. This process was repeated on a separate occasion and then the two data sets given to an independent party to compare them for any discrepancies. This ensured that the data was as accurate as possible.

3.6 Pilot studies

The questionnaire was piloted twice. The first pilot study was conducted using a hard copy of the questionnaire that was distributed to a group of dietitians in the Gauteng province. The purpose of this pilot study was to determine any ambiguous, confusing and possibly irrelevant questions that required adaptation. After analysis of the responses to the first pilot study the following changes were made:

- Open-ended questions were converted into closed-ended and more relevant options were provided, based on common answers given.
- The wording of certain questions was changed to reduce or prevent subject confusion.

The purpose of the second pilot study was not to change any of the questions, but rather to identify any potential problems with the website that the questionnaire was embedded in. This was done using a sample of community service dietitians who did not participate in the actual study. This pilot test brought to light that Department of Health (DOH) email addresses could not be used due to security settings on departmental computers. This meant the researcher had to contact every government-employed dietitian with a DOH email address to obtain a personal one. Apart from the above, no other problem areas in administering the online questionnaire were detected.

3.7 Reduction of bias

In order to reduce the likelihood of bias in the questionnaire, the following guidelines were followed (Buckingham & Saunders 2004, pp76-85):

- Avoidance of leading questions;
- Use of easy-to-understand and explicit questions;
- Ensuring that subjects had clear instructions on how to complete the questionnaire.

3.8 Variables included in the study and data analysis thereof

The responses from the questionnaires were entered into SPSS version 21 for collation and statistical analysis. Chi-square tests were used for the data from the questionnaire in order to determine how closely the observed frequencies were to the expected frequencies (Leedy & Ormrod 2010, p282).

Table 3.4 summarises the variables that were examined in order according to the study objectives, the relevant variables and questions related to each objective and the methods of data analysis used.

Table 3.4 Data analysis of the objectives

Objectives	Related variables	Method of data analysis and significance
To determine dieticians' attitudes toward a LCHF diet, the prescription of the diet in practice and concerns regarding the diet.	<ul style="list-style-type: none"> • Prescription/non-prescription of diet • Influence for use • Regularity of use • Reasons for non-use 	Chi-square tests. Significance below 0.005.
To determine if there was a relationship between the subjects socio-demographic characteristics, areas of work as well as professional interest and research involvement and their use of a LCHF diet in practice.	<ul style="list-style-type: none"> • Age • Gender • University • Post-graduate qualifications • Main area of professional interest • Most common patients seen for nutrition counselling • Research involvement 	Chi-square tests. Significance below 0.005.

3.9 Ethical considerations and confidentiality

Ethical clearance was obtained from the Humanities and Social Sciences Ethic Committee of the University of KwaZulu-Natal (Appendix H, p117). In addition, permission from the KwaZulu-Natal Department of Health to contact government-employed dieticians was granted (Appendix I, p118).

The subjects who took part in the questionnaire were informed in the consent form that the researcher would be able to link their questionnaire to their email address and so the questionnaire was not anonymous. However, the consent form (Appendix I, p118) assured the subjects that their answers and details would be kept confidential. The subjects were given the opportunity to not participate in the study if they were not satisfied with the above conditions. Of the 155 questionnaires emailed, 65 did not participate.

3.10 Summary

After considering all possible options, the research instrument was designed to accommodate the time frame to conduct the study, the available funding and the study population kept in mind. Appropriate sources were consulted to facilitate the development of the research instrument and methods were put into place to ensure validity, reliability and avoidance of bias to the best of the researcher's ability. The next chapter discusses the results of the study.

CHAPTER 4: RESULTS

4.1 Sample characteristics of the subjects

4.1.1 Socio-demographics

Ninety of 155 subjects participated in the questionnaire, resulting in a response rate of 58%. It should be noted that although some subjects did not complete certain questions, their responses were still used in the data analysis.

Section one of the questionnaire focused on socio-demographic characteristics and was completed by all 90 subjects. Table 4.1 summarises this section and presents the socio-demographic characteristics of the subjects including gender, age, year of qualification, the University where they obtained their dietetics degree, post-graduate qualifications, whether they worked in government or private practice, whether they counselled patients at the time of the study and how many years of experience in nutrition counselling they had.

Table 4.1 Socio-demographic characteristics of subjects participating in the questionnaire

Demographic variable	Category	n	%
Gender	Male	1	1.1
	Female	87	96.6
	Gender not indicated	2	2.2
Age	20-29	51	56.6
	30-39	31	34.4
	40-49	4	4.4
	50-59	3	3.3
	>70	1	1.1
Year that qualification was obtained	1950-1959	1	1.1
	1970-1979	1	1.1
	1980-1989	3	3.3
	1990-1999	10	11.1
	2000-2009	47	52.2
	> 2010	28	31.1
University where qualification was obtained	UKZN	67	74.4
	University of Pretoria	5	5.6
	University of Stellenbosch	4	4.4
	North West University	4	4.4
	University of Cape Town	4	4.4
	University of the Western Cape	2	2.2
	University of the Free State	2	2.2
	University of Limpopo	1	1.1
	Other	1	1.1
Post-graduate qualification	Yes	62	68.8
	No	26	28.8
	Not indicated	2	2.2
Type of post-graduate qualification	PG Diploma in Dietetics/Hospital Diploma in Dietetics	49	79.0
	PG Other	2	3.2
	Honours Dietetics	4	6.5
	Masters Dietetics	6	9.7
	Other	1	1.6
Current job	Government	52	59.1
	Private practice	36	40.9
Current involvement in nutrition counselling	Yes	85	96.6
	No	3	3.4
Years of counselling experience held	0 - 1 years	3	3.3
	1 - 5 years	46	51.1
	5 - 10 years	22	24.4
	> 10 years	19	21.1

The mean age of the subjects was 31.3 years, with the majority of the subjects being 20 to 29 years of age. More than 70% of the subjects held a post-graduate qualification (70.5%, n=62), with the majority of this group having a Post-Graduate Diploma in Dietetics or a Hospital Diploma in Dietetics as their highest post-graduate qualification (79%, n=49). Just under sixty percent (59.1%, n=52) of the field worked in the government sector, with the remainder (40.9%, n=36) working in the private sector.

Eighty five of the ninety subjects (96.6%) answered that their current job entailed nutrition counselling of patients. More than half of the subjects had between 1 and 5 years of experience in nutrition counselling (51.1%, n=46); 24% had between 5 and 10 years of experience (n=22); 21% had over 10 years of experience (n=19) and only 3% had less than 1 year of experience (n=3). For those who answered that they did not counsel patients, it can be assumed that they were in a managerial or administrative position.

The subjects were asked what their patient's most common condition requiring counselling was, and what their main area of professional interest was. The results are illustrated by the following figures:

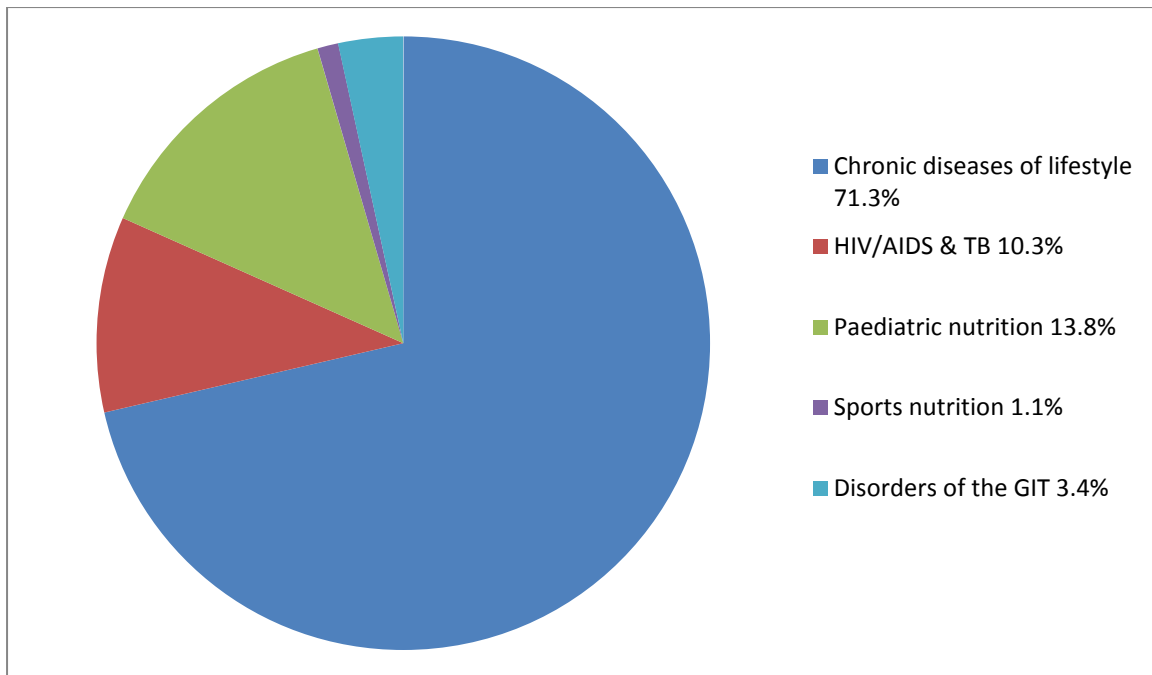


Figure 4.1 Percentages of patient conditions counselled by subjects participating in the questionnaire

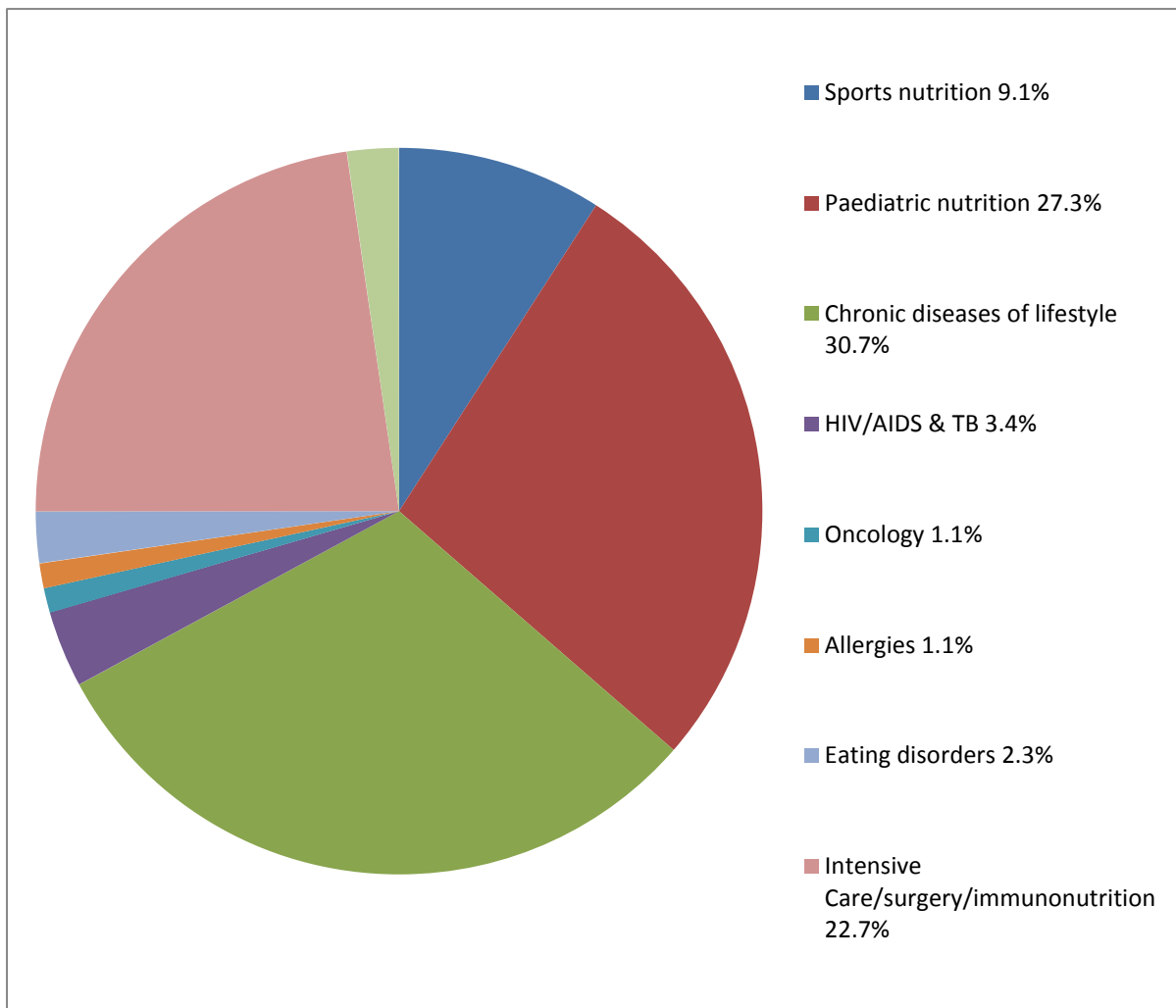


Figure 4.2 The main areas of professional interest of the subjects participating in the questionnaire

As can be seen from the above figures, patients suffering from chronic diseases of lifestyle or NCDs were most commonly seen for nutrition counselling (71.3%, n=62). This was also the most common response for the subject's main area of professional interest (30.7%, n=27).

4.1.2 Research involvement of the subjects

Eighty four (93%) subjects completed section four of the questionnaire. This section investigated their research involvement. Table 4.2 summarises the activities involved in each level; which RDs should be achieving the activities associated with each level; and the scores of the subjects from the current study.

Table 4.2 The subjects average score for each level of research activity

Level	Activities involved	RDs for whom level is aimed at	Maximum score obtainable	Average score of subjects
Level 1: Understand interpret and apply research	Understand scientific principles Interpreting basic data analysis Identifying research gaps in general areas of practice Appreciating the ethical framework of research Conducting comprehensive literature reviews to inform practice Using findings from research in practice	All RDs at qualification	30	12.11 (40%)
Level 2: Active involvement in research	Participating in research as part of a team Interpreting advanced data analysis Participating in research under supervision Involvement in internal presentations Identifying research gaps in specific areas of practice Involvement in external presentations	Having met level the one criteria, any RD wanting to become more actively involved in research	30	7.84 (26%)
Level3: Leading research	External presentations of research RD has led Development and management of a research budget Managing research within governance and ethical frameworks Leading the development and design of research Independently formulating research questions/hypotheses Review of research of others	Having met the level two criteria, any RD wanting to lead research	30	6.9 (23%)
Level 4: Supervision and leadership in research	Education of colleagues in research methods Extensive involvement in the review of the work of others Developing and leading research Supervising and being a mentor in the research of others Influencing the research of others Undertaking research as a major component your job	Having met the level three criteria, any RD wanting to provide supervision and leadership research	30	6.5 (22%)

Source: BDA (2009)

A total research score for each subject was determined by the researcher by adding the score from each of the 24 questions. The lowest possible research score was 24 points and the highest was 120 points. The majority of the subjects scored between 21 and 30 ($n=34$, 40.4%), and between 31 and 40 ($n=34$, 40.4%). Less scored between 41 and 50 ($n=12$, 14%), between 51 and 60 ($n=2$, 2.2%), 61 and 70 ($n=1$, 1.1%) and 91 and 100 ($n=1$, 1.1%), with no scores being higher than 100. Figure 4.3 demonstrates the number of subjects who scored within certain research scores and Figure 4.4 illustrates the percentages that the subjects achieved for the total research score.

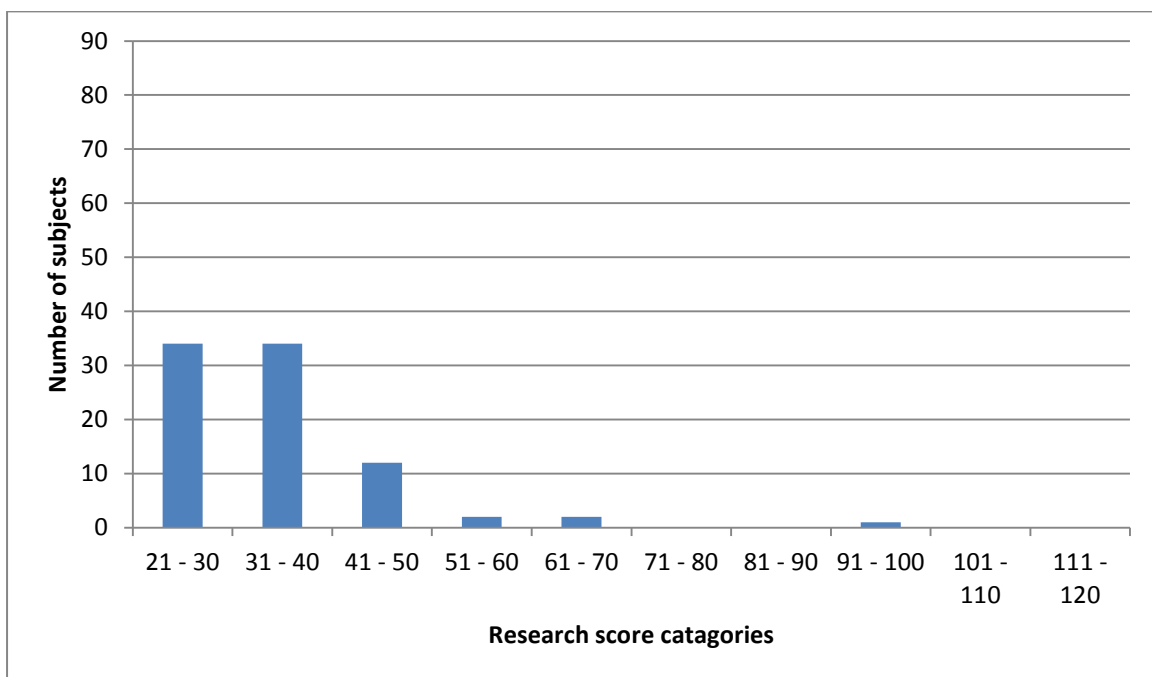


Figure 4.3 The research scores of subjects participating in the questionnaire ($n = 84$)

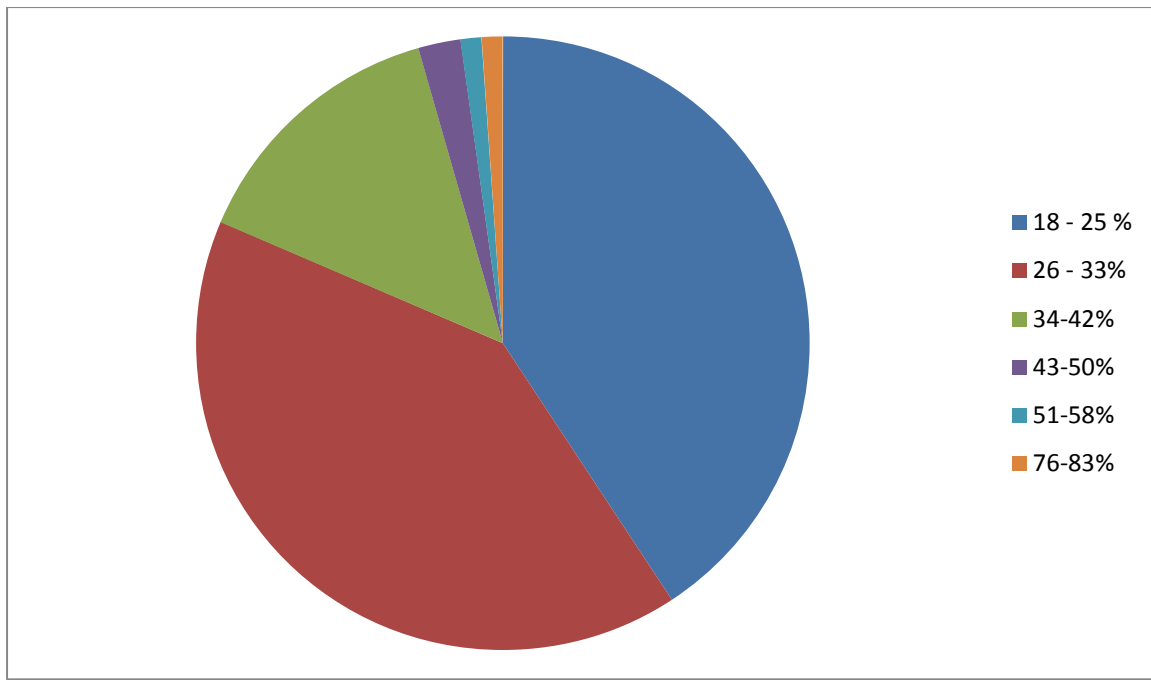


Figure 4.4: The research scores of the subjects shown as percentages

4.2 Results of the statistical analysis of the variables

4.2.1 Sample characteristics related to the use of a low carbohydrate, high fat diet

In this section, the sample characteristics depicted in Table 4.2 were measured against the prescription of the LCHF diet in patient management. Relationships between the sample characteristics and whether the subject worked in a government setting or private practice were also examined.

Eighty five subjects responded to the question regarding whether or not they had prescribed a LCHF diet in the past. Of these, 17.6% (n=15) responded “yes”. From this point, this group will be referred to as LCHF prescribers, while those who responded “no” to whether they had prescribed will be referred to as LCHF non-prescribers.

Government versus private practicing subjects

Table 4.3 shows the division between government and private practice:

Table 4.3 The use of the LCHF diet in government (n=48) versus private practice (n=35)

	Has subject prescribed a LCHF diet				Total
	Yes		No		
	n	%	n	%	
Government	5	11%	43	89%	48
Private	10	28.6%	25	71.4%	35
Total	15		68		83

It should be noted that the total number of subjects reflected in the above table is 83. This is because two subjects did not indicate if their job at the time of completing the questionnaire was in government or in private practice. However, it is evident that a larger percentage of subjects in private practice than in a government setting had prescribed a LCHF diet.

When asked if the patient's response, in terms of their health indicators, to the LCHF diet was successful or unsuccessful, 13 of the 15 (87%) LCHF prescribers responded with "successful", and two did not respond. However, the diet is not prescribed regularly amongst this group. Table 4.4 shows the frequency of its prescription:

Table 4.4 Table showing the overall frequency of use of the diet by LCHF prescribers

Response	Frequency	
	n	%
Always	1	6.6%
Usually	1	6.6%
About half the time	2	13.3%
Seldom	11	73.3%
TOTAL	15	100%

Chi-square tests indicated a significant relationship between working in private practice and being a LCHF user. Table 4.5 shows these results:

Table 4.5 Relationship between being in private practice and being a LCHF user

	Yes	No	p-value*
Government (n=48)	5 (10%)	43 (89%)	0.034
Private (n=35)	10 (29%)	25 (71%)	

*Chi-square test

Influence for the prescription of LCHF diet

LCHF prescribers were asked what influenced their decision to prescribe a LCHF diet. The most common reason given was “personal experience with a LCHF diet” (n=8, 47.1%). This was followed by “patient experience with a LCHF diet” (n=3, 17.6%), “other” (n=3, 17.6%), “personal research into a LCHF diet” (n=2, 11.8%), and finally advice from other dieticians” (n=1, 5.9%). Figure 4.5 demonstrates these differences:

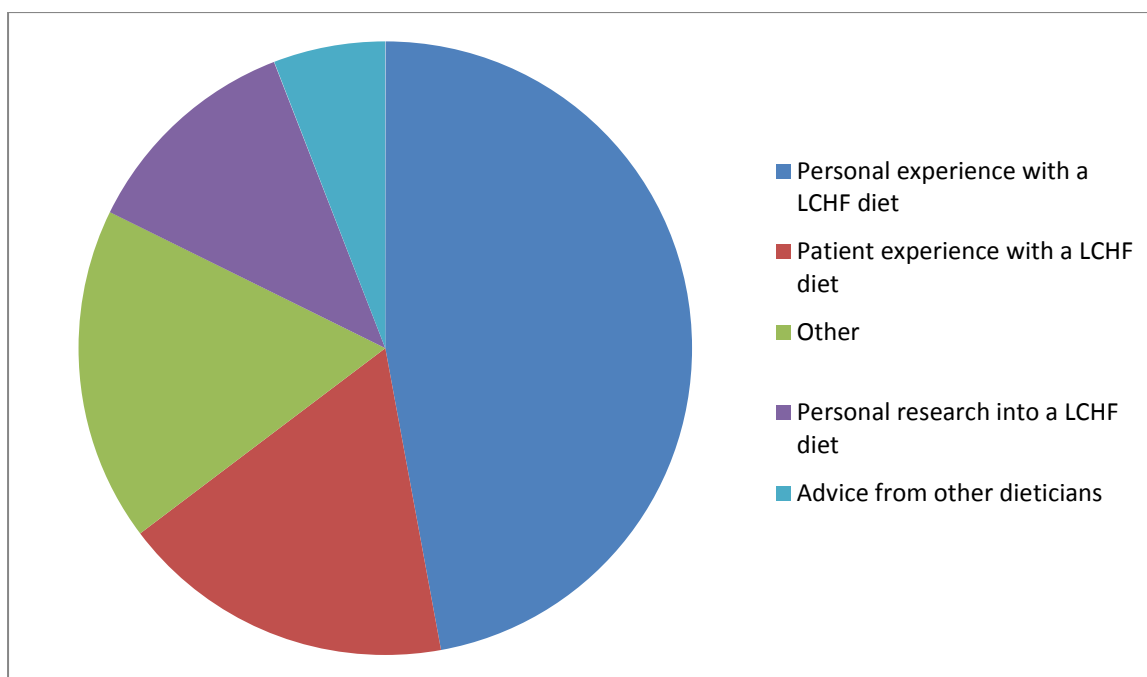


Figure 4.5 Factors influencing the prescription of the LCHF diet

No significant differences were found with regards to the above and whether the subject was in government or private practice.

Patient types for which the LCHF diet is prescribed

LCHF prescribers were asked to describe the patient conditions for whom the diet was prescribed. The question was open-ended, and so Table 4.6 summarises the frequency of which each listed condition was mentioned:

Table 4.6 Patient conditions for which dietitians prescribed a LCHF diet (verbatim).

Patient type/condition	Frequency of which patient types was mentioned by LCHF prescribers
Weight loss	9
Diabetes or insulin resistance	4
Carbohydrate intolerance	1
Epilepsy	3
All patient types	1
Patient with abdominal obesity, diabetes/insulin resistance but with <u>no</u> liver or renal complications	1
Females with menopausal symptoms	1
Polycystic ovarian syndrome	1
Hypertension	2
Dyslipidaemia	2
Gastrointestinal disorders	1

No significant differences were found between government and private practice dietitians with regard to the patient types that the LCHF diet was prescribed for.

The prescription of the LCHF diet in relation to the most common areas of nutrition counselling and professional interest

The LCHF prescribers were asked what the most common patient condition was seen for nutrition counselling. Subjects in both government and private practice indicated that they saw patients suffering from NCDs (71.3%, n=62) most commonly. A statistically significant association was found between the use of the LCHF diet and this being the most common area of nutrition counselling (p=0.032).

Subjects were also asked what their main area of professional interest was. Overall, the management of NCDs was indicated to be most prevalent (30.7%, n=27). However, when divided into the two employment categories, there was a statistically significant association found between whether the subject worked in government or private practice and the main area of interest (p<0.00). More than half of the subjects in private practice stated that their

main area of interest was in NCD management (58%, n=21), compared to only 11.5% (n=6) of the subjects working for the government.

The prescription of a LCHF diet in relation to the response to statements regarding the treatment of NCDs

There was a significant relationship ($p=0.001$) found between the prescription of a LCHF diet and whether the subjects agreed or disagreed with the statement that “a diet high in saturated fat and cholesterol can cause atherosclerosis and cardiovascular disease”. In the LCHF prescriber group, just over a quarter (n=4, 27%) disagreed with the statement, compared to one subject (n=1, 1.4%) in the LCHF non-prescriber group, while 13% (n=2) in the LCHF prescriber group strongly agreed with the statement, compared to 57% (n=40) in the non-prescriber group.

In addition a significant relationship ($p0.001$) was found between the prescription of the LCHF diet and whether subjects agreed or disagreed with the statement “all T2DMs should follow a diet providing 50 – 60% unrefined carbohydrates, 25 – 30% fat and the remainder as protein”. Amongst the LCHF prescribers, 33% (n=5) strongly disagreed, compared to 3% (n=2) in the LCHF non-prescribers, while only 13% (n=2) in the LCHF prescriber group agreed with the statement, compared to 46% (n=32) in the LCHF non-prescriber group.

In the entire subject group, no significant relationships were found between being a LCHF prescriber or non-prescriber and the following statements:

- “A weight reduction diet should focus on a reduction in total energy intake”.
- “A dietician is the most qualified person to advise patients with obesity and related diseases (such as insulin resistance, type 2 diabetes mellitus, dyslipidaemia or cardiovascular disease) on dietary choices”.
- “It is important for dieticians to remain up to date regarding both the prevention and management of obesity and chronic diseases of lifestyle”.

- “Dieticians should offer patients a range of options for the management of obesity, insulin resistance, type 2 diabetes and dyslipidaemia”.
- “Reduced-calorie diets result in weight loss, regardless of which macronutrients they emphasize”.

Table 4.7 summarises the responses to the above statements regarding the management of NCDs.

Table 4.7 Responses to statements in LCHF prescribers compared to LCHF non-prescribers.

Statement	Options	LCHF prescribers (n=15)		LCHF non-prescribers (n=70)	
		n	%	n	%
“A weight reduction diet should focus on a reduction in total energy intake”.	Strongly disagree	2	13%	1	1.4%
	Disagree	1	7%	2	2.9%
	Neutral	0	0%	4	5.7%
	Agree	8	53%	32	46%
	Strongly agree	4	27%	31	44%
“A dietician is the most qualified person to advise patients with obesity and related diseases (such as insulin resistance, T2DM, dyslipidaemia or CVD) on dietary choices”.	Strongly disagree	0	0%	3	4.3%
	Neutral	1	6.6%	0	0%
	Agree	4	27%	24	34%
	Strongly agree	10	67%	43	61%
“It is important for dieticians to remain up to date regarding both the prevention and management of obesity and chronic diseases of lifestyle”.	Strongly disagree	0	0%	1	1.4%
	Agree	0	0%	6	8.6%
	Strongly agree	15	100%	62	89%
“Dieticians should offer patients a range of options for the management of obesity, insulin resistance, T2DM and dyslipidaemia”.	Strongly disagree	0	0%	1	1.4%
	Disagree	0	0%	5	7%
	Neutral	2	13%	11	15.7%
	Agree	7	47%	30	42.8%
	Strongly agree	6	40%	22	31.4%
“Reduced calorie diets result in weight loss regardless of which macronutrients they emphasise”.	Strongly disagree	1	6.6%	2	2.9%
	Disagree	4	27%	13	18.5%
	Neutral	4	27%	11	15.7%
	Agree	3	20%	30	42.8%
	Strongly agree	3	20%	13	18.5%

The prescription of the LCHF diet and number of years of counselling experience

There was no significant relationship between the use of the LCHF diet and how many years of counselling experience the subjects had.

However, the number of years of experience in counselling also differed significantly ($p=0.003$) in government versus private practice, with 36% ($n=13$) in private practice having over 10 years of experience, compared to 11.5% ($n=6$) in government. Table 4.8 shows the relationship between the two study variables:

Table 4.8 Relationship between government/private practice and number of years counselling experience

	Number of years counselling experience				p-value*
	0 – 1 years	1 – 5 years	5-10 years	>10 years	
Government (n=52)	1	35	10	6	0.003
Private (n=36)	0	11	17	13	

*Chi-square test

The prescription of a LCHF diet and research involvement

When the relationship between the prescription of a LCHF the test score for each level of research skill and involvement and subjects' total research score was investigated, no significant relationships were found. In addition, no significant differences were found between government and private practicing dietitians with regard to research involvement.

4.2.2 The non-prescription of a low carbohydrate, high fat diet

More than eighty percent of the subjects (82.4%, $n = 70$) participating in the questionnaire responded that they had never previously prescribed a LCHF diet in patient management. Subjects were asked to give their main reason for not doing so by choosing the most applicable reason from a list of options, If none of the reasons given were viewed as applicable they had to opt for the "other" option and were required to elaborate. This resulted in a variety of reasons. The frequency at which each reason occurred is summarised in the following table:

Table 4.9 Reasons given by subjects who did not prescribe a LCHF diet

Reason	Frequency
“I have never thought about it”	1
“I have not had the chance to”	1
“I do not feel there is enough evidence to support its use”	34
“My patients have always been successful on a conventional diet”	6
“I feel that it is an impractical diet”	18
“It is not what I was taught to plan/use at university”	7
“A low carbohydrate diet can worsen depression in those that already have”	1
“It is an unsustainable diet”	2
“It is not feasible for government sector patients”	3
“I am concerned over the safety of a high saturated fat intake”	3
“Consumers won’t know to decrease fat intake from “junk” food”	1
“Concerned over the elimination of important nutrients found in unrefined carbohydrates”	1

No statistically significant differences were found between government and private practicing dietitians regarding the reasons for not prescribing a LCHF diet.

4.3 Summary

Ninety subjects took part in the questionnaire. The mean age of the 90 subjects was 31.3 years, with most of the subjects in the 20 to 29 years of age category. Only one of the subjects was male. The biggest proportion of the subjects had qualified at the University of KwaZulu-Natal. Most of the subjects (n=52, 59.1%) worked in government, with the balance (n=36, 40.9%) working in private practice.

It was found that among those participating in the questionnaire, the most common condition seen for nutrition counselling were for patients suffering from NCDs. It is this same set of conditions that was the most popular area of interest among the subjects working in private practice but not in government. The questionnaire included a section on research involvement. The results of this showed that overall the subjects scored poorly in each level of research.

Significant relationships ($p < 0.005$) were identified between the use of the LCHF diet in those completing the questionnaire and the following:

- Whether the subject worked in private practice or in the government sector;
- Whether the main area of interest was chronic diseases of lifestyle;
- Whether the most common type of patient receiving nutrition counselling was those suffering from an NCD.

Significant relationships were also identified between different variables and whether the subject worked in government or private practice. These included:

- Those working in private practice had a greater number of years of counselling experience ($p=0.003$);
- Those working in private practice were more likely to choose management of patients with chronic diseases of lifestyle as their main area of interest ($p=0.000$).

CHAPTER 5: DISCUSSION OF FINDINGS

The purpose of this study was to investigate the attitude toward and the prescription of a low carbohydrate, high fat (LCHF) diet by clinical dietitians working in KwaZulu-Natal (KZN).

5.1 Socio-demographic characteristics of the subjects

The current study had a response rate of 58%, which is relatively high in comparison to other studies using online questionnaires (Nulty 2008). The mean age of the subjects was 31.3 years old, and all subjects except for one were female. Close to three quarters of the subjects had obtained their degree at the University of KwaZulu-Natal (UKZN). Considering that the study was conducted in KZN, this result is not unexpected. The subjects were relatively young, with most of them qualifying between the years of 2000 and 2010 and thereafter. More than 70% of the subjects had a post-graduate qualification, with the most common of these qualifications being a post-graduate diploma or hospital diploma in dietetics.

Most subjects had counselling experience ranging from one to five years. This is in accordance with the young age of most of the subjects as shown by the mean age. Less than 20% had over ten years of experience, while only 3% had less than one year of experience. It can be assumed those subjects had completed their community service the previous year.

Subjects working in government and private practice had the most experience in counselling patients with NCDs. This was also the main area of professional interest for the subjects in private practice but not in government, as more than half of the subjects working in private practice stated that their main area of professional interest was NCD management (58%, n=21), compared to only 11.5 % (n=6) in government. This finding could possibly be explained by the fact that private practicing dietitians are more likely to see a larger complement of patients with NCDs due to the fact that they are often viewed as “diseases of affluence” and private practising dietitians are more likely to counsel patients that are on medical aid and therefore employed (Schneider, Bradshaw, Steyn, Norman & Laubscher 2009). In contrast, government dietitians are often employed in hospitals with a substantially larger and poorer patient complement when compared to private hospitals, and are more

likely to see patients with health problems that are associated with malnutrition, infectious diseases and violence as well as patients suffering from NCDs (Schneider *et al* 2009). Hence the percentage of patients counselled because of NCDs would make up a relatively smaller proportion of the patients being counselled.

5.2 Description of subjects who had prescribed a low carbohydrate, high fat diet and the conditions it was prescribed for

Only 17.6% (n = 15) of the subjects had prescribed a LCHF diet at the time of the questionnaire. Of this sub-group, there was a significant association between having prescribed a LCHF diet and being a private practicing dietician. There are several reasons why private practicing dieticians may be more likely to prescribe a LCHF diet:

- (i) Dieticians in private practice are more likely to council and treat patients with a medical aid; and due to the unequal distribution of wealth as described by van den Berg (2011), the possession of a medical aid plan could be a marker for a higher socio-economic status, being employed and hence the ability to afford a LCHF diet.
- (ii) It is possible that those working in private practise experience fewer constraints when making a treatment choice due to their decisions not being limited by the policies and protocols that government dieticians are bound to. Due to this independence of private practicing dieticians, it is possible that they are more likely to explore new dietary interventions. An opinion article on the requests that patients make to their doctors for the treatment of the patient's choice explained that doctors may grant these requests in order to maintain the relationship with their patient (Brett & McCullough 2012). It is possible that this situation could be true of private practice dieticians if their patients' specifically request to follow a LCHF diet. A study examining the requests that patients made to their physician found that the requests were influential on the physicians' behaviour, and that those patients that did not have their requests registered significantly lower satisfaction levels than the patients who did (Kravitz, Bell, Azari, Kelly-Reif, Krupat, Thom 2003). No studies of this theme relating specifically to dieticians could be identified.

- (iii) It is possible that patients who consult private practicing dietitians are more aware of topical dietary and lifestyle issues due to having more exposure to social media, mass media such as radio, television, newspapers, magazines, books and the internet, as compared to patients making use of government health care. No studies which focused on these types of differences between South African private health care and government health care patients could be identified; however an American study indicated that patients using the Internet to seek health information have a higher income and education level than those who do not (Cotton & Gupta 2004). When one considers that information on the LCHF diet has been largely available to the public on social media websites, magazines and newspaper articles, it is not unjustified to assume that patients who consult private dietitians are more likely to be informed about the LCHF diet than patients being consulted by government employed dietitians. Although no South African studies could be identified, an Australian study found that most consumers rely on the media to learn about conditions even though this information may be less reliable than asking their health care provider (Hogue, Doran & Henry 2012).
- (iv) The current study found a significant association between being a private practicing dietitian and having more years of counselling experience. Although it still stands to be substantiated by research, it is possible that having more years of counselling experience increases the likelihood of a dietitian using alternative or non-mainstream dietary therapy. If this is indeed true, it could explain why private practicing dietitians were more likely to prescribe a LCHF diet.

The most common conditions for which subjects had prescribed a LCHF diet was for weight loss, diabetes and insulin resistance. Some of the subjects reported that they had only prescribed a LCHF diet for uncontrolled paediatric epilepsy, as it was an accepted treatment for this condition (Cooper *et al* 2012). This information reflects that even the subjects who had prescribed a LCHF diet may feel apprehensive towards the prescription of it for a condition/conditions for which it has not been widely accepted. One can assume that this is because the LCHF diet has not yet been accepted by the medical fraternity as a treatment option due to a lack of evidence, and that the dietitians are adhering to evidence-based practice. Another reason for the limited prescription of the LCHF diet can be that dietitians practice what Ball, Eley, Desbrow, Lee and Ferguson (2014) described in a study on the

personality traits of dieticians as “harm avoidance”, meaning that they tend to be over-cautious or anxious and are unable to accept risk.

5.3 Factors preventing subjects from prescribing a low carbohydrate, high fat diet

The main reason given for not prescribing a LCHF diet was that there was not sufficient scientific evidence to support its use. The second most frequently stated reason was that the subjects felt it was impractical and unaffordable. Subjects in government positions commonly stated this reason, with some indicating that it is not a feasible diet for their patient population, considering the socio-economic status of patient’s making use of government health care. Generally, those needing to access government health care are those who cannot afford private health care and therefore are very unlikely to be able to afford to follow a LCHF diet. It is well-known that starch-based foods such as maize meal and bread make up a large proportion of the lower socio-economic populations diet as they are inexpensive as compared to protein sources of food (Labadarios, Steyn, Maunder, MacIntyre, Gericke, Swart, Huskisson, Dannhauser, Vorster, Nesmvuni & Nel 2005). A study which investigated the cost of a healthy diet in a South African context found that those from poor socio-economic backgrounds are more likely to purchase nutrient-poor foods such as biscuits, chocolates and sweets than cost-equivalent healthier option such as oats, beans carrots and apples. A healthy diet as found to be unaffordable for most of the population as it would cost a family roughly 69% more to follow than the diet that they currently follow (Temple & Steyn 2011).

Verbatim reasons given by subjects for not prescribing the LCHF diet included:

- “I have yet to meet a patient who can sustain it for a few months”
- “Advocating a high sat fat intake is confusing for the consumer who is not educated enough on and then follows the high sat fat part and not the low carb part or has junk food as their source of sat fat” (sic)
- “I work in government -this type of diet is not feasible or practical for my patient population (with regards to socio economic status mainly). but even if this was not the case, I don't think I would recommend it to the majority of my patients as I feel the

evidence supporting it is lacking and it is not a sustainable solution to living a healthy life or long term weight management” (sic).

- “In the public sector where starchy foods are the most affordable, it is impractical to recommend a diet low in carbohydrates”.
- “I have had patients who are on anti-depressants who develop severe depression when they have gone on low CHO diets” (sic)
- “I feel that it is unbalanced and unhealthy due to high fat intake that could be high in saturated fat. such a low cho (carbohydrate) diet would cut out important nutrients found in unrefined cho sources” (sic)

Taking all of the above into account, the following diagram summarises the barriers that dieticians experience in prescribing a LCHF diet:

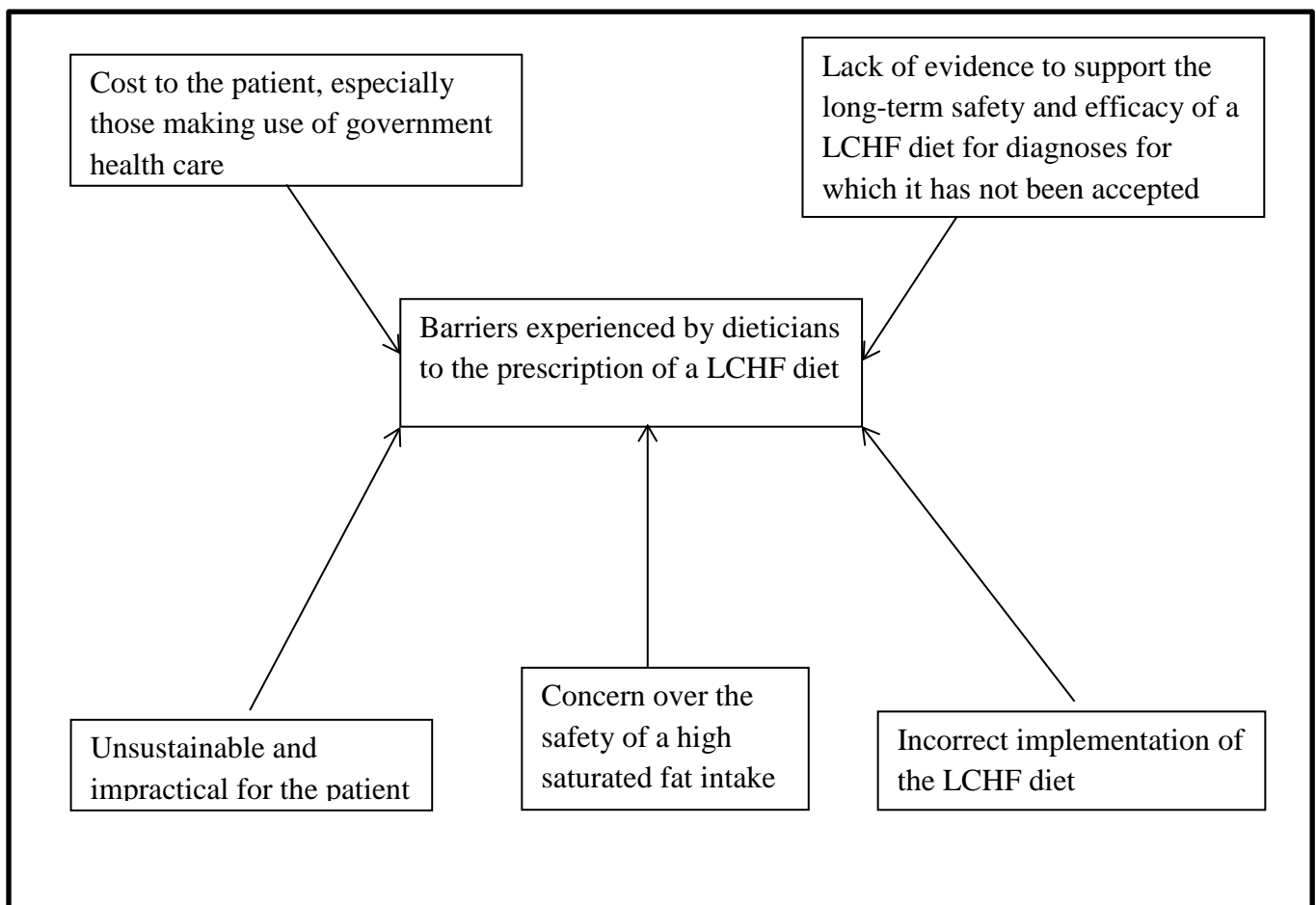


Figure 5.1 Barriers experienced by Registered Dieticians in prescribing a LCHF diet

As no other studies investigating the barriers toward the prescription of a LCHF diet amongst dietitians have been conducted, these findings cannot be compared to those of other authors.

5.4 Research involvement and the prescription of a low carbohydrate, high fat diet

There were no significant relationships found between the subjects' level one, two, three, four or total research scores and the prescription of a LCHF diet. The research involvement of the subjects on all four levels was low. The fact that the subjects were practicing clinical dietitians and not involved in academic research explains the low scores obtained for levels two, three and four. However, as explained by the BDA (2009) the activities involved in level one should be achievable by all RDs at the time of qualification, and these activities should be maintained and improved upon throughout a RDs career. One should therefore expect the subjects of the current study to score close to the maximum allocation of 30 points; however the average score was only 12 (40%). The subjects had the opportunity to score 120 points in for their total research involvement, yet the majority ($n = 68$, 81%) scored only between 31 and 40 points. The most common answer given by LCHF prescribers for the prescription of the diet was "personal use of the LCHF diet". Only two subjects answered with "personal research into a LCHF diet". This may support the finding of a low research involvement amongst the subjects as it indicates that RDs are more likely to use the diet on themselves than to research it.

No other studies which have used the RIQ to assess the research involvement in dietitians globally or locally can be found. An American study which used a different instrument to determine a research score amongst dietitians found that the average score was 44%, which is comparable to the current study (Byham-Gray, Gilbride, Dixon & Stage 2006). The current study found no significant relationships between research involvement and post-graduate qualifications as the majority of the subjects had low scores. However, studies which have investigated the predictors for research involvement amongst RDs have found that a higher research involvement can be predicted by education related to research methodology and design further than what is offered in a undergraduate dietetics degree (Byham-Gray, Gilbride, Dixon & Stage 2005; Byham-Gray *et al* 2006).

5.5 Summary

Overall, a small proportion of the subjects had prescribed a LCHF diet. The LCHF diet prescribers were more likely to be in private practice than to be employed by government. The prescription of the LCHF diet was not done regularly. The most common reason given by the subjects for not prescribing a LCHF diet was that there was insufficient evidence to support its use. Several other barriers to the prescription of a LCHF diet were identified. These were that it was unaffordable for some patients, it was an unsustainable and impractical diet; the concern over the safety of a high saturated fat intake and that patients would implement the diet incorrectly.

The level one research score of the subjects was low. Activities involved in level one are those that should be achievable at the time of qualification and should be maintained and improved upon throughout a dietician's career. The total research score of the subjects was comparable to that of another study which investigated research involvement in RDs.

The hypotheses set out at the beginning of this study were:

1. Dieticians will have a negative attitude toward a LCHF diet. This hypothesis is accepted.
2. Dieticians will not prescribe a LCHF diet for the management of NCDs. This hypothesis is accepted.

Due to the uniqueness of the current study, very few studies could be found in order to compare findings. Recommendations based on the findings of the current study will be given in the following chapter.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

NCDs continue to be a major public health problem, globally and in South Africa. South African studies have indicated that the prevalence of obesity, T2DM and CVD is increasing amongst the population. This, along with the burden of communicable diseases such as HIV and TB, is placing the South African health system under considerable strain. Diet is one of the modifiable risk factors that can to be addressed in order to decrease the risk of South Africans developing NCDs, and to improve the health of those who are already living with diagnosed NCDs.

It is well-accepted globally and locally that an energy-restricted prudent diet is the most appropriate diet for the prevention and management of obesity and NCDs (WHO 2003). This diet induces weight loss due to its energy restriction. Based on the knowledge of the relationship between saturated fat intake and the development of dyslipidaemia and CVD, the prudent diet restricts saturated fat to less than 10% and total fat to less than 30% of the total energy. Carbohydrates, encouraged to come from wholegrain sources, usually contribute to half or more of the total energy in a prudent diet (Kelley *et al* 2011).

Recently, it has been proposed that a LCHF diet is superior or equally effective as an energy-restricted prudent diet for the prevention and management of obesity and NCDs. This diet differs from a prudent diet in that it provides less than 20% of the total energy from carbohydrates and 60% or more of the total energy from fat. A LCHF ketogenic diet is a well-accepted treatment for the management of uncontrolled epilepsy in children. However, it has not been accepted by health and nutrition authorities to be more superior to the prudent diet for the management of obesity and NCDs (Appendix B, p100).

Dieticians are the health professionals responsible for the dissemination of scientifically-based nutrition information to the public. The purpose, therefore, of this study was to determine the attitude toward and prescription of a LCHF diet by clinical dieticians in KwaZulu-Natal, for the prevention and management of obesity and NCDs.

This study was topical and relevant as a LCHF diet is gaining popularity among the public of South Africa and is a cause of debate among many health professionals, and so it was important that RDs attitude toward the diet was investigated.

The objectives set out by the study were:

1. To determine dieticians' attitudes toward a LCHF diet, the prescription of the diet in practice and concerns regarding the diet.
2. To determine if there is a relationship between the dieticians socio-demographic characteristics, areas of work and professional interest and research involvement and their prescription of a LCHF diet.

This chapter concludes the findings of the study related to each of the above objectives. It then explains the limitations to the study, followed by the implications of the findings for dietetic practice. The chapter is ended with further research recommendations.

6.1 Conclusion of study findings

6.1.1 Dieticians attitude toward a low carbohydrate, high fat diet, prescription of a low carbohydrate, high fat diet and concerns regarding a low carbohydrate, high fat diet

Dieticians were found to have a negative attitude toward the use of a LCHF diet for the prevention and management of NCDs. This was determined by the fact that the majority of the subjects had never prescribed a LCHF diet; with the main reason for this being that they felt there was not enough evidence to support its use. Other barriers to the prescription of the diet by dieticians were the affordability, sustainability and practicality of the diet and concern over the long term safety of a high saturated fat intake.

6.1.2 Relationship between socio-demographic characteristics, areas of work and professional interest and research involvement and the prescription of a low carbohydrate, high fat diet

Dieticians in private practice were more likely to prescribe a LCHF diet than dieticians in government. This is likely to be due to the higher socio-economic and education levels of the patients seen in private compared to government. In addition, it is thought that those in private practice may be more likely to adhere to the requests of the patients than those in government. Those who had the strongest interest in NCD management were more likely to prescribe a LCHF diet. There was no relationship found between the research involvement score and the prescription of a LCHF diet, as so few subjects scored well for research involvement.

6.2 Study limitations

The response rate to the questionnaire was 58%, making it higher than most other studies which made use of this survey method. However, many of the statistical tests were conducted on the sub-group of subjects who responded that they had prescribed a LCHF diet, which was only made up of 15 subjects. This would have an impact on the statistical power of the tests conducted and indicates that caution must be used when interpreting the results.

Studies to investigate the research involvement and skills may need to be designed within a South African context. However, the research activities as set out by the BDA (2009) should still be consulted as one can assume that these activities should not differ from country to country.

6.3 Recommendations based on the results of the study

6.3.1 Further research on the attitude toward and prescription of a low carbohydrate, high fat diet by Registered Dietitians

A larger study incorporating RDs from the whole of South Africa should be conducted on this topic. Face-to-face interviews may have allowed more clarity on certain issues, and this method, amongst others, should be considered for future studies on this topic. This will allow for lucidity on concerns that RDs have about a LCHF diet and provide insight into suggestions that RDs have to ensure that correct nutrition messages are directed to the public.

6.3.2 Dieticians' research involvement and skills

The most important recommendation based on the results of the study is that research involvement and skills amongst RDs needs to be investigated further. The current study found KwaZulu-Natal dietician's research involvement on the most basic level to be low. In order to obtain a clearer picture, a larger study should be done involving dieticians across the whole of South Africa. The RIQ should be used as a basis for this but the questionnaire should be adapted to contain only questions relating to level one questions. This should be done in order for the questionnaire to be more specific to research activities and skills that all RDs should have and be maintaining throughout their career; and not activities and skills relevant to only those in the academic or research fields. This is crucial in maintaining evidence-based practice amongst RDs consulting to the public.

A study of this kind could provide crucial information for universities to determine if modules on research in the Dietetics undergraduate degree need to be improved. It could also provide data for which the HPCSA could use to determine if current methods of monitoring Continuing Professional Development (CPD) in qualified dieticians need to be improved. This would need to be done to ensure that RDs are continually exposed to tasks that will improve their research skills and involvement.

6.3.3 Undergraduate training for dieticians

Based on the results of the recommended study investigating South African RDs research involvement and skills, undergraduate training at University should be adapted to ensure that RDs can successfully achieve the activities based on level one of the RIQ. This will ensure that dieticians enter the working environment with the skills needed to practice evidence-based nutrition.

6.3.4 Continuing Professional Development for dieticians

A more rigid structure should be implemented by the HPCSA to ensure that the CPD points that RDs need to earn each year are obtained in such a way that ensures that dieticians are regularly involved in activities that relate to those on level one of the Research Involvement Questionnaire (RIQ). Currently it is possible for an RD to earn all their annual CPD points

through answering multiple choice questions based on research articles. A downfall to this system is that it is possible for the RD to answer all the questions correctly without fully analysing or understanding the article.

A possible solution to improving the CPD system is to develop a network of HPCSA-accredited RDs who receive a separate income for being responsible for the monitoring of RDs professional development. These accredited RDs would need to apply to the HPCSA for the title to be awarded to them. The accredited RD could be responsible for analysing and marking activities that are allocated to their group of RDs. Such activities could include literature reviews, summaries of various ethical guidelines and activities that further educate the RDs about study critique methods and simple data analysis.

6.3.5 Research specific to the low carbohydrate, high fat diet

A well-designed randomised clinical trial comparing a prudent diet to a LCHF diet in a South African context needs to be conducted as soon as possible. The public interest in the diet demands that researchers investigate the long-term efficacy and safety of it. The trial would need to be extremely well-planned in order to minimise as much as possible any effects on the results by other factors such as attrition, exercise and gender. The trial would need to contain a large enough study group in order to ensure the results are generalisable to the public. In addition, the length of the trial is important considering that currently there are none which have exceeded two years.

6.3.6 Communication to the lay public regarding the use of a low carbohydrate, high fat diet

The verbatim reasons for not using the diet given in section 5.2.1 illustrated RDs reluctance to consider the prescription of the diet. Thus far, public communication distributed regarding the LCHF diet (Appendix B, p100), although scientifically valid, may have tainted the public's perception of dieticians and led them to believe that dieticians are not open to consider the prescription of a LCHF diet or to conduct primary research on it. With some of the South African public getting positive results from the LCHF diet (Noakes 2013) as well as the media interest surrounding it, the popularity of the diet is likely not to be affected by

publications such as Appendix B. This, in turn, may have caused some of the public to seek nutrition advice from unreliable sources such as magazine articles and social media groups. The goal, therefore, is to encourage members of the public to continue to rely on RDs for nutrition information and education. It is recommended that a country-wide advertising campaign be conducted by ADSA and any other relevant authorities encouraging those who are interested in following a LCHF diet to seek advice from a RD before doing so.

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APPENDIX A: OPEN LETTER TO TIM NOAKES

(Available at <http://www.health24.com/Medical/Heart/Foods-diet-and-your-heart/Heart-Foundations-open-letter-to-Tim-Noakes-20130210>).

We all know that taking in fewer kilojoules will result in weight loss – so yes, a high-fat, high-protein, low-carbohydrate diet will give you weight loss. But so does a low-fat diet. In fact, following any diet that decreases kilojoule intake will result in weight loss in the short term. Yet we know many people revert to their old eating habits, and regain the lost weight, *plus more*.

We do support Prof Tim Noakes's argument in part; however, we also support the arguments presented by some of Cape Town's cardiologists, noting that both messages hold merit. At the same time we as the HSF have the responsibility to present facts and correct misperceptions evident from comments coming from the public.

Type of fat is important: The HSF does not say "no" to fats! But the message is more nuanced. For good health we need some fat in our diet. The real issue is the quality of fats we eat, against the total kilojoules in the diet. While studies are unclear about the effect of saturated fats on health, there is solid proof that replacing saturated fats with unsaturated fats will improve cholesterol levels, reduce heart disease risk and prevent insulin resistance, a precursor of diabetes. Eating good fats in place of saturated fats lowers the risk of heart disease. *Replacement* is key.

Very bad fats: We trust that Prof Noakes is not recommending that people increase their trans fat intake (this is a fat too!). We know that trans fats significantly increase the risk for cardiovascular disease (CVD) and so should be avoided. Trans fats have a worse effect on cholesterol levels than saturated fats, and they also fire inflammation - that Prof Noakes quite rightly refers to. These raise the risk of CVD and diabetes. This type of fat is commonly found in reused frying oil (as found in restaurants or fast food outlets), in commercially fried and baked foods, processed snack foods and hard margarines.

The traditional Mediterranean diet is an example of a diet that is relatively high in fat, yet lowers the risk of CVD and diabetes. Most of the fat in this diet is from plant sources (olive oil, nuts, seeds – also recommended by Prof Noakes), but saturated fat content is low. The diet is also rich in vegetables, fruits, beans, nuts, wholegrains, and some cheese and yoghurt. In comparison, the westernised diet that we advise against, is high in kilojoules, bad fat, sugar and salt, and is low in fruits and vegetables, wholegrains and healthy fats.

Not all carbohydrates are bad: There is no doubt that unrefined or wholegrain carbohydrates are healthy and protective against certain diseases including cancer. Refined carbohydrates on the other hand should be treated with caution. If there is one thing that everyone agrees on, it is this. The real issue is the abundance of refined carbohydrates found in most everyday foods we eat. These, together with hidden sugars and fats, are the traps found in most processed and convenience foods.

In reality, when people cut back on fat, they fill up on foods full of refined carbohydrates (e.g. white bread, sugary drinks) or use fat-free products without the healthy fats and which contain hidden sugars. The result is an increased risk for obesity, CVD and diabetes, which is why we recommend replacing foods high in bad fats with foods high in good fats—not with refined carbohydrates.

Then there is matter of over-simplifying the causes of heart disease. It is common knowledge that the causes of heart disease are multi-factorial, and are not exclusive to only blood cholesterol and a high fat diet as claimed. In fact, overweight and obesity are one of the risk factors. Maintaining a healthy weight requires much more than a diet. It means having to balance your energy intake with energy used through exercise. Despite Prof Noakes advocating exercise together with his diet, the exercise message gets lost in the debate – which is a danger.

Perhaps the recent debate will feed your need to believe that you can indulge in butter, bacon, biltong and boerewors. Unfortunately, this cannot be without moderation, nor can it be in isolation of all other factors. As the Harvard School of Public Health reminds us, "looking at a single nutrient in isolation cannot tell us the whole story about a person's heart disease risk. It is important to remember that people eat food not nutrients and it is eaten in an overall dietary pattern". To ignore other contributing factors, behaviours and living context that lead to heart disease would be erroneous and dangerous.

- Dr Vash Mungal-Singh, Chief Executive Officer, Heart and Stroke Foundation SA.

APPENDIX B: JOINT STATEMENT ON LCHF DIETS

Low carbohydrate diets are *not* more effective for weight loss than balanced diets, so what does this mean?

Issued by: Association for Dietetics in South Africa, Chronic Disease Initiative for Africa, Heart and Stroke Foundation South Africa, Nutrition Society of South Africa and Professional Board for Dietetics and Nutrition of the HPCSA

10 July 2014

A recent systematic review combining the findings of 19 clinical trials in 3 209 people found that low carbohydrate diets result in similar weight losses over 2 years compared to diets containing a recommended balance of carbohydrate, fat and protein [1]. This review included overweight and obese people with and without diabetes. Little or no difference was detected for known heart disease and diabetes risk factors over 2 years. But what does this mean for the general public wanting to lose weight, maintain the weight loss, as well as be healthy?

1. Low carbohydrate diets are NOT more effective for weight loss than balanced diets

- **The review confirms that reducing overall energy (kilojoule) intake over a period of time will result in weight loss.** Low carbohydrate (<45% of energy from carbohydrates) diets and balanced diets both produced similar weight loss [1], confirming that the proportion of carbohydrate, fat and protein in the diet does not influence weight loss, only the total energy intake itself.
- **Adherence to a reduced energy intake is key for successful weight loss.** In most trials included in the review [1], subjects struggled over time to adhere to energy, carbohydrate, fat and protein goals, irrespective of the type of diet. This illustrates that people's ability to adhere to a diet over time is one of the most important determinants of successful weight loss [2, 3].

2. Uncertainty still remains over the long-term safety and effects on health of low carbohydrate diets

- **The review showed little or no difference in effect on heart disease and diabetes risk factors with low carbohydrate diets and balanced diets over 2 years** [1]. The effects of eating a low carbohydrate diet over the long-term on heart disease and diabetes remain uncertain, as no eligible studies longer than 2 years were found in this review [1].
- **Any diet recommended to the general public as a short or long-term choice should be safe.** The recommended balanced diet, based on quality food choices, along with a healthy lifestyle over the long-

term, is associated with a lower risk of chronic lifestyle diseases such as heart disease, stroke, diabetes and certain cancers [5-8]. The effects of eating a low carbohydrate diet on health over the long-term remain unknown. Some recent preliminary studies have indicated an increased risk of death and heart disease risk with low carbohydrate diets [9-12]. Also, eating large amounts of unhealthy fats over the long-term, as advised with some of these diets, is concerning [13, 14]. Low carbohydrate diets are often high in protein. Diets higher in protein have been linked with increased risk of poorer kidney function [15-17] and various cancers [18]. Based on current best evidence low carbohydrate diets cannot be recommended to the public as part of a long-term healthy lifestyle.

- **Researching people on a diet for two years is too short to provide a clear-cut picture of long-term effects.** Chronic lifestyle diseases like heart disease, stroke, cancer and diabetes develop over many years of exposure to risk factors. An unhealthy diet is also only one risk factor for these conditions. Other risk factors include smoking, obesity, high alcohol intake and inactivity, as well as a family history (genetic predisposition) for these conditions. Thus, developing these conditions is not dependent on diet alone.
- **Weight loss in itself improves risk factors of heart disease and diabetes.** In the short term, weight loss will generally improve heart disease and diabetes risk factors, regardless of how the weight is lost. Weight loss of at least 2.5 kg (or 2% of body weight) is linked to improvements in blood pressure, blood cholesterol and diabetes risk [4, 19-21]. These improvements need to be sustained with a healthy lifestyle in order to reduce long-term risk.

3. A healthy balanced diet is about quality food choices and eating the right amount for a healthy weight.

- **A healthy diet is not only about the quantity and proportions of carbohydrate, fat and protein.** While weight loss is only dependant on overall quantity (total energy of the diet), the quality of the diet (types of carbohydrates, fats and proteins) is important for health. It is well known that the types of carbohydrates and fat in the diet influence heart disease and diabetes risk factors [14].
- **Fat and carbohydrate are good, but quality is key.** Different types of fat and carbohydrate found in foods have different effects on health. Reducing saturated and *trans* fat (animal and processed fats) and replacing them with unsaturated fats (plant fats and oils) reduces the risk of heart disease [22-24]. Removing saturated fat and replacing it with refined carbohydrates may be harmful [25]. Carbohydrates should be eaten as unrefined grains and cereals, beans, lentils, peas, fruit and root vegetables rather than as refined carbohydrates and added sugars.
- **The fundamental issue is not so much losing weight, but maintaining the weight loss.** Different weight loss diets work for different people as long as they are able to achieve a reduction in energy intake [4]. Diets that are popularised in various ways, for example by celebrities or the diet industry, often result in the misconception of a “magic bullet” solution, with one diet being claimed to be the answer for all. This misconception also undermines the truth of the need for permanent dietary (and other lifestyle e.g. physical activity) changes to ensure long-term healthy weight management. A diet may help people to lose weight over the short term, but when the diet is stopped weight is often regained. Therefore, once weight is lost, it is important for people to adopt eating habits that make maintaining weight loss easy and that are linked to better health over the long-term.
- **Overall, the combination of foods and nutrients we eat (our dietary pattern) influence our health, not any single food, nutrient or food group on its own.** We can vary the intake of one component in our diet and not alter diet quality or health. A healthy dietary pattern, (as described below) has been linked consistently with reduced risk of disease [26, 27], demonstrating how foods and nutrients work together for health, for example, the Mediterranean dietary pattern [28, 29].
- **Healthy dietary patterns emphasise quality food choices, and are explained in the South African Food Based Dietary Guidelines (FBDGs).** These guidelines were developed to address existing public health problems in South Africa and are in line with current evidence on eating for health. The FBDGs [30] encourage us to eat a variety of foods, plenty of vegetables and fruit, choose unrefined starchy foods, eat beans, peas and lentils regularly, have dairy products every day and use vegetable oils rather than hard fats. Fish, chicken, lean meat or eggs can be eaten daily. Sugar, salt and foods high in these should

be used sparingly. This includes highly processed foods such as cookies, cakes, pastries, chips, snack bars, ready-to-eat savoury or sweet snacks and sweetened drinks.

- **To maintain a healthy weight, one should aim to balance the amount of food eaten (total energy) with activity levels.** Eating more energy than you use over a period of time will result in weight gain.

4. Affordability and sustainability

The majority of South Africans follow diets that are based on affordable carbohydrate-rich staple foods. Aside from the health implications, a diet low in carbohydrates and high in fat and/or animal protein is likely to be more costly. Adopting costlier diets will not be affordable or practical for most South Africans, impacting negatively on food security, especially in resource-scarce settings. The impacts of populations adopting low carbohydrate diets on sustainability of food systems and the environment, as well as the ethical implications thereof, should be considered. The cultivation of meat products versus carbohydrate-rich staple foods places a greater burden on the environment and global food supply [31].

APPENDIX C: DIETITIANS NZ POSITION STATEMENT ON LCHF DIETS

(Available at: <http://dietitians.org.nz/news/item/low-carbohydrate-high-fat-diet-position-statement/>)

Low carbohydrate, high fat diet - Position Statement

There has recently been a lot of coverage in the media about the proposed benefits of the Low Carb High Fat diet.

Nutrition science is always evolving, therefore, registered dietitians continually review evidence and adapt recommendations as required. Based on the current evidence, Dietitians NZ maintains the following position regarding the Low Carb high fat diet.

Dietitians NZ considers there not to be any substantive evidence that saturated fat is good for you in the long term.

Dietitians NZ also considers there not to be any evidence that a diet high in fat and low in carbohydrates is more beneficial for sustained weight loss than any other dietary regimen that results in a lower intake of kilojoules.

Dietitians NZ recommends that people eat foods from the following food groups which can be combined in various ways to suit individual dietary patterns:

- Vegetables and fruits – with a focus on non-starchy vegetables
- Cereals and grains – with a focus on minimally processed wholegrains
- Lean meat, fish, poultry, tofu and eggs
- Legumes (pulses) and nuts
- Low fat and fat reduced dairy products
- Unsaturated oils

A range of fat intakes is acceptable provided that there is emphasis on appropriate types of fat (mono and poly-unsaturated) but some degree of fat restriction is universally recommended by experts due to its high energy density.

Limitation of “free” or “added” sugars and alcohol is advised for those who need to limit total energy intake, because they often provide kilojoules without other beneficial nutrients.

Highly processed cereal based foods such as white rice, pasta, bread and flour should also be limited for similar reasons, and replaced with wholegrain versions where possible.

Registered dietitians are able to provide individualised dietary advice. If you would find this helpful, you can find a registered dietitian near you [here](#).

APPENDIX D: STATEMENT FROM AUT UNIVERSITY**Response to the Dietitians NZ Position Statement and supporting reference-based documentation about low-carbohydrate, high-fat diets
June 2014**

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Preamble

This document has been prepared in response to a Position Statement and associated macronutrient recommendation reference list developed and distributed by Dietitians NZ regarding the low-carbohydrate, high-fat (LCHF) debate. The position statement begins by acknowledging that the science of nutrition is always evolving, and that registered dietitians continually review evidence and adapt recommendations as required. While this may be true, the aim of this response is to highlight some of the limitations of the mainstream evidence cited to support the Position Statement, plus to provide several other sources of robust evidence to support the LCHF approach.

We have provided the statement, verbatim, below followed by our responses to the statement, with supporting references and documentation at the end. Dietitians NZ provided no commentary on any of the references; however, we have chosen to do so due to the numerous occasions where study interpretations and conclusions do not reflect study data. Two key documents feature in the appendices, Appendix 1 (p19) our Ministry of Health draft guidelines submission, and Appendix 2 (p44) our Ministry of Health saturated fat rebuttal. These documents have only been placed in the Appendices section for prevention of text duplication, rather than as "add-on" material. They are concrete evidence-based documents in themselves and need to be considered as important components of this overall response.

We are open to debate around any, or all, of the scientific points we make in this document. We are also open to this review and response being put forward for public scrutiny.

Regards



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(The full document can be accessed at http://www.dietitians.org.nz/fileadmin/assets/Resource_Library/Weekly_emails/17_June_2014/Dietitians_NZ_Position_Statement_reponse_FINAL.pdf)

APPENDIX E: 2011 DISCOVERY HEALTH MAGAZINE ARTICLE

Against the grains

It's taken a lifetime to realise it but **Professor Tim Noakes** now believes the overconsumption of refined carbohydrates may be toxic for the body.

I am not one to shy away from controversy. But I suspect that this column will attract more unfavourable comment than perhaps anything else I have recently written. Yet the message could be life-changing for some.

It has taken me 61 years to suspect that bread and cereals – the biblical staff of life – as well as rice, pasta and refined carbohydrates may not be healthy for me personally as I had always believed.

My attention to this possibility was piqued by the release of the most recent 2010 US Dietary Guidelines. These guidelines promote the concept of the Food Pyramid built on 6-11 daily servings of bread, cereals, rice and pasta. Although Americans now follow these guidelines more closely than ever, obesity has become the single greatest medical problem in the US. Thus the question: is this epidemic linked in some way to this increased carbohydrate intake? I decided to investigate.

First, I learned that cereals and grains have been a staple of the human diet for only the past 20 000 years, whereas we began to eat meat perhaps 2.5 million years ago.

More interestingly, this change from a protein- to a cereal-based diet produced a reduction in average human height and the first appearance of nutritional-deficiency diseases, including beriberi, pellagra and scurvy. These diseases led to the discovery of vitamins only in the early 1900s.

The second is the burgeoning literature written by those who experiment with low-carbohydrate diets. Some suggest that we humans evolved our current size and especially our large brains over the past two million years only because we found sustainable novel sources of high-protein foods, especially meat and fish.

Such high-energy sources are especially important during infancy and early childhood when brain size increases rapidly. As a result, the human intestine is especially well designed for digesting high-protein foods and bears more resemblance to that of the carnivorous lion than to that of our nearest living relatives, fruit- and plant-eating chimpanzees. Perhaps humans are really closet carnivores. Third, low-carbohydrate weight-loss diets produce results at least as good

as those achieved with the traditional low-fat, high-carbohydrate diets. No published evidence shows that these unconventional diets will produce undesirable health consequences.

Fourth, I learned that protein is a potent appetite suppressant, perhaps because a too-high-protein diet is toxic to humans. As a result, low-carbohydrate diets with increased protein do not cause the frequent sensations of hunger and privation that accompany calorie-restricted, high-carbohydrate diets.

This absence of hunger is more likely to encourage compliance and sustained weight loss. In contrast, there may be an addiction, especially to rapidly-assimilated carbohydrates like sugar and refined carbohydrates, that drives the overconsumption of all foodstuffs, fat included, and hence leads to weight gain.

Thus, my untested theory is that it is the

unrestricted intake of especially refined and hence addictive carbohydrates that fuel an overconsumption of calories, not a high-fat intake as is usually believed.

There is a saying that to find the root cause, follow the money trail. If a low-carbohydrate diet is more healthy than we might expect, then what is that fact hidden? The answer is that some very large industries, including the soft-drink, sugar confectionary industries (all of which produce high-carbohydrate products with minimal nutritional value) do not want us to know this.

Finally, I submitted myself to an experiment rigorously avoiding all bread, cereals, rice, pasta and refined carbohydrates and replacing that nutritional deficit with healthy meats, fish, fruit vegetables and fats, including nuts.

Five months later, I am at my lightest weight in 20 years and I am running faster than I have in 20 years. For the first time since I ran heroic weekly mileages in training have I learned exactly how to maintain an ideal body weight without any sense of privation. And with only as much exercise as I want to do. Even my friends are impressed. They agree that not even the most expensive cosmetic surgery could have produced such a remarkable change. 😊

APPENDIX F: ONLINE QUESTIONNAIRE**SECTION 1:****Question 1:**

What is your age? (Free text)

Question 2:

What is your gender? (Drop down menu male/female)

Question 3:

What year did you qualify as a dietician? (Drop down menu)

Question 4:

At which university did you obtain this qualification? (Drop down menu including “other” which allowed free text)

Question 5:

Do you have any post-graduate qualifications? (Yes/No)

Question 6:

If you answered yes to question 5, please indicate your highest post-graduate qualification

- Post-graduate/hospital diploma in dietetics
- Post-graduate diploma in another discipline
- Honours in Dietetics
- Honours in another discipline
- Masters in Dietetics
- Masters in another discipline
- PhD in Dietetics
- PhD in another discipline
- Other (this option allowed free text)

Question 7:

Please indicate whether your current job is in the government or the private sector
(Government / Private)

Question 8:

Does your current job involve counselling patients? (Yes / No)

Question 9:

Please indicate the number of years of experience you have in counselling patients (either one-on-one or group sessions) in your time as a dietician

- 0 to 1 years
- 1 to 5 years
- 5 to 10 years
- Over 10 years

Question 10:

Rank the following patient types according to how much experience you have in counselling for each one.

1. Chronic diseases of lifestyle
2. HIV/AIDS and TB
3. Cancer
4. Paediatric nutrition
5. Renal diseases
6. Liver diseases
7. Sports nutrition
8. Disorders of the gastrointestinal tract

Question 11:

Please indicate your main area of interest (system only allowed one option to be chosen)

- Sports nutrition
- Paediatric nutrition
- Chronic diseases of lifestyle management
- HIV/AIDS and TB
- Oncology
- Allergies
- Eating disorders
- Intensive care/surgery/immuno-nutrition
- Other (this option allowed free text)

SECTION 2:**Question 1:**

You are counselling a patient who is obese, has type 2 diabetes mellitus and dyslipidemia. He has family history of heart disease. Please jot down the main dietary aspects that you feel are the most important to convey to the patient in the time that you are seeing him (Free text).

Note: The remaining questions are all statements the respondent was meant to indicate level of agreement

The choices for the remaining questions in this section are as follows:

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Question 2:

A weight reduction diet should focus on a reduction of total energy intake.

Question 3:

A diet high in saturated fat and cholesterol can cause atherosclerosis and cardiovascular disease

Question 4:

All type 2 diabetics should follow a diet which provides 50% to 60% of unrefined carbohydrates, 25% to 30% fat (with less than or equal to 10% as saturated fat) and the remainder as protein.

Question 5:

A dietician is the most qualified person to advise patients with obesity and related diseases (such as insulin resistance, type 2 diabetes mellitus, dyslipidemia or cardiovascular disease) on dietary choices.

Question 6:

It is important for dietitians to remain up to date regarding both the prevention and management of obesity and chronic diseases of lifestyle.

Question 7:

Dietitians should offer patients a range of options for the management of obesity, insulin resistance, type 2 diabetes and dyslipidemia.

Question 8:

Reduced-calorie diets result in weight loss, regardless of which macronutrients they emphasize.

SECTION 3:**Question 1:**

Have you ever advised a patient on a LCHF diet? (Yes/No)

Question 2:

What influenced you to use a LCHF diet in patient care?

- Personal experience with a LCHF diet
- Patient experiences with a LCHF diet
- Advice from other dietitians
- Advice from other health professionals (other than dietitians)
- Academic qualifications
- Personal research into a LCHF diet
- Other (this option allowed free text)

Question 3:

What types of patients have you used a LCHF diet on? (Free text)

Question 4:

How regularly do you use a LCHF diet?

- Always
- Usually
- About half the time
- Seldom

Question 5:

How would you describe your patient's response to a LCHF diet?

- Successful
- Unsuccessful

Question 6:

Please choose the most valid/appropriate reason you have never used a LCHF diet in patient management.

- I have never thought about it
- I do not feel there is enough evidence to support its use
- My patients have always been successful on a conventional diet
- I feel that it is an impractical diet
- It is not what I was taught to plan/use at University
- Other (this option allowed free text)

SECTION 4:

The response to each statement in this section indicates the respondent's involvement in that activity

The choices for each question in this section were as follows:

- Not at all
- A little bit
- Quite a bit
- A lot
- A great deal

Question 1:

Interpreting basic aspects of data analysis (e.g. means, medians, standard deviations, t-tests, P values) when reading journal articles.

Question 2:

External presentation (e.g. national / international conferences or publications in peer-reviewed journals) of results of research projects you *have led*.

Question 3:

Participating in research as part of a collaborative team.

Question 4:

Using the literature to identify what research studies still need to be conducted within general areas.

Question 5:

Developing the research budget and subsequently managing funding, staffing and time management issues for a research project.

Question 6:

Educating colleagues in research methodology and methods (NB this does not include supervising a BSc/MSc student project).

Question 7:

Appreciating the ethical framework in which research should be conducted.

Question 8:

Extensively involved in reviewing the research of others (e.g. peer review of manuscripts for journals and reviewing grant applications).

Question 9:

Applying for approval from research ethics and R&D departments, and managing projects in line with research governance frameworks.

Question 10:

Understanding and interpreting advanced data analysis (e.g. correlation, meta-analysis, qualitative data analysis) when reading journal articles.

Question 11:

Participating in research under the supervision or mentorship of colleagues.

Question 12:

Critically appraising aspects of research methods when reading journal articles. This includes understanding the appropriate use of different study designs (e.g. randomised controlled trial, case-control study, focus group, etc.).

Question 13:

Undertaking comprehensive literature searches using electronic databases (e.g. Medline) in order to inform your practice.

Question 14:

Developing and leading programmes of research (i.e. a planned series of projects designed to answer research questions within a particular area).

Question 15:

Leading on the development and design of a research protocol following an appropriate literature review, including identifying appropriate research methods and statistical analyses.

Question 16:

Internal presentation (e.g. to other healthcare professionals or scientists) of results from research projects in which you have *been involved*.

Question 17:

Independently formulating research questions or hypotheses within your area of practice.

Question 18:

Supervising and mentoring colleagues to undertake research (NB this does not include supervising a BSc/MSc student project, but could include supervising a PhD project).

Question 19:

Influencing the research of others through active participation in research-related committees or external organisations (e.g. Research Ethics Committee, Research Council).

Question 20:

Undertaking research as a major component of your current job description.

Question 21:

Using the literature and your experience to identify what research studies still need to be conducted within your area of interest.

Question 22:

Participating in the review of the research of others (e.g. peer review of manuscripts for a journal).

Question 23:

External presentation (e.g. at a conference or in a journal article) of results from research projects in which you have *been involved*.

Question 24:

Using the findings from journal articles / original research studies when making decisions within your area of practice.

APPENDIX G: ETHICAL CLEARANCE FROM UKZN



30 April 2014

Ms Stephanie Alexandra Joyner 17030
School of Agricultural, Earth and Environmental Sciences
Pietermaritzburg Campus

Protocol reference number: HSS/0373/013M

Project title: KwaZulu-Natal based state-employed and private practicing dietician's attitude toward and use of a low carbohydrate, high fat (LCHF) diet in treating patients with pre-diabetes, type 2 diabetes, obesity and dyslipidaemia.

Dear Ms Joyner

Full Approval – Expedited

This letter serves to notify you that your application in connection with the above has now been granted full approval.

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach/Methods must be reviewed and approved through an amendment /modification prior to its implementation. Please quote the above reference number for all queries relating to this study. Please note: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

Best wishes for the successful completion of your research protocol.

Yours faithfully

Dr Shamila Naidoo (Deputy Chair)

/px

cc Supervisor: Dr Nicola Wiles
cc Co-Supervisor: Mrs Susanna Kassler
cc Academic Leader Research: Professor D Jaganyi
cc School Administrator: Ms Michelle Francis and Ms Sibongile Ntuli

APPENDIX H: PERMISSION FROM DEPARTMENT OF HEALTH

health

Department:
Health
PROVINCE OF KWAZULU-NATAL

Health Research & Knowledge Management sub-component
10 – 103 Natalia Building, 330 Langalibalele Street
Private Bag x9051
Pietermaritzburg
3200
Tel.: 033 – 3953189
Fax.: 033 – 394 3782
Email.: hrkm@kznhealth.gov.za
www.kznhealth.gov.za

Reference : HRKM 211/13
Enquiries : Mr X Xaba
Tel : 033 – 395 2805

Dear Ms SE Joyner

Subject: Approval of a Research Proposal

1. The research proposal titled '**State-employed and private practicing dieticians attitude toward and use of a low carbohydrate, high fat diet in treating patients**' was reviewed by the KwaZulu-Natal Department of Health.

The proposal is hereby **approved** for research to be undertaken among Dieticians in all hospitals.

2. You are requested to take note of the following:
 - a. Make the necessary arrangement with the identified facility before commencing with your research project.
 - b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.
3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mr X. Xaba on 033-395 2805.

Yours Sincerely

Dr E Lutge

Chairperson, Health Research Committee

Date: 24/01/2013

APPENDIX I: CONSENT FOR QUESTIONNAIRE



Dear Dietitian,

Thank you for taking the time to participate in my Masters research. I am registered with the University of KwaZulu-Natal and have received ethical clearance (Ref: HSS/0373/013M). My supervisors are Dr Nicola Wiles (WilesN@ukzn.ac.za) and Mrs Suna Kassier (Kassiers@ukzn.ac.za).

Study title:

KwaZulu-Natal based dietician's attitudes toward and their use of a low carbohydrate, high fat (LCHF) diet in treating patients with obesity and non-communicable diseases.

Participation in the study is voluntary and opting out will not have any negative consequences for you. The researcher will only have access to your email address, and will not share this or any of your answers with any third party without your consent.

By clicking on "I am happy, continue" below, you:

- consent to participate in this questionnaire
- understand that absconding from the study once you have started will have no negative impact on you
- understand that your responses will be linked to your email address

By clicking on "I am not happy, do not continue", you:

- understand that opting out now will have no negative impact on you
- understand that you will not be able to receive CPD-accredited ethics articles
- will not be eligible for the lucky draw prize

Your participation is greatly appreciated.

Stephanie Joyner

stephjoyner18@gmail.com

072 670 3544