Perceptions and acceptability of Low Carbohydrate, High Fat (LCHF) diets among Māori whānau in Dunedin

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Abstract

OBJECTIVE:
Low carbohydrate, high fat (LCHF) diets are currently much debated in both the media and the academic literature. However, little is known about the acceptability of these diets among Māori, who commonly consume diets high in carbohydrates, and how they might interpret recommendations to follow these diets. This study aims to investigate how LCHF diets are perceived by members of the Māori community (Dunedin) and some of the barriers and facilitators to following this type of diet.

METHODS:
Face-to-face interviews was conducted with n=18 Māori participants, (13 females, 5 males). They were recruited by word of mouth around the University of Otago and door approaches in low decile neighborhoods. Interviews focused on their perceptions about carbohydrates, such as how often they ate carbohydrates, and their food habits including high carbohydrate and high-fat foods. Other questions included the participants' thoughts on the LCHF diet, and if they would be willing to try an LCHF diet. Interview transcripts were analysed by inductive thematic analysis.

RESULTS:
Māori are highly motivated to living healthy lives. Motivating factors include family, culture, achieving a desired body weight and fear of developing diet-related diseases experienced by other family members. Participants’ knowledge and views of dietary fat are diverse. Saturated fat is still considered by many as unhealthy however, saturated fat from natural (less processed) sources is perceived by a significant number of participants as being healthy. As a staple food in Māori diets, starchy carbohydrates appeal because they are cheap, satiating and convenient. LCHF diets are viewed positively because it emphasizes eating fewer processed
foods, which are associated with poor health outcomes and resembles diets of pre-colonised Māori. Barriers to LCHF diets were the cost of foods, concern for children’s food preference, lack of time, information, understanding and meal ideas.

CONCLUSION:

Our study suggests that perceptions of the LCHF diet by Māori adults is divided and their understanding is not based on sound evidence. Significant barriers and facilitators cause indecision in the application of the LCHF diet. Further research is needed to determine whether Māori perception of LCHF is accurate.

KEYWORDS:

Carbohydrates, High Fat, Diet, Nutrition, Processed foods, Saturated fat, Māori, Health, Traditional foods
Preface

Dr. Lisa Te Morenga, the candidate’s primary supervisor, and Dr. Reremoana Theordore, the candidate’s secondary supervisor, prepared the project proposal for the research candidate, Te Huri Arthur, a Masters of Dietetics student at the University of Otago. Both supervisors guided the research design of the overall study, developing research objectives and presenting findings. As the lead academic supervisor, Dr. Lisa Te Morenga oversaw the process of obtaining ethical approval, participant recruitment, data collection, and analysis. In addition to frequent email correspondence, regular meetings were also held by the candidate and both supervisors to provide counsel, feedback and to ensure the research project was progressing and conducted appropriately.

The primary researcher of this thesis began this research project as a summer internship in 2015. It coincided with another research project investigating the same objectives (perception of LCHF diets) but in Pasifika communities. During the summer internship period the primary researcher was only able to conduct interviews with 18 participants (eight interviews with another researcher and 10 interviews unaccompanied) that self-identified as being Māori. Transcription, thematic analysis and write up was not completed. Approval was provided to continue with this research project as a HUND5B thesis project.

The first eight Māori participants were recruited and are associated with the University of Otago in some capacity as either an employee or a student. They were interviewed with the assistance of a follow researcher. To get an accurate representaiton of Māori perceptions of LCHF diets a further 10 Māori participants were solely recruited by door knocking in low socioeconomic status (LSES) communities in Dunedin. Consequently, this exceeded the original aim of recruiting 10 Māori participants as initially stated in the participants
information sheet (Appendix B). Funding for this study was provided by the University of Otago.

The questioning guide was jointly developed with another follow researcher who was investigating the perceptions of LCHF diets in Pasifika communities. Most questions applied to both Māori and Pasifika participants. The role of leading and support interviewer alternated between two researchers. The lead interviewer was responsible for asking the questions’, however the support interviewer was able to ask any confirmation or follow up questions. The support interviewer also took general notes of participants’ behaviours throughout the interview.

The primary researcher was responsible for

- Reviewing literature relevant to perceptions and beliefs of carbohydrates, fats, and low carbohydrates high-fat diets in Māori or other indigenous populations.

- Developing semi-structured interview questions, with the guidance of Otago Pacific health advisor.

- Recruiting participants from Dunedin communities

- Organising, collecting and transcribing verbatim 18 participants interviews.

- Coding and theme development from all 18 interviews using general inductive analysis.

- Full thesis write-up, with guidance from Dr. Lisa Te Morenga and Dr. Reremoana Theodore.
Tuatahi, me mihi ki tō tātou Matua Nui i Te Rangi mō ōnā ringaringa tautoko, tohutohu hoki i tēnei haerenga mātauranga. I roto i tōku haerenga, ka hoki mai nga matapihi o te Atua. Ka whiwhi tōku whānau i ngā manaakitanga. E kore tēnei haerenga e tutukitia inā kore a Matua Nui Te Rangi. He korōria, he hōnore ki a Io Matua mō ake tonu atu.

Tuarua, he mihi tēnei ki ōku kaiako rangatira a Dr Lisa Te Morenga rāua Dr Reremoana Theodore. E whakawhetai ana ahau ki a kōrua mō tō kōrua maramatanga me tō kōrua manawanui. Kāore ahau e mahi mō te Ao matauranga engari i tautoko mai kōrua i tēnei mahi nui.

Hei whakamutu, ki tōku hoa rangatira – tako aroha, tako aroha, tako aroha. Kua tukuna e koeaku hapa, aku pouritanga me toku whakahemanawatanga, engari kei te noho tonu koe ki te aroha, ki te atawhai me te tukuna noa. Tēnā koe mō tō tauira nui ki a au. Kei te utu tonu ahau ki a koe mō ō patunga. Ka mihi ki a koe mō tō tiaki i ahau me tō tātou whānau. Tako aroha mutunga kore ki a koe Caroline.
# Table of Contents

Abstract .......................................................................................................................... ii  
Preface ........................................................................................................................... iv  
He mihi (Acknowledgements) ...................................................................................... vi  
List of Tables .................................................................................................................. x  
Translation of Māori terms ......................................................................................... xi  
List of Abbreviations .................................................................................................. xii

1 Introduction ................................................................................................................. 1

2 Literature Review ........................................................................................................ 3  
   2.1 Dietary Patterns .................................................................................................... 5  
   2.2 Obesity ................................................................................................................ 6  
   2.3 Cardiovascular risk factors .................................................................................. 7  
   2.4 Diabetes ............................................................................................................... 10  
   2.5 Perception and belief about Carbohydrates, Fats and LCHF diets ....................... 11  
   2.6 Conclusion ......................................................................................................... 13

3 Objective Statement ................................................................................................... 17

4 Methods ..................................................................................................................... 18  
   4.1 Participant selection and recruitment .................................................................. 18  
   4.2 Questionnaire design ......................................................................................... 18  
   4.3 Data collection .................................................................................................... 20
# Table of Contents

4.4 Data analysis.................................................................22

5  Results .............................................................................23

5.1 Māori: Motivated to live healthily..................................26

5.1.1 Culture .......................................................................26

5.1.2 Body weight...............................................................26

5.1.3 Fear of sickness/disease and death ..............................27

5.1.4 Future posterity...........................................................27

5.2 Challenges of dietary fat................................................28

5.2.1 Fat is tasty......................................................................28

5.2.2 Diverse beliefs and views of fats .................................30

5.3 Starchy carbohydrates are difficult to live without .......32

5.3.1 Cheap, and filling ......................................................32

5.3.2 Carbohydrates are habitually used to provide variety ...32

5.3.3 Starchy carbs: Staple part of traditional and current diets...33

5.4 Natural traditional foods are best.................................35

5.4.1 Processed foods ..........................................................35

5.4.2 Natural foods are prioritised over saturated fat ..........37

5.4.3 Paleo is popular among Māori..................................38

5.4.4 Diet of our tīpuna.......................................................39

5.5 Fad diets are not family friendly....................................40

5.5.1 Feeding children can be tricky....................................40

5.5.2 The effect of budget on food ......................................42

5.5.3 LCHF diet and anticipated challenges .......................43

6  Discussion ........................................................................46
6.1 Māori, mixed messages, and media ........................................... 47
6.2 Main drivers of LCHF .................................................................. 48
6.3 Main barriers of LCHF diets ......................................................... 51

7 Conclusion .................................................................................. 54

8 Application of Research to Dietetic Practices ................................. 56

References ...................................................................................... 59

Appendix A Ethics Approval ............................................................... 64
Appendix B Participant Information Sheet ......................................... 65
Appendix C Consent Form for Participants ....................................... 67
Appendix D Participant Questionnaire ............................................. 68
Appendix E Australian Government Recommendations .................. 69
List of Tables

Table 1: Summary of studies reviewed ............................................................................. 15
Table 2: Overview of semi-structured interview protocol .............................................. 20
Table 3: Baseline Characteristics .................................................................................. 24
Table 4: Participants demographic characteristics ......................................................... 25
Table 5: Comparison of macronutrients between LCHF diet and tipuna kai .................... 50
<table>
<thead>
<tr>
<th>Māori Term</th>
<th>English Meaning</th>
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<tbody>
<tr>
<td>Hauora</td>
<td>Health</td>
</tr>
<tr>
<td>Iwi</td>
<td>Tribe</td>
</tr>
<tr>
<td>Kai</td>
<td>Food</td>
</tr>
<tr>
<td>Kai moana</td>
<td>Seafood</td>
</tr>
<tr>
<td>Kaumātua</td>
<td>Older man</td>
</tr>
<tr>
<td>Kererū</td>
<td>New Zealand pigeon</td>
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<tr>
<td>Kina</td>
<td>Sea urchin</td>
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<tr>
<td>Kiore</td>
<td>Rat</td>
</tr>
<tr>
<td>Kūmara</td>
<td>Sweet potato</td>
</tr>
<tr>
<td>Kurī</td>
<td>Dog</td>
</tr>
<tr>
<td>Mana</td>
<td>Authority and power</td>
</tr>
<tr>
<td>Marae</td>
<td>Māori meeting house</td>
</tr>
<tr>
<td>Mauri</td>
<td>The essential quality and vitality of a being or entity</td>
</tr>
<tr>
<td>Moa</td>
<td>large extinct flightless birds of nine subspecies</td>
</tr>
<tr>
<td>Mokopuna</td>
<td>Grandchild</td>
</tr>
<tr>
<td>Paepae</td>
<td>Area occupied by those who are entitled to speak on behalf of the marae during a gathering</td>
</tr>
<tr>
<td>Pāua</td>
<td>abalone</td>
</tr>
<tr>
<td>Pūhā</td>
<td>Sow thistle</td>
</tr>
<tr>
<td>Tī</td>
<td>cabbage trees of various species</td>
</tr>
<tr>
<td>Tīpuna</td>
<td>Ancestors</td>
</tr>
<tr>
<td>Tītī</td>
<td>Mutton bird</td>
</tr>
<tr>
<td>Tūī</td>
<td>a songbird that imitates other birds'</td>
</tr>
<tr>
<td>Wānanga</td>
<td>seminar, conference, forum, educational seminar</td>
</tr>
<tr>
<td>Weka</td>
<td>a brown-feathered endemic flightless bird</td>
</tr>
<tr>
<td>Whaikōrero</td>
<td>A formal speech</td>
</tr>
<tr>
<td>Whānau</td>
<td>Family</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>AI</td>
<td>Adequate intake</td>
</tr>
<tr>
<td>ANS</td>
<td>2008/2009 New Zealand Adult Nutrition Survey</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardiovascular disease</td>
</tr>
<tr>
<td>HDL-C</td>
<td>High density lipoprotein – cholesterol</td>
</tr>
<tr>
<td>IHD</td>
<td>Ischemic heart disease</td>
</tr>
<tr>
<td>LC</td>
<td>Low carbohydrate</td>
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<tr>
<td>LCHF</td>
<td>Low carbohydrate high diet</td>
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<tr>
<td>LDL-C</td>
<td>Low density lipoprotein – cholesterol</td>
</tr>
<tr>
<td>LF</td>
<td>Low fat</td>
</tr>
<tr>
<td>LFHC</td>
<td>Low fat high carbohydrate</td>
</tr>
<tr>
<td>LSES</td>
<td>Low socioeconomic status</td>
</tr>
<tr>
<td>MI</td>
<td>Motivational interviewing</td>
</tr>
<tr>
<td>MoH</td>
<td>Ministry of health</td>
</tr>
<tr>
<td>NCD</td>
<td>Non-communicable disease</td>
</tr>
<tr>
<td>NTD</td>
<td>Neural tube defect</td>
</tr>
<tr>
<td>NZ</td>
<td>New Zealand</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for economic Co-operation and Development</td>
</tr>
<tr>
<td>SSB</td>
<td>Sweet sugary beverages</td>
</tr>
<tr>
<td>UPFD</td>
<td>Ultra-processed foods and drinks</td>
</tr>
<tr>
<td>FPQ</td>
<td>Food preference questionnaire</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
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1 Introduction

The low carbohydrate high fat (LCHF) diet, which limits total energy intake from carbohydrate and encourages liberal intake of fat from natural sources including saturated fat, has attracted the attention and interest of many communities around the world (1). Persistent coverage from media outlets such as healthy eating television programs and documentaries, social media advertisements, articles in health magazines and radio talk shows indicate that even today the presence of LCHF diets remain strong and is widespread (2-5). Thus, the broader community receives frequent messages that suggest LCHF dietary guidelines are superior to the current healthy eating guidelines (6).

LCHF diets (e.g., Aitkens diet, Paleo diet, South Beach diet) have grown in popularity and are viewed as acceptable dietary approaches for some populations (7, 8). In recent years a vocal group of health professionals, academics, nutritional pundits, and sport athletes have been promoting the LCHF diet and criticising conventional dietary guidelines that encourage consumption of carbohydrates, which has seen an increase in the popularity of LCHF diets and its variants (9-11). LCHF diets have been promoted as being of potential benefit to people with, or at high risk of, diabetes because they have shown to reduce more weight and improve glycaemic control compared to LF diets (7). Because many indigenous populations, such as Māori, have an increased risk of diabetes, obesity and cardiovascular disease (CVD) (12), some have argued that LCHF diets might be of particular benefit for Māori (13, 14). How Māori view LCHF diets and whether they are acceptable and feasible for Māori families, however, is not known. Likewise, few studies have investigated perceptions and beliefs of LCHF diets amongst other indigenous peoples. One particular study was a 12-week dietary intervention of obese Pasifika women, which sought to examine the feasibility of
effectiveness of LCHF diets on weight loss which reported that LCHF diets seemed to be acceptable and reasonable for this group of Pacifika women (15).

The LCHF diet is fast becoming a diet many New Zealanders are expressing interest in and consciously attempting to adopt, taking them away from the conventional dietary recommendations supported by our current dietary guidelines (16, 17). It is unknown whether the LCHF diet is considered culturally acceptable and financially feasible among the general Māori population. Successful adherence to any dietary advice given to Māori families and communities requires that the information is culturally and socially acceptable, takes into account the food knowledge and resources of the whānau, and is financially feasible (18). Some aspects of the LCHF diet may appeal to Māori because of its similarity to traditional diets that are relatively higher in protein. A study showed that Māori participants placed on a high protein diet demonstrated greater long-term compliance because the diet was viewed as a more traditional diet similar to what Māori consumed before the introduction of refined carbohydrate type foods (18). However, with the increasing prevalence of Māori whānau experiencing low food security in New Zealand (19), it is unclear whether the LCHF diet is an affordable dietary guideline for Māori families to follow consistently.

Understanding nutritional knowledge and beliefs, as well as barriers and facilitators of LCHF diets for Māori, is essential. Prescription of radical fad diets can be misinterpreted and lead to unhealthy dietary behaviours and subsequently poor individual health and higher health inequity for Māori. Providing correct nutritional education with acceptable diets that lead to improved health and wellbeing is particularly crucial for Māori, who already experience high rates of diet-related diseases (20).
2 Literature Review

Low carbohydrate high fat (LCHF) diets have gained global recognition for their claims to protective health benefits against non-communicable diseases that are so prevalent in the world today. Since the first reported low carbohydrate diet by William Banting in 1860, several other low carbohydrate diets have gained popularity within the past 40 years (1). Although the names of these diets vary (Dupont, Aitkens, Banting, South Beach, Paleo Ketogenic diet) and there are some subtle differences in acceptable food groups between these diets although their primary dietary principle to radically reduce carbohydrate and freely consume fat (including saturated fat) remains the same (1).

The dire global and national health statistics are often cited as an urgent call for changes to the current dietary guidelines (21). In 2015 almost a third of all deaths (31%) were caused by CVD (22). Furthermore, in 2014 about 422 million people were diagnosed with type 2 diabetes and since 1980 the global prevalence of diabetes has doubled from 4.7% to 8.5% (23). Similarly, global obesity rates have increased since 1980 to about 600 million people are now classified as obese (24).

Global health concerns are reflected in the health statistics for New Zealand. In 2012 ischemic heart disease (IHD) was the leading cause of death in NZ. The annual update of key results from the 2015/2016 Health Survey reported that nearly one in twenty adults (4.6%) had ischemic heart disease (IHD) (20). The prevalence of diagnosed diabetes rose from 5.1% in 2006 to 5.8% in 2015 (20). Based on biochemical data collected in the 2008/09 New Zealand Adult Nutrition Survey (ANS), Coppell et al estimated the population-wide prevalence of diabetes to be 7% when taking into consideration those with undiagnosed diabetes (25). The National Health Statistics Record reports that 32% of New Zealand adults are classed as obese (26). Currently, New Zealand has the third highest obesity rate in the Organisation for
Economic Cooperation and Development (OECD) (27). Furthermore, adult and childhood obesity has risen in the past decade from 27% to 32% and 8% to 11% respectively (26). The poor health statistics are further magnified when focussing on Māori health. Diabetes and obesity rates for Māori are 7.6% and 47% respectively (20). Similarly, the prevalence of IHD, stroke, and heart failure are slightly higher for Māori compared to non-Māori (20).

Health services and health professionals have responsibility to deliver services which give equitable outcomes for Māori and Non-Māori (28).

In response to these poor health statistics, some health professionals are questioning the effectiveness of the current healthy eating guidelines (7). At the centre of the debate is the controversy over whether diets should be higher or lower in carbohydrates and fat.

Carbohydrates are considered problematic because associations have been made with the increasing amount of carbohydrates consumed and the increasing rates of obesity and diabetes (7). Additionally, high carbohydrate diets are said to kick-start a fat accumulating cycle where ingesting carbohydrate promotes insulin secretion, and hyperinsulinemia stimulates hunger and encourages overeating that leads to diet-related disease (7). Current guidelines recommend carbohydrate and fat intake to be around 45 - 65% and 20 - 35% of total daily energy intake respectively (29-31). Low carbohydrate (LC) diets range from as low as 20 grams to as high as 130 grams of carbohydrates per day (32). In addition to excluding ultra-refined carbohydrates like sugary beverages, biscuits, chips, baked goods and fast foods, LCHF diets also encourage a radical reduction in starchy carbohydrates such as starchy root vegetables, fruit, legumes, whole grain bread, and cereals. Furthermore, LCHF diets encourage liberal intake of total and saturated fat from minimally processed foods like animal fats, whole milk, cream, butter, avocado, nuts, eggs, cheese, fish, coconut and olive oil. (5, 7, 21). LCHF diets have been introduced as a nutritional approach to prevent and treat obesity, improve CVD risk factors and help to normalise blood glucose levels and glycated haemoglobin (HbA1C) (7, 33-35).
The purposes of this literature review are firstly, to assess LCHF diets and their effects on obesity, diabetes and CVD risk factors, and secondly, to discuss people’s perceptions, beliefs, and understandings of LCHF diets.

2.1 Dietary Patterns

Māori have diets that are higher in total and saturated fat compared to the healthy eating guidelines (19, 29, 31). The average energy intake of total and saturated fat is 36% and 14% for Māori adults respectively (36). A significant proportion of Māori reported using high-fat foods such as butter, butter blend, dripping or lard, and whole milk, and following meal preparation methods that contribute to elevated fat consumption such as leaving fat and skin on meat and chicken. This indicates that Māori regularly consume fatty foods.

Also, of significance to the LCHF diet is their limitation of fruit and starchy vegetables. About half of Māori adults meet the daily recommendations for fruit and vegetables (36). Fruit and vegetables are essential sources of dietary fibre, vitamins and minerals (30). LCHF diets restrict vegetable consumption to mostly green leafy vegetables and further limit fruit to a few berries or small fruit occasionally.

Given the dietary profile of Māori, there are potential health concerns and benefits for Māori who choose to follow an LCHF diet. Firstly, Māori might misinterpret what foods are acceptable and think LCHF diets give the green light to eating all foods high in fat including takeaways and ultra-processed foods. Secondly, Māori may continue to eat amounts of saturated fats without fully committing to reducing the quantity of carbohydrates they eat and just continue to consume high amounts of fats because they think it's healthy. Both points may increase the risk of diet-related diseases. Lastly, Māori adults already struggle (16 and 21g/day for females and males respectively) (36) to reach the adequate intake (AI) for dietary fibre (25 and 30g/day for females and males respectively) (29). Systematic reviews show that
total dietary fibre intake is inversely associated to CVD and type 2 diabetes (37, 38). Diets that restrict vegetables and fruits may make it even more challenging to reach the AI for dietary fibre given that vegetables and fruits are good sources of dietary fibre (30). However, considering Māori diets are relatively high in refined carbohydrates and ultra-processed foods (i.e., white bread, sugary beverages, fast foods and processed meats) (36), the LCHF diet may be beneficial in helping to reduce intake of energy-dense foods.

2.2 Obesity

The average body mass index (BMI) for Māori adults over the age of 15 is 30 kg/m2 (39). The prevalence of obesity has risen, in the past five years the incidence of obesity for Māori increased by 3% (40). The latest national Health Survey (2015/16) reports that 47% of Māori adults are now obese (20). Furthermore, about 35% and 30% of Māori males and females respectively were overweight (36)

Low Carbohydrate (LC) diets have shown to significantly decrease body weight compared to low-fat diets in short-term studies of less than six months (41, 42). In a clinical trial, 30 obese adolescents were randomly assigned to an LC or an low fat (LF) diet group for two months. At the end of the study, the LC group had a mean weight loss of 9.9 ± 9.3 kg, and the low-fat group had a mean weight loss of 4.1 ± 4.9 kg (41). Similarly, 63 adults were randomly assigned to an LC or an LF group for 12 months. Three- and six-months follow-ups showed the LC group had greater average weight loss compared to the LF group. At three months the LC group had lost -6.8 ± 5.0 % of body weight compared to the LF group which lost -2.7 ± 3.7% of body weight (p=0.01). At six months the LC group had lost -7.0 ± 6.5% of body weight compared to the LF group which lost -3.2 ± 5.6% of body weight (p=0.02) (42).

However, control trials ranging from 12-24 months in duration, examined the effects of a low-carbohydrate diet compared with a low-fat diet on body weight in obese adults have shown no
difference in weight loss between LC and LF diets (34, 42, 43). The same clinical trial by Foster et al. showed at 12 months, difference in weight loss between the LC and LF group was not significant (-4.4 ± 6.7 vs -2.5 ± 6.3 percent of body weight, P=0.26) (42). A clinical trial of 105 overweight adults with type 2 diabetes mellitus (T2DM) examined weight differences between LC and LF diet groups. The low carb diet was modelled after the Atkins diet; the low-fat diet followed the recommendations from a diabetes prevention programme (44). At the end of 12 months, almost the same weight loss was seen in both groups (LC -3.4 kg ± 4.8 kg, LF -3.1 kg ± 5.8 kg).

Differences in weight loss between LC and LF diet groups are minimal when coupled with long-term behavioural support by allied health professionals (34). Over 300 obese adults participated in a 24-month randomised trial comparing LC and LF diets. Both groups received a comprehensive lifestyle programme. Weight loss was approximately 11 kg (11%) at one year and 7 kg (7%) at two years. There were no differences in weight and body composition at any point (3, 6, 12 or 24 months). This indicates that both LC and LF diets are equally useful for short and long-term weight loss up to 24 months when combined with behavioural support.

In summary, compared to LF diets, LC diets produce a more significant reduction in body weight in short-term of less than six months in obese subjects, but there is no evidence of a difference in weight loss between LC and LF diets at 12 and 24 months. Beyond 24 months little is known about what effect the low carbohydrate diet has on body weight.

### 2.3 Cardiovascular risk factors

The 2015/16 New Zealand Health Survey reports the prevalence of IHD, stroke and self-reported high blood pressure are 4.8%, 1.8% and 14% respectively for Māori adults (20). Additionally, 9.5% of Māori have high cholesterol. This is a 4% increase in the past decade
Similarly, a cross-sectional survey including over 1000 Māori adults sought to describe mean serum lipid concentrations in Māori and Pacific people. Results from this study show average total cholesterol (5.45 mmol/L), LDL-C (3.36 mmol/L), and triglyceride concentration (1.54mmol/L) to be higher and HDL-C (1.33mmol/L) to be lower than serum lipid reference ranges (45). Elevated blood pressure and cholesterol are major risk factors for CVD and are of concern for Māori. It is essential that dietary recommendations do not exacerbate these risk factors as this could lead to an increasing prevalence of CVD among Māori.

It is well documented and accepted that high saturated fat diets increase serum cholesterol concentrations and lead to cardiovascular problems (29, 30). However, this belief has been disputed by advocates of LC diets who argue that most studies have failed to show any association between dietary lipids and increased risk of CVD (7, 46) and that over-consumption of refined carbohydrates is the main cause of CVD (47). A clinical trial by Brinkworth et al. included 118 obese participants that were randomly assigned to either an energy-restricted (6–7 MJ) LC diet (4%, 35%, and 61% of energy as carbohydrate, protein, and fat, respectively) or an isocaloric LF diet (46%, 24%, and 30% of energy as carbohydrate, protein, and fat, respectively). Those in the LC group had greater LDL-C (0.6 ± 0.2mmol/L; 95% CI: 0.2, 1.0 mmol/L; P = 0.001) and HDL-C (0.23 ± 0.09 mmol/L; 95%CI: 0.06, 0.40 mmol/L; P = 0.018) but lower triglycerides compared to the LF group at 12 months (43). Also, mean blood pressure was lowered in both groups with no significant difference between each group.

Similarly, Bazzano et al. carried out a 12-month clinical trial on 148 obese adults (33). The LC group was limited to <40g of carbohydrates per day. The LF group restricted total fat and saturated fat to <30% and <7% of total energy respectively. There was no calorie restriction for either group. Results show the LC group had a greater decrease in triglyceride level (mean difference in change, -0.16 mmol/L; 95% CI, -0.31 to -0.01 mmol/L, P=0.038) and greater
increases in HDL-C (mean difference in change, 0.18 mmol/L 95% CI, 0.08 to 0.28 mmol/L; P= 0.001) at 12 months. Unlike the previous study by Brinkworth et al., there was no differences in LDL-C in the two diets even though at the end of 12 months, energy, carbohydrate, and fat intake was similar between the two groups of each study. This may suggest that types of carbohydrates and fats are more important than the amount. There was also no difference in blood pressure between LC and LF groups at 12 months.

A longer 24-month clinical trial of 307 obese adults by Foster et al. investigated similar effects as the previous two studies with the addition of long-term behavioural support for each group. The LC group limited carbohydrate intake (20 g/d for three months) in the form of low glycaemic index vegetables with unrestricted consumption of fat. After three months, participants in the LC group increased their carbohydrate intake (5 g/d per wk) until a stable and desired weight was achieved. The low-fat diet consisted of limited energy intake (1200 to 1800 kcal/d; <30% calories from fat). Results show the LC group had lower triglyceride at 12 months of -31.52mg/dL (-39.5 to -23.6; P=0.03) but there was no difference between diets at 24 months: -12.19mg/dL (-22.9 to -1.49; P=0.76). There was no difference between the LF and LC groups in LDL-C at 12 months (LC group: -8.66mg/dL 95% -12.7 to -4.56 and LF: group -8.57 mg/dL 95% -12.9 to -4.26; P= 0.98) and 24 months (LC group: -8.01mg/dL 95% -11.4 to -4.62 and LF: group - 4.78mg/dL 95% -9.17 to -0.39; P= 0.25). Like the previous clinical trials, HDL-C significantly increased in the LC group at all follow-up points (3, 6, 12 and 24 months) (34).

In summary clinical trials investigating the effects of LC diets compared with LF diets on CVD risk factors for at least 12 months appear to have favourable effects on HDL-C and triglycerides. However, LC diets may increase LDL-C and seem to not affect blood pressure in studies longer than 12 months.
2.4 Diabetes

Low carbohydrate diets are often recommended for people with diabetes because of studies reporting more significant improvements in glycemia, insulin sensitivity and a reduction in the use of medication for both insulin dependent diabetics and type 2 diabetics requiring medication (7, 32). However, most of these studies have small sample sizes and are of short duration. Also, the quality of the research designs varied with some having no comparison group. With obesity and CVD, diabetes is also a growing health concern for Māori. The 2015/16 New Zealand Health Survey reported the prevalence of diagnosed diabetes for Māori is 7%. This is likely to be higher considering a substantial number of New Zealand adults age 15 years and older are undiagnosed (48). A recent systematic review showed that differences in fasting blood glucose, insulin sensitivity and HbA1c were not different when comparing conventional LF diets (restricted-energy diet with less than 30% of energy from fat) with very low carbohydrate ketogenic diets (VLCKD) (total carbohydrate intake to less than 50g/day) (49). Although, short-term studies (<12 weeks) regularly show LC diets reduce HbA1c compared to LF diets. Gannon et al.(8) investigated the effect of LC diet (carbohydrate 20% of energy, fat 50% of energy) compared to control group (carbohydrate 55% of energy, fat 30% of energy) on 8 participants with untreated diabetes. After five weeks results showed that glycated haemoglobin was lower in the LC group compared to the control group (-7.6%± 0.3, and 9.8% ±- 0.5 respectively) (8). Similar results were seen in an inpatient comparison study (50) with ten obese patients with type 2 diabetes. Participants consumed their usual diets for seven days then followed a LC diet (<21g/d) for 14 days. Mean HbA1c decreased from 7.3% to 6.8%, and insulin sensitivity improved by approximately 75% (50). A larger study including 336 obese adults (102 diabetics) involved a 24-week intervention trial. Participants choose either a low-calorie diet (LCD) or a low carbohydrate ketogenic diet (LCKD). This study aimed to investigate the effects of LCKD compared with the LCD on blood glucose levels. Results showed that at the end of 24 weeks mean HbA1c levels decreased in both
groups. However, the LCKD group had a greater reduction in HbA1c compared to the LCD group ($p < 0.0001$) (51). With regards to diabetes it appears that short duration studies show that LCHF diets have a more positive effect on glycated haemoglobin compared to LF diets.

### 2.5 Perception and belief about Carbohydrates, Fats and LCHF diets

Recent studies that have assessed dietary perceptions show opposing beliefs about the health effects of excess fat and carbohydrates. Some believe carbohydrates are nutritious and good for health and fat is unhealthy and increases the risk of some chronic diseases. Conversely, others believe all sources of carbohydrates are harmful, and fat (particularly saturated fat) is beneficial for health. Because carbohydrates are of importance to people with diabetes, several of these studies have assessed the dietary and healthy eating perceptions of people’ with type 1 and 2 diabetes (52, 53). Despite low representation of indigenous or Māori participants in these quantitative studies, these studies may be of significance considering the growing number of Māori diagnosed with diabetes.

There is a growing body of international literature that suggests LCHF diets are perceived favourably. A recent study conducted in Australia using a Food Preference Questionnaire (FPQ) examined whether being able to choose a diet regimen (low-calorie low fat vs low carbohydrate) yields higher weight loss than being randomly assigned to a diet. Results of this study showed that participants’ choice of diet groups was associated with their diet preference. Out of 105 participants, 61 (58%) choose the LC group, and 44 (42%) choose the LF group. This confirms the popularity of LC diets and suggests the belief of LC diets are acceptable dietary approaches for healthy living. Furthermore, in a recent cross-sectional study of 330 adults aimed to explore the differences in dietary perceptions between those on a self-reported “LCHF diet,” “other diet,” and “no diet.” Results showed that those in the “LCHF diet” group indicated a sure belief that whole grains, sugars and refined wheat
products, and vegetable oils as harmful to health compared to the “other diet” and “no diet” groups. Furthermore, in support of LCHF diets, those in the LCHF diet group strongly believe that saturated fats were beneficial compared to the “other diet” and “no diet” groups (54).

A couple of national studies continue to show that dietary beliefs which align with current healthy eating guidelines continue to be upheld. A dietary survey was retrieved from 414 individuals, which was sought to gain an understanding of consumers’ attitudes and beliefs regarding starchy carbohydrates. Results showed that most consumers view starchy carbohydrates as nutritious and good for health. However, consumers were also mindful of the association between excess starchy carbohydrate consumption and weight gain (55). An earlier survey conducted by Wiseman et al. retrieved responses from 823 adults, of which a small percentage (6%) are Māori, showed participants believed eating less fat (91%), salt (84%), saturated fat (80%) and sugar (66%) would reduce the risk of heart disease (56). A quantitative study that investigated the dietary perceptions of adults diagnosed with pre-diabetes and type 2 diabetes found that participants’ perceptions of sugar and fat were unfavourable because of their effects on glycaemic levels and body weight respectively (53).

Other practical aspects of diets need to be considered such as whether these diets are sustainable and acceptable for families and individuals. Following a LCHF diet maybe more expensive, particularly if all household members are not on board with the new dietary changes. Furthermore, LCHF foods and meals maybe unusual and foreign, especially for families with young children. LC diets are possibly more effective in controlling glycaemic levels but may not be practical for individuals and communities to follow. Therefore, a diet that shows slower improvements in controlling glycated haemoglobin and is sustainable to follow might be a more appropriate approach to control long term blood sugar concentrations in people with diabetes.
2.6 Conclusion

Low carbohydrate diets have become a widespread phenomenon in recent years. It has attracted the attention and interest of many people. LCHF diets often claim to be a superior way of eating due to more significant and faster weight loss, improvement in most serum lipid levels, and better glycaemic control compared to conventional low-fat diets. These risk factors are of relevance for those who experience positive weight challenges and those with diabetes and CVD. Recent health surveys report that Māori have high risk of diabetes, obesity and CVD.

Healthy eating patterns can help to relieve individuals and high-risk population of diet-related diseases. Diets of Māori are high in ultra-processed foods: sugary drinks, takeaways, refined carbohydrates, and animal fats, and are low in fruits and vegetables. Thus, the LCHF dietary pattern might be an acceptable approach for Māori to address health risks by eliminating energy dense ultra-processed foods while continuing to eat foods naturally high in saturated fat. However, there are concerns that LCHF may make it more difficult for Māori to achieve the adequate intake level for dietary fibre by limiting fruit and vegetables.

There are a number of randomised control trials (RCT) that have investigated the effects of LC versus LF diets and their effects on changes in weight, glycaemic control, and CVD biomarkers. Compared to the low-fat diet, the low carbohydrate diet appears to have more positive improvements in weight changes, HDL-C, TAGs, and HbA1c, and adverse effects in LDL-C. Results are often significant at three months but then slowly progress to no significance after 24 months for most measures.

People’s perceptions of LCHF diets, fats and carbohydrates are divided. Studies investigating dietary perceptions, attitude, beliefs or understanding of carbohydrates, fats and LCHF diets mostly include European adults who are obese and are diagnosed with diabetes. Indigenous
populations including Māori are underrepresented in these studies. Furthermore, to my knowledge, there are no studies that have investigated the perception of LCHF diets in Māori communities. This is important because LCHF diets are marketed towards Māori to curb the growing prevalence of obesity and other chronic diseases. However, little is known about what perceptions Māori have about LCHF diets, carbohydrates, and fats in general. This understanding may assist nutritional experts in determining whether a LCHF diet is acceptable and suitable for Māori.
<table>
<thead>
<tr>
<th>Study (year)</th>
<th>Population (number)</th>
<th>Design/Duration (months)</th>
<th>Energy (Kcal)</th>
<th>LCHF group</th>
<th>LFHC group</th>
<th>Weight loss</th>
<th>Effect on lipids</th>
<th>Glycaemia</th>
<th>Blood pressure (BP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brinkworth et al. (2009)</td>
<td>Obese adults with at least one additional metabolic syndrome risk factor (118)</td>
<td>RCT (12)</td>
<td>Both groups restricted energy to (1400 – 1600)</td>
<td>4%, 35%, and 61% of energy as carbohydrate, protein, and fat, respectively</td>
<td>46%, 24%, and 30% of energy as carbohydrate, protein, and fat, respectively</td>
<td>ND* in weight loss @ 12 mths</td>
<td>LC ↓ TAGs, ↑HDL-C, LDL-C compared to LF</td>
<td>↓ fasting blood glucose independent of diet</td>
<td>↓ BP independent of diet</td>
</tr>
<tr>
<td>Bazzano et al. (2014)</td>
<td>Adults without clinical CVD and diabetes. (148)</td>
<td>Randomized parallel-group trial. (12)</td>
<td>ad lib</td>
<td>&lt;40 g/d</td>
<td>&lt;30% of daily energy intake from total fat and &lt;7% saturated fat</td>
<td>LC diet ↑ wt loss @ 12mths</td>
<td>LC ↓ in HDL-C ratio, TAGs LC ↑ HDL-C</td>
<td>ND in diastolic BP</td>
<td></td>
</tr>
<tr>
<td>Foster et al. (2010)</td>
<td>Obese Adults (307)</td>
<td>Randomized parallel-group trial (24)</td>
<td>LF group restricted to (1200-1800)</td>
<td>20 g/d for three mths, unlimited fat After 3mths CHO intake increase 5 g/d per wk until the desired weight</td>
<td>&lt;30% calories from fat</td>
<td>No difference @24mths</td>
<td>LC ↑ HDL-C ND in TAG and LDL-C</td>
<td>ND in diastolic BP</td>
<td></td>
</tr>
<tr>
<td>Sondkie et al. (2003)</td>
<td>Obese adolescents (30)</td>
<td>RCT (3)</td>
<td>ad lib</td>
<td>&lt;20 g of carbohydrate per day for 2 weeks, then &lt;40 g/day for 10 weeks</td>
<td>&lt;30% of energy from fat.</td>
<td>LC↑ weight loss at 3mths</td>
<td>ND in TC‡ and HDL-C LC ↑ in LDL-C</td>
<td>ND at 12 mths</td>
<td></td>
</tr>
<tr>
<td>Davis et al. (2009)</td>
<td>Type 2 diabetics (105)</td>
<td>RCT (12)</td>
<td>ad lib</td>
<td>20–25 g/day</td>
<td>Fat =25% of energy requirements</td>
<td>ND at 12 mths</td>
<td>LC ↑ HDL-C @12mths</td>
<td>ND at 12 mths</td>
<td>ND at 12 mths</td>
</tr>
<tr>
<td>Study (year)</td>
<td>Population (number)</td>
<td>Design/Duration (months)</td>
<td>Energy (Kcal)</td>
<td>LCHF group</td>
<td>LFHC group</td>
<td>Weight loss</td>
<td>Effect on lipids</td>
<td>Glycaemia</td>
<td>Blood pressure (BP)</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
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<td>------------</td>
<td>-------------</td>
<td>----------------</td>
<td>-----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Foster et al. (2003)</td>
<td>Obese adults (63)</td>
<td>RCT (12)</td>
<td>LC unrestricted fat and protein intake</td>
<td>LF = 1200-1800</td>
<td>ND at 12 mths</td>
<td>LC ↑ HDL-C, LC ↓ TAGs</td>
<td>LC↓ insulin response in an oral glucose load</td>
<td>↓ in diastolic BP in both groups</td>
<td></td>
</tr>
<tr>
<td>Gannon &amp; Nuttall (2004)</td>
<td>Obese, diabetic males (8)</td>
<td>randomised crossover (5wks)</td>
<td>ND at 5 weeks</td>
<td>LC unrestricted fat and protein intake</td>
<td>LF = 1200-1800</td>
<td>ND at 12 mths</td>
<td>LC ↑ HDL-C, LC ↓ TAGs</td>
<td>LC↓ insulin response in an oral glucose load</td>
<td>↓ in diastolic BP in both groups</td>
</tr>
<tr>
<td>Hussain et al. (2012)</td>
<td>Overweight and obese adults (363)</td>
<td>Intervention trial (6)</td>
<td>20 g/d</td>
<td>2200 Kcal</td>
<td>VLKD ↑ weight loss compared to the Low-calorie diet</td>
<td>VLKD ↓ in TAGs, TC and LDL-C</td>
<td>VLKD ↓ in HDL-C</td>
<td>LoBAG↑ ↓ fasting glucose concentration</td>
<td></td>
</tr>
<tr>
<td>Boden et al. (2005)</td>
<td>Type 2 diabetics (10)</td>
<td>Inpatient comparison of 2 diets. (3wks)</td>
<td>LC diet, mean energy intake ↓ from 3111 kcal/d to 2164 kcal/d.</td>
<td>2200 Kcal</td>
<td>VLKD ↑ weight loss compared to the Low-calorie diet</td>
<td>VLKD ↓ in TAGs, TC and LDL-C</td>
<td>VLKD ↓ in HDL-C</td>
<td>Mean HbA1c ↓ from 7.3% to 6.8%</td>
<td></td>
</tr>
</tbody>
</table>

*ND = No difference, ↓ = significant decrease, ↑= significant increase, †LoBAG = low biologically available glucose, ‡TC = Total cholesterol
3 Objective Statement

It is unknown whether the LCHF diet is considered culturally acceptable and financially feasible among the general Māori population. The objective of this research is to gain insights into how Māori adults and whānau living in Dunedin perceive low carbohydrate high-fat diets and identify the challenges and strengths of the LCHF diet for Māori in order to determine whether this approach has potential for addressing the high burden of obesity and diabetes in Māori communities.
4 Methods

4.1 Participant selection and recruitment

Following ethical review by the University of Otago Human Ethics Committee, ethics committee reference number D15/294 (Appendix A). Interviews with 18 purposefully selected Māori participants were conducted between November 2015 and February 2016. Multiple recruitment methods were used to identify a heterogeneous sample of participants. First recruitment into the study began through both authors’ informal networks (of friends and staff) from the University of Otago (UoO) and subsequent referrals. Followed by door knocking approaches in LSES communities (Kaikorai, Brockville, South Dunedin and North Dunedin) in Dunedin.

Participants were Māori males and females aged between 25-65 with various household arrangements, including parents with children spanning all life cycles residing at home to grandparents with the permanent care of grandchildren. Initially, potential participants verbally identified themselves as Māori following the researcher’s inquiry into their ethnic background. Ethnicity was confirmed after completing a participant questionnaire form before being interviewed. Existing health conditions were not an exclusion criterion as interviews posed no physical dangers for participants.

4.2 Questionnaire design

The primary supervisor provided initial input and guidance into the questioning framework. The questioning framework (Table 2) was further developed by the primary researcher (Te Morenga) and a research dietitian (Winter). This was pretested in a practice interview with a community development facilitator of the community organization Pacific Trust Otago.
(PTO). The PTO community development facilitator has extensive experience in working on health promotion and nutrition with individuals and groups from various Pacific Island communities. Based on feedback from the PTO community development facilitator the interview guide was modified to include some general questions that would help to develop interviewees’ confidence and encourage conversation that would potentially offer a more abundant source of data. Additionally, a research/clinical dietitian observed an early interview to provide feedback to improve the researchers interviewing techniques. The questioning framework was not reviewed by a consultant member of the local iwi (Ngāi Tahu)

The interview schedule included questions that not only sought to extract participants’ knowledge of carbohydrates, fats and the LCHF diet, but also delved into participants’ experiences, thoughts, and beliefs about these topics.
### Table 2: Overview of semi-structured interview protocol

<table>
<thead>
<tr>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overview- Understanding of foods</strong></td>
</tr>
<tr>
<td>Have you heard of the Low Carbohydrate High Fat diet?</td>
</tr>
<tr>
<td>What kind of foods do you think are healthy foods to eat?</td>
</tr>
<tr>
<td>What kind of foods do you think are unhealthy foods for you to eat?</td>
</tr>
<tr>
<td><strong>Importance of carbohydrates, reasons for having carbohydrates</strong></td>
</tr>
<tr>
<td>Could you explain to us what YOU think a Carbohydrate is?</td>
</tr>
<tr>
<td>Could you give examples of foods that you think are high in carbohydrates?</td>
</tr>
<tr>
<td>Could you give examples of foods you think are low in carbohydrates?</td>
</tr>
<tr>
<td>How often would you have foods that are high in carbs per week?</td>
</tr>
<tr>
<td>What high carbohydrate food would you have THE MOST in your house per week?</td>
</tr>
<tr>
<td>Why?</td>
</tr>
<tr>
<td><strong>Knowledge on fats</strong></td>
</tr>
<tr>
<td>What do YOU think High-Fat means?</td>
</tr>
<tr>
<td>What do YOU think are healthy fats and unhealthy fats?</td>
</tr>
<tr>
<td>Could you give examples of foods you think are high in HEALTHY fats?</td>
</tr>
<tr>
<td>Could you give examples of foods you think are high in UNHEALTHY fats?</td>
</tr>
<tr>
<td>How often do you have foods that are high in fats in your house per week?</td>
</tr>
<tr>
<td><strong>Thoughts on the LCHF diet</strong></td>
</tr>
<tr>
<td>Would you say carbohydrates play an important part in your diet?</td>
</tr>
<tr>
<td>What then, do you think is a Low carbohydrate AND high-fat MEAL? (that is realistic for you and your household)</td>
</tr>
<tr>
<td><strong>Willingness to try the diet/ barriers and facilitators</strong></td>
</tr>
<tr>
<td>Why? Why not?</td>
</tr>
<tr>
<td>What would you find MOST challenging about following this diet for three months?</td>
</tr>
<tr>
<td>What would make you want to try the LCHF diet?</td>
</tr>
<tr>
<td>What would motivate you to try it?</td>
</tr>
<tr>
<td>What would your family think if you started following an LCHF diet?</td>
</tr>
<tr>
<td>Do you think you could get full on this type of diet?</td>
</tr>
<tr>
<td>Would you be willing to try this diet?</td>
</tr>
</tbody>
</table>

### 4.3 Data collection

Two researchers of Māori, Cook Island and Samoan ethnicity conducted face-to-face semi-structured interviews (58) with open-ended questions to encourage participants to speak
openly about their nutritional knowledge and experiences related to the research aim, to investigate how low carbohydrate diets are perceived by members of the local Māori community and the barriers and facilitators to following a diet low in carbohydrate.

Establishing connections between the researchers and participants was the primary focus before conducting the interview. Standard procedure before all interviews was to provide participants with three forms (consent form, participant questionnaire, and information form regarding the study). Two of the three forms (consent form, participant questionnaire) were filled out and returned to the researchers. Interviews were moderate in length lasting between 25-60 minutes. These discussions stimulated reflective thoughts that were consciousness-raising towards habitual food purchases, meal preparations, and eating practices. Interviews were held in a setting of the participant’s choice such as their work place, office, or own home (indoors or outdoors).

An interview guide was used to direct each interview. But the way the meeting unfolded was typical of semi-structured interviews (58, 59) in that they were flexible and allowed discussion of other emerging issues that participants felt were relevant. For example, some questions lead participants to talk about preparing foods and eating on the marae although none of the questions were directed towards this topic.

Qualitative studies require a few purposefully selected participants to provide information-rich cases (60). Recruitment and interviews ceased after the 18th participant; the primary researcher and supervisor felt that by the 18th participant, answers towards understanding what Māori perceptions and beliefs of the LCHF diet are and what are the barriers and facilities to following this diet began to be repetitive and no new information was being told.
4.4 Data analysis

The Interviewer is of Māori and Samoan descent and was able to relate to the interviewees in several occasions culturally. Married to a woman with type 1 diabetes and father to five young children issues such as budget and whānau importance were some aspects the interviewer was able to associate well with. Interviews were transcribed verbatim from digital audio recordings. To ensure the accuracy of transcriptions, each transcript was checked by the author against audio recordings. Data were thematically analysed into themes and sub-themes using the inductive approach (61) by the primary researcher. The establishment of themes and sub-themes evolved through a process that included communication and discussion with supervisors to ensure that research data was accurately analysed. The inductive approach is a qualitative method where research data is analysed to identify repetitive codes that create sub-themes and themes. The transcriptions were coded using both Nvivo (a software qualitative data analysis tool) and a rigorous process that included reading, re-reading, identifying segments (using different coloured highlighter pens and sticky notes) and categorising identified segments under sub-themes. The long table approach was used to frame the detected data into a structural framework. Pseudonyms were used for all participants to preserve anonymity as agreed to in participants signed consent forms (Appendix C)
5 Results

All 18 participants (13 females and 5 males) completed a face-to-face interview at the participant home or a place of convenience. Participants were between the ages of 36-55 years and lived in households with 3-4 other people. The majority of participants were employed and 66% of participants reported having no significant medical conditions. Although most participants identified themselves as the key kitchen person (primarily responsible for planning, preparing, and cooking household meals), the shopping was mostly a shared responsibility with another adult household member. Participant baseline and demographic characteristics are shown in Table 3 and Table 4. Participants have been given pseudonyms to protect their anonymity.
Table 3: Baseline Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 - 25</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>26 - 35</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>36 - 45</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>46 - 55</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>56+</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>13</td>
<td>72</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Number of people in household</td>
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<td></td>
</tr>
<tr>
<td>1 - 2</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>3 - 4</td>
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<tr>
<td>5 - 6</td>
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<td>11</td>
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<tr>
<td>Key Kitchen Person (KKP)</td>
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<tr>
<td>Participant</td>
<td>8</td>
<td>44</td>
</tr>
<tr>
<td>Not participant</td>
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<td>33</td>
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<tr>
<td>Shared</td>
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<td>22</td>
</tr>
<tr>
<td>Person responsible for shopping in household</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant</td>
<td>6</td>
<td>33</td>
</tr>
<tr>
<td>Not participant</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>Shared</td>
<td>8</td>
<td>44</td>
</tr>
<tr>
<td>Person in household with significant medical conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>67</td>
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<tr>
<td>No answer</td>
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<tr>
<td>Previously seen a dietitian</td>
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<tr>
<td>Yes</td>
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<tr>
<td>No</td>
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<td>No answer</td>
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<tr>
<td>Employment status</td>
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<tr>
<td>Unemployed</td>
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<td>15</td>
</tr>
<tr>
<td>Tertiary Student*</td>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>

*two tertiary students were also working part-time jobs
Table 4: Participants demographic characteristics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age Range (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Terina</td>
<td>F</td>
</tr>
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All 18 participants were open and cooperative in their interviews that sought their knowledge, beliefs, and experiences with food, notably two of the three macronutrients, fats, and carbohydrates. Five major themes emerged from the analysis: (1) Māori are motivated to live healthy lives; (2) inconsistent and opposing views of fats; (3) starchy carbohydrates are difficult to live without; (4) natural traditional foods are best; and (5) fad diets are not family friendly.
5.1 Māori: Motivated to live healthily

Participants were not explicitly asked about their motivation to living healthy during the interview. However, most participants naturally linked their motives for eating healthy and desires for self-reliance to questions that inquired about their willingness to try the LCHF diet and their ability to sustain an LCHF diet for at least three months. The primary motivators to living healthy lives are culture, fear of developing chronic diseases, reducing body weight, and family posterity.

5.1.1 Culture

Early death was recognised as having negative consequences for maintaining Māori culture and customs. Participants expressed concerns about the ability of the younger generation to take on the responsibility of sitting on the paepae or doing the whaikōrero (making a formal speech) without living kaumātua to guide them and one participant observed that marae and health promoters should be recognising this threat and helping to promote healthier eating:

So what they should push is eating for your mokopuna (grandchildren), what would your marae look like if it didn’t have those types of food and it wasn’t killing us and if you didn’t have gout if you were healthy what could you achieve.

So I think they need to come in at health promotion in that way in, a more compassionate way. (Terina - female)

5.1.2 Body weight

Body weight measures were not necessary for this qualitative study and therefore not included on the participant's questionnaire form. Many participants talked about patterns of dieting attempts, but that none directly mentioned weight loss, a common motivation for dieting, and that this, in turn raises a possibility of sensitivity of body weight.
5.1.3  Fear of sickness/disease and death

The link between diets and health was well understood, and experiences with serious illness and early death within whānau were a significant motivator for participants to lead healthier lifestyles and to improve their diets.

*I know I need to get my diabetes under control. I know I need to start looking after my health as well....... A lot of the things my mother got when she was my age I’m getting and I don’t want that....... So I know I have to make changes in terms of my health to make sure that I am still around. My mum drank a bottle of coke, 1.5 litres every day and it was normal, so she drank a lot of sugar. So she got diabetes around my age she had lots of other health problems as well. I'm trying to make sure that I don't follow the same track. That's kind of my motivation to make sure that I look after myself.* (Hera – female)

Participants were well aware that Māori suffer from chronic diseases and death at a younger age. Several participants reported family members dying at the age of 50 due to diet-related diseases.

*You just see in particular Māori and PIs and think oh my gosh, in my island side, like they are big and they die young. Like in their 50s and die from like heart disease and diabetes. Just so yeah, diet is huge.* (Irina – female)

5.1.4  Future posterity

Participants were also well aware of the link between excess body weight and risk of disease and early death and saw losing weight as important for both their health but also the wellbeing of their whānau:
As I've gotten older I want to make good choices, how is my life going to look in the next 20 – 40 years if I'm lucky. I want to have a healthy kaumātua stage. I want to be able to still run with my mokopuna and great grand mokopuna, and if I don't change that and implement good health practices, I want my mokopuna to have my “ism.” The way I can ensure that is to have a good diet be active at this moment limited with budget, limited with knowledge. (Aroha - female)

5.2 Challenges of dietary fat

5.2.1 Fat is tasty

Some participants like the taste of fat from chicken skin and the fat layer on cuts of meat were often considered one of the most delicious parts of a meal: “yep, that's my favourite part... because it is the tastiest part”. As a result of the palatable taste properties of fat, some participants said they found it difficult to follow advice of health professionals to reduce saturated fat intake by removing fatty parts of the meat and chicken. There appears to be a definite disconnect between healthy eating knowledge and eating behaviour amongst most participants. These participants show that knowing healthy eating principles rarely translates into healthy eating behaviours:

I know eating fat on the steak is not good. Even though I love my fat, If there is a lot of fat on it I do tend to cut it off. I have been told that skin on the chicken is not that good. Again, I love my skin, so I do tend to eat it. (Raiana - female)

Furthermore, older participants were more likely to leave fat on meat and skin on chicken because of its desirable taste properties compared to younger participants. This indicates that there is possibly a generational change in preference toward animal fats.
... like mum and them like to leave the fat on the meat because it's yum, but I think it is gross I don't like it's too chewy. But I think it's more like an older generation thing where as my generation we don't mind eating in a better way, but if there aren't any options and everyone around you is eating high-fat foods, it is going to drive you to do it too. So, it's got to be a collective effort for anything that you do.

(Terina - female)

Participants with chronic illness or older participants who visit health professionals regularly were aware of health messages that encourage reducing saturated fat. These participants identified saturated fat as unhealthy and knew to avoid solid animal fats like dripping and fatty cuts of meat. They also had good knowledge of food preparation methods that reduce saturated fat content of meals:

You shouldn’t be cooking in fat like dripping; some oils are not good. I don't know what oils are good or bad. You should cut fat off meat and skin on chicken. (Ria – female)

....... even with having the chicken you don’t eat the skin because that is where most of the fat is. Chicken is quite lean, or else if you’ve got chicken pieces once it is thawed out you cut off the fat or keep the skin on and take it off before you eat it. (Anahera – female)

Conversely, participants that were younger and not affected by chronic illness demonstrated awareness of current healthy eating guidelines to reduce foods high in saturated fat. However, they seem to be more accepting of messages that promoted diets high in saturated fats, mainly from non-meat sources like coconut oils, butter, and whole milk.

I’ve come around to thinking that high fats are what we need to do for Māori and Pacific Islanders, I think that they’re on to something when they talk about high
fats I do think they are good for you in a way that I’ve never thought before.

(Terina - female)

5.2.2 Diverse beliefs and views of fats

Knowledge and belief of the functions, sources, and effects of some fats varied considerably among participants. In harmony with current nutrition recommendations, most participants said some high-fat foods such as full cream, whole milk, animal fats, processed meats, biscuits, butter, chips, and takeaways are unhealthy and associated diets high in saturated fat with increased risk of CVD.

Fats you need to be careful with what you eat fat affects your heart. So, I’m very careful with what I eat. I make sure I have no fatty foods. (Raiana – female)

Initially what comes to mind is dietary fat, when you hear the word fat, it’s not good ...... But umm yea dietary fat, I just think of things that clog your arteries, and they're no good for you. That's what comes to my mind. (Mere – female)

However, amid participants’ current knowledge of fat, there were scatterings of unusual beliefs. Among the standard sources of fats, such as meat, nuts, and dairy products, fruit was also reported as a high source of fat. There was also inaccurate knowledge about what sources of high-fat foods cause heart disease. One participant said eating large quantities of nuts leads to atherosclerosis. Participants were mostly aware that there were “good fats” and “bad fats” however, a majority of those were unsure about which sources of high-fat products were “good” or “bad.” In addition to the two common categories of fat, another class of fats, termed ‘bearable fats,’ elicited inaccurate and vague beliefs about the physiological function of fat. A participant who is supportive of ancestral eating said eating fat from some fowls can
assist in the digestion of “stuff”. A significant amount of inaccurate information regarding fat exists among Māori:

_We eat titi (mutton-bird). It’s a real delicacy actually, but that's got good fat in it._

_So, there are certain birds so like duck fat which is actually good for you, and I suppose what else you're eating with it. Regarding the good fats, it helps break down stuff I think._ (Irina - female)

Few participants reported receiving nutritional information from a nutritionist or dietitian. Conversely, most participants said they receive nutritional information from other people (family members and friends). Other common sources are television and radio programmes, social media advertisements, internet articles, columns, and blogs.

_People, people who have been on the diet and they'll say oh you should try this or you will see on facebook, and they'll have those little ads of whatever it is, and they have like lose weight fast, or you'll see people and like they’ll say this is my before and my after. But its other people who have either been on it themselves or they've heard of, and they've said, “hey let’s give this a go.” That’s where I would have heard about the diet. Definitely wouldn’t find me reading about it._ (Mere - female)

Surprisingly, with the plethora of sources and the ease of access to nutritional information, most participants called for more information to be available and accessible for whānau following their difficulty to differentiate between healthy and unhealthy fats and foods.

_we don’t have the education around what’s good food and what’s bad, cause we’ve just collapsed it all into one…..We do lack the education around what is good and what is bad and what’s been proven to be good for us. But if we know that, then we can definitely do that._ (Terina - female)
5.3 Starchy carbohydrates are difficult to live without

5.3.1 Cheap, and filling

Starchy carbohydrates are a vital component of participants diets. Participants identified that starchy carbohydrates are cheap, filling and often reported them as foods they have grown up with.

Well bread is cheap, and it's affordable, and if you eat bread with your meal, you're full. (Oriwia - female)

In addition to bread, participants reported other starchy carbohydrates are also common fillers used to provide satiety.

I like rice, I see it as a cheap filler, bread is a cheap filler for big whānau……. Potatoes were always used to make you full. Bread, potatoes, was always used to make you full. If there wasn't enough to make you full there were bread and potatoes to make you full to take away the hunger, to fill the hunger. In my view, rice would be the same equivalent as the cheapest, easiest way to cook. (Aroha - female)

Participants were mostly concerned with avoiding feelings of hunger. Providing highly refined processed foods and starchy carbohydrates such as potatoes, pasta, rice, and bread ensured participants that family members were left feeling satiated following evening meals.

5.3.2 Carbohydrates are habitually used to provide variety

Participants who are the key kitchen persons in the home explain why starchy carbohydrates feature in their dinner meals. Preparing and including different types of starchy carbohydrates
(mainly potatoes, pasta, rice, and bread) over the week for evening meals creates interest, provides variety, and prevents menu boredom among family members.

*with our evening meals one night we would have rice, another night we will have mash potatoes the next night we will have pasta. We try and mix it up.* (Raiana - female)

*The main meals in the evening are always fish, red meat, or chicken. Then we will mix that with either mash potatoes, pasta or rice.* (Hohepa – male)

Starchy carbohydrates are habitually paired with certain meals making it difficult for participants to replace or omit. Participants are used to the way these carbohydrates complement their meals.

*Potatoes just go with anything, goes with curry, stews, soups or roast. Just goes with anything that’s probably why we have potatoes.* (Kaharau - male)

This habitual combination of starchy carbohydrates with meat-based dishes during meals reflects the sorts of diets participants grew up with:

*....do you realise that growing up I always had my dinners with bread and then I went over to a pakehas friend’s house, they didn’t eat bread. I didn’t know our diets were so high in carbs.* (Terina - female)

### 5.3.3 Starchy carbs: Staple part of traditional and current diets

Older participants that grew up eating starchy carbohydrates were dubious about following a diet void of starchy carbohydrates.
there's no substitute for potatoes if you don't have potatoes then what do you eat?

……our household are potato eaters we all eat potatoes, that diet won't live with us .... we’ve eaten potatoes all our lives. (Ria - female)

Not only was eating starchy carbohydrates a way of life for older participants but so too was planting and harvesting starchy carbohydrates.

Because I was brought up with that (Potatoes). I couldn’t go without potatoes.
That's just the way I was brought up when I was a kid. We grew up with a big garden, and we had potatoes in the garden, and we went to the garden, and we got potatoes. (Huia – female)

Participants that grow a domestic vegetable garden continue to include starchy carbohydrates along with leafy greens.

But the carbs we will eat are, like corn, potatoes, and kūmara. Cause I grow a garden, so the garden is big for us. And eating organic. And trying to grow organic and eat lots out of the garden. (Irina - female)

Although younger participants were more accepting of dieting fads such as restrictive carbohydrate diets, they had found it challenging to adhere long term to these dieting fads.

because I'm used to potatoes and those sort of things........ That was hard, and it was only like two weeks without having potatoes, and that was hard. It's a big difference; it's like something was missing from off your plate. It's like bread and butter. (Irina - female)
The apparent omnipresence of starchy carbohydrates is also a challenge for adherence to diets that restrict carbohydrates such as Paleo or Low-Carb diets, especially during organised Māori events or hui.

*Potatoes are the most addictive carbs because when you go out to eat they always serve potatoes with the veges or salad and fries, it’s hard to get away from carbs sometimes.* (Hera - female)

*We're always on wānanga, ...... and there was always potatoes, there was mash potatoes, roast potatoes, new potatoes, and butter. So, there was always potatoes being served, I know you can opt out of eating it there’s not much else you can do. Like there are potatoes and bread at the table, and when you’re hungry, you just grab it.* (Hera - female)

Diets promoting extreme restriction of all forms of carbohydrates seem to be unacceptable for older Māori participants because potatoes, pumpkin, and kūmara are central food items that have been a part of their diet for many years, although LC diets appealed more to younger Māori participants. However, extreme carbohydrate restriction was unsustainable for an extended period because of the ubiquitous nature of potatoes and craving sensations felt from excluding potatoes from their diet after at least a few weeks.

5.4 Natural traditional foods are best

5.4.1 Processed foods

It is widely accepted by participants that processed foods are unhealthy regardless of food processing purposes. There is a heightened sense of caution surrounding foods that have been altered from their natural state.
Participants demonstrated a good knowledge of ultra-processed foods and drinks (UPFD) and their adverse effects on health. Sweet sugary beverages (SSB) biscuits, chips sausages, chicken nuggets, prepared foods including takeaways, refined grains such as white rice, pasta, and bread were commonly identified as less healthy options. Furthermore, they recognised that overconsumption of UPFD can lead to obesity, diabetes, CVD, and other adverse health outcomes. However, sometimes participants expressed views on processed foods that were incorrect. Their incorrect opinions were often linked to ideas that all processed foods, including minimally processed foods, are unhealthy. For example, one participant thought oats should be avoided because they are processed.

_We try to stay away from the processed stuff. But then like oats and stuff, and muesli. They reckon that’s good for you. But its processed. And paleo is to get away from processed._ (Irina - female)

Additionally, among the most common processed foods thought of to be unhealthy are those that have been modified through processing methods that are used to preserve foods, and improve nutritional quality, through enrichment fortification and genetic modification.

_Unhealthy foods are foods high in chemicals that I can’t pronounce that don’t have anything natural, things that are GMO I think are not very healthy you know that has been genetically modified._ (Aroha - female)

_So I think it could be because of the era I come from. It’s different you have a wider choice of things, and everything is processed, and processed foods can’t be good for you because they just can’t be. I don’t think they are._ (Anahera - female)

Processed foods do not align with participants’ beliefs about eating as their ancestors ate. It appears that messages claiming benefits of eating like our ancestors (i.e., paleo diets)
currently prevalent in the popular press are creating confusion. Participants also very much value the convenience and cost-effectiveness of processed foods.

5.4.2 Natural foods are prioritised over saturated fat

There is consensus amongst participants that saturated fat is unhealthy. However, when choosing between natural foods that are high in saturated fat or alternative processed options that are low in fat, the former choice is preferred because it has undergone less processing and is, therefore, closer to its natural state. This point is frequently illustrated when participants compare butter versus margarine and skim milk versus whole milk.

*Fat is not good, with margarine you can get low-fat margarine but because it's not natural as butter I would prefer to use butter...... I know that saturated fats aren't good.* (Kararina - female)

*Yeah we’ve kind of had a thing with animal fats. Well if you’re going to have the fat, you may as well have butter. Cause it's real. Whereas you get stuff like margarine and that and it's been processed. So, I’ve been trying to buy butter, and use butter.* (Irina - female)

Participants’ preference for natural foods is also determined by sensory properties, particularly that of taste and sight. The appearance and taste of low saturated fat dairy products and spreads such as margarine deter participants as an increasing degree of suspicion hangs over whether natural sources of foods should be modified by food processing methods.

*I generally only use real butter because I hate the taste of margarine. I think it is all bad because I don't think there's anything good about margarine. Some margarine is almost fluorescent in colour, and that makes me wonder if I even should be eating it.* (Oriwia – female)
Look at what they put on their toast it’s just as bad its colourated. Coloured and I do look at preservatives. (Huia – female)

Despite long-standing recommendations to choose foods low in saturated fat, it appears that contradicting nutritional messages promoting saturated fat from natural sources as healthy are being heard and are resonating with Māori participants. Health conscience participants confidently stated that natural foods high in saturated fat such as whole milk, butter, fatty meats, and coconut oil are healthy. Additionally, participants expressed views that nutrient-rich foods are proportional to its degree of naturalness. For example, butter and whole milk are less processed and therefore must be healthier than margarine and skim milk respectively.

Because butter is good (laughter). It's interesting because they say, society says that butter is not good for you, but I believe that if you eat foods that are closest to its natural state surely, there must be more goodness in it then for likes of margarine which is manmade if you know what I mean. (Anahera - female)

5.4.3  Paleo is popular among Māori

The paleo diet was often brought up by participants when asked about the LCHF diet. This indicates that the paleo diet is synonymous with the LCHF diet among participants.

Additionally, foods that were understood to be part of the paleo and LCHF diet were fatty cuts of meat, poultry, fish, butter, whole milk, full-fat yogurt, green leafy vegetables, nuts, seeds, limited fruits, and dhal. However, lentils (dhal) is not acceptable on paleo and LCHF diets, and high-fat dairy products are acceptable on LCHF diets but not paleo diets.

Participants are more inclined to try the paleo diet if family members and friends had recommended it’, particularly if notable physical changes such as weight loss were evident.

The paleo diet appeared to be popular with female participants that were overweight. These participants said they had tried the paleo diet before succumbing to barriers such as winter.
comfort foods, emotional eating, time constraints that make preparing daily meals complicated, and high food prices of paleo diet type foods.

5.4.4 Diet of our tīpuna

Several participants described their attempts to align their diets with that of their ancestor’s pre-colonisation diets, sometimes referred to as “Tīpuna kai.” These participants felt that by avoiding processed foods and following a diet comparable to that of their ancestors it would lead them to a healthy Mauri (life force).

> I believe the way foods are grown and treated effects my mauri. If I ate a chicken or eggs of a chicken that was trapped in a cage all its life, what type of mauri do you think that chicken would have? What effect would that have on my mauri? (Aroha – female)

The types of foods these participants associated with their ancestors diets included kūmara, various fish and shellfish such as snapper, blue cod, cockles, muscles, pāua (abalone) and kina (sea urchin) but also red meat, chicken, pork and potatoes:

> We also try to do a lot of hunting and gathering. (my husband) Goes hunting. He works for a venison company. So that’s good protein. Umm pig. We got a mate that gets pig now and again, but we don’t have any at the moment. Umm kai moana so umm fish. Blue cod and kai moana like cockels. Yeah, we try to tap into the tīpuna kai (the kai that our tīpuna ate) that’s what our kind of aim is. yeah to get away from all the preservatives and just try and stick to what our tīpuna used to eat because we know that that’s what’s good for us. (Irina – female)
Despite the desire to eat foods that are viewed as being part of a traditional diet, participants are aware of the practical and environmental challenges that prevent Māori from eating foods similar to what their āpūnaha ate:

...we want to maintain a healthy lifestyle. Cause we want to maintain for us what our āpūnaha ate. So here pollution is a big thing. We can't eat the food, which our āpūnaha used to eat. You used to be able to hunt and gather in like the forest. But now the forest has been cut down. You can't do that anymore. Birdlife used to be huge, but you can't eat the kererū anymore. Yeah all those birds, it's all because of habitat loss. So that’s a challenge, going back to our old way of kai, but you can’t do it anymore. (Irina - female)

Ancestral diets are frequently described as being high fat, high protein and low in carbohydrates. At first, most participants, mainly those familiar with LCHF diets, believe that their ancestors had diets that were high in protein and natural fat derived from animal sources. However, upon further reflection, they also think that starchy carbohydrates such as kūmara and potatoes were a central part of their diet as well.

5.5 Fad diets are not family friendly

5.5.1 Feeding children can be tricky

Participants felt great responsibility to feed their children well but found it challenging because their children are fussy eaters. Because of this, participants with dependent children faced opposition when providing their children with whole foods.

It’s harder for my children because they don’t understand that wholemeal pasta is healthier. But it doesn’t taste as good to them as the white pasta which they are used to. (Kararina – female)
Participants who are parents found responsibility for their children's health motivates them to provide foods they believe are healthy. Mothers of dependent children in this study were the primary decision makers for purchasing foods and the key kitchen person for preparing meals. They feel they have an important role in providing their children with adequate nutrients for growth and development. Parents worried about adopting extreme dietary beliefs and the possibility that fad diets may cause unnecessary avoidance of foods and subsequently lead to some nutrient deficiencies among children. Mothers of young children are however influenced by some fad diets marketing rapid weight loss, which may not be palatable or necessary for young children. Children’s priorities for eating coupled with their lack of understanding of parental food choices makes it difficult for children to comply with parents’ healthy eating beliefs.

It’s hard for the kids because they think I'm mean, they take their lunch box with a chicken wrap, with vegetables and they have 3 or 4 types of fruit and veges ......., but I'm responsible for their health. (Kararina – female).

Participants described a link between toddler’s energy needs for growth and carbohydrate requirements. They viewed carbohydrates as an important source of energy for toddlers, which caused uncertainty about whether a restricted carbohydrate diet is best for the entire family.

It probably wouldn't suit our family. My son loves it (bread), and he's only two. I can't go cutting things out of his diet because he's running around all day. And he can eat whatever he likes pretty much. Because it's not going to anything to him, he's not going to put on weight or anything. And my partner, I don't think he would go for it. (Maia - female)
5.5.2 The effect of budget on food

Most participants acknowledged that their household income influences their ability to eat whole foods.

*One thing I must point out is that if you are rich as in, not in wealthy rich but with sufficient finances you will eat well and if you are not you will not eat well. I think in this day and age, what you eat really depends on what you can afford. So if you cannot afford the good stuff, you will end up eating a lot of carbs, because it is cheap and it goes a lot further.* (Anahera – female)

Ensuring family members received a well-balanced diet was not always a priority. For some participants, purchasing decisions were made to avoid family members from going hungry and to ensure there was enough food to last throughout the week. For low-income families, this is often done by bulk buying relatively cheap highly refined, carbohydrate foods such as white rice, pasta, bread, and noodles. Additionally, potatoes were often used as a meal filler by participants.

*It's what you can afford when you are in a low socioeconomic group. It's what you can afford to put on the table, so the people don't starve. Even though they know it's unhealthy they still eat it, because it's what they can afford. So I think a lot of it is governed by financial status.* (Hone – Male)

*So, if you want quantity you have to buy cheap the fillers to spread you across the rest of the week. It's always around budget; it's never around what I like it's always been around budget. You buy what you can.* (Aroha - female)
5.5.3 LCHF diet and anticipated challenges

There were some positive outcomes associated with similar variations of LCHF diets by participants who had tried the Paleo diet previously but were no longer doing it (at time of interview). However, these participants also identified several challenges. In general, participants commented that the paleo diet “worked very well.” However, they were not specific as to what exactly worked very well. As weight loss was the primary goal for these participants, it was assumed that participants were referring to the effect the Paleo diet had on weight loss.

For those participants who were not familiar with the LCHF diet, the interviewer spent some time explaining what foods are allowed and not allowed on this diet. These participants immediately recognised potential challenges that would make it difficult for them and their family members to adhere to the diet regime. The inherent difficulties that were anticipated by these participants were supported by those that had tried the Paleo diet. These challenges included insufficient information about LCHF diet guidelines, limited understanding of what foods are low in carbohydrates and high in fat, lack of time to plan and prepare meals, being unable to afford lots of whole foods, increased feeling of hunger, and being concerned for their children’s ability to accept LCHF foods.

*Feeling hungry and sometimes I struggle for ideas. I don't have much colour and skill, and I don't put a lot of effort and love into it, but yeah, I need ideas.* (Oriwia - female)

*a challenge would be not truly understanding what it is, not knowing what foods are high carb, low carb, and high fat or low fat. If I didn't understand that, then that would be a challenge...the challenge would understand what the diet is.* (Mere - female)
Few participants seem to have a good grasp of Paleo diets and could probably eat quite healthily on a Paleo diet if they could afford it, the concept of the LCHF diet is quite confusing, and this possibly reflects the way the LCHF diet has been presented in the popular press. It used to be all about eating as much bacon, butter, and cream as you like, and it seems that participants have linked LCHF foods with unhealthy foods in general. One participant described what she thought an LCHF diet would look like.

Rubbish, a lot of process foods umm yeah like takeaways and unhealthy oils and ahhh meat loaded with the fat on it ... low carbs.....I keep on thinking of takeaways......Because that would be loaded with fat, like unhealthy fat the way that they have been cooked. With very small nutritional value. Or you might have a carrot or broccoli, but it would be doused in like cheese sauce or something. Something potentially good for you but mixed with stuff that is not so good for you. Sauces could be one, lots of sugar, salt. A lot of rice, pasta, bread, potatoes yea fatty meat, process foods that the sort of foods I think would be on your plate.

(Mere - female)

The lack of accurate information and education especially on fad diets can lead many to dietary behaviours that are dangerous regardless of educational background. A experienced medical professional currently undertaking tertiary studies towards becoming a doctor included energy-dense foods from highly refined carbohydrates like sugar and high saturated fatty foods as acceptable LCHF type foods. Adding to the confusion, LCHF diets can be misinterpreted because fat has different meanings, and is used as both an alternative noun for lipids and as an adjective.

When I think of high fat, I either think a lot of sugar or umm bad fats. You know you have good fats and bad fats and so a lot of bad fats. (Huia - female)
Most participants were initially open-minded to trying the LCHF diet. The idea of eating fresh whole foods and reducing packaged or processed foods appealed to most participants’ food preferences. However, most participants realised that purchasing whole foods (eggs, fish, meat, nuts & seeds, green leafy vegetables) compatible with the LCHF diet would be challenging under their current financial circumstances and challenging to sustain over an extended period.

Eating a healthy diet is often not the most pressing priority for Māori. One participant was adamant that following the LCHF diet or any diet would not be appropriate for him in his current circumstances that include struggling each day to overcome drug addictions.

(Anaru – male)

(shakes head) I've got too many things on I'm trying to stop already, like I get up, “don't drink” (repeats three times) and don't look for drugs, don't ring your mates, don't do this. These are the things that go through my head when I wake up and then I do my girl’s hair, I put the cartoons on for her, I go and make her rice bubbles, I come back to bed and sit down to have my coffee.... I take her to school, go to the chemist, get my methadone and go home. If I tried to do this (LCHF diet) it would be too much because I smoke as well, I'm a smoker. I'm just doing too much; I tell you what if I gave a few things up I could have a go at it.
6 Discussion

Prior to conducting this research it was uncertain whether the LCHF diet would be considered culturally acceptable and financially feasible among the general Māori population. My research found that nutritional beliefs and behaviours among Māori is a complicated issue that makes the promotion of LCHF diets risky. Views and knowledge on the health benefits of fats and carbohydrates are conflicting. While traditional beliefs that saturated fat is unhealthy continues to prevail in the general Māori population, one of the main findings from this study is that younger Māori participants’ belief was that saturated fat is beneficial for physical health. Views about processed foods being a significant contributor to poor health among Māori negatively influences participants’ beliefs about carbohydrates and shifts them towards pro-fat beliefs and diets like the LCHF diet.

A major theme of my results show that Māori want to live healthy lives and are motivated to making healthier decisions. This may lead to Māori being more vulnerable to nutritional messages and diets that proclaim rapid health benefits, particularly that of fast weight loss. Nutritional advice that encourages extreme dietary behaviours which are unrealistic and therefore not sustainable (62) can lead to adverse future health outcomes for example, CVD, osteoporosis, kidney problems and rebound weight gain (63, 64), thus adversely impacting Māori health. Therefore, it is essential that nutritional messages are both scientifically robust and culturally acceptable and appropriate (18) if they are to provide any significant long-term health benefit for Māori.

The strength of this study is the sampled population. This study had a greater number of participants then usually found in qualitative studies. Also, the sampled population included Māori with diverse backgrounds (age, gender, level of education, household and family situation). This allowed for a holistic understanding of what Māori perceptions are of LCHF
diets. Another strength is the thorough analysis of transcribed and coded transcripts for repeated themes. This study also has some limitations. The researcher failed to remain in contact with participants following the initial interview to check the accuracy of transcripts. Also, no contact was made with participants post interview to confirm interpretation of research data. Another limitation of this study was the lag time (10 – 12 months) between when the interviews were conducted and the commencement of the thematic analysis. Also, this research was confined to the geographical area of Dunedin (Ngāi Tahu). Future research could include multiple prominent iwi locations (e.g Tainui, Ngapuhi, Ngāti Porou) around Aotearoa to see if the perceptions of LCHF diets among Māori whānau are similar or different between various iwi locations.

6.1 Māori, mixed messages, and media

In recent years, there has been a paradigm shift towards the belief that saturated fat is good (65, 66). This has led to an accelerated global increase in consumption of saturated fat since early 1960s. Furthermore, fat consumption is expected to grow from 26% of total energy to 31% in 2030 (67). Presently, there are numerous sources (websites, books, magazines, newspapers, personal communications, social media, television advertisement, and programmes) that are normalising and encouraging liberal intake of saturated fat (5, 6, 16, 17, 65). My research suggests that such messages are attracting the attention of Māori. It is possible that one reason why these messages are accepted is that it justifies their natural preferences for food high in saturated fat like whole milk, butter, cheese, and animal fat (such as skin on chicken or the fatty strips on meat). Also, it appears that arguments in popular media press between fats and carbohydrates are interpreted by many Māori that only one of the macronutrients can be healthy and the other by default is unhealthy.
Participants in my study said they received nutritional information from multiple sources, many of which lack scientific credibility. These sources included social media channels, television programmes, and individual experiences of family members and friends. These nutritional messages have a significant influence on people’s willingness to try new diets in search of hopeful solutions to improve their health or the health of family members (68). However, mixed media messages may lead to dietary practices that hinder instead of supporting healthy living. My research suggests that Māori are overwhelmed by the contradicting nutritional messages that they regularly face. Therefore, a more visible presence of authorised dietary agencies (i.e., Dietitians NZ) in the media would be beneficial to promote healthy eating. Further studies are required to investigate how priority groups (usually indigenous ethnic groups, low levels of formal education, unemployed, low socio-economic status communities) can counteract harmful social media diet messages.

6.2 Main drivers of LCHF perceptions.

In this study participants believe processed foods are responsible for diet-related disease prevalent among Māori. Ultra-processed foods were referred to by participants as being harmful, nasty, dangerous, addictive, and the leading cause of poor health. It is well known that high consumption of ultra-processed foods is associated with adverse health outcomes such as increased body weight and increased risk of heart disease (69, 70). Ultra-processed foods have a higher proportion of refined carbohydrates, free sugars, total and saturated fats, energy density, and are nutrient poor (71). Therefore, diets taking a hard stance against processed food such as the LCHF diets were viewed positively because they emphasize unprocessed, whole and organic foods. Sometimes even fresh fruit, vegetables, eggs, and meat were questioned if they were not organic. There are, however, a wide range of processed foods (frozen vegetables, canned fruit, milk powder, legumes, wholegrain breads) that are nutritious, affordable, and free from microbial contamination found on spoiled unprocessed
food (dairy products, red meat, poultry and fish) that would be beneficial for physical health and wellbeing (72, 73).

Participants' views of saturated fats and whether they are healthy or not are determined by the food source. Although LCHF diets can be high in saturated fats, Māori participants did not see this as a problem because LCHF diets recommend minimally processed foods and therefore believe that the saturated fats consumed in an LCHF diet are healthy. This study showed that participants viewed natural foods high in saturated fat such as fatty cuts of meat, coconut oil, whole milk, cream and butter as healthy. Our findings correspond with a cross-sectional study of 330 participants that investigated food characteristic choice, motivations, health perceptions and behaviours between those on self-reported “LCHF diet,” “other diet,” and “no diet” results showed participants in the self-reported LCHF diet group perceived all fat types, including animal fat, to be beneficial. Furthermore, self-reported LCHF diet group was more motivated to eat butter, cream beef, pork, and chicken than “other dieter” or “no diet” groups (54).

Finally, negative views of processed foods stems from a Māori desire to return to dietary patterns similar to their ancestors which did not include processed foods found nowadays. This study's findings suggest that Māori are taking an interest in messages encouraging them to eat real, natural, whole foods. This follows the opinions of other ancestral diet proponents encouraging Māori to emulate consumption of traditional foods (14).

Food sources of pre-colonised Māori iwi differed across the country depending on the natural edible resources that were available for the local iwi (74). Although it is unclear precisely what pre-colonised Māori ate all year round, early settlers recorded that uncultivated bracken fern (*Pteridium esculentum*) or “fern root,” kūmara (*ipomoea batatas*) and fish (including shellfish) were stapled foods in most districts (74, 75). Other commonly eaten cultivated root crops included taro and yam. Traditional animal foods included kiore (forest rat) and kurī
Moa (large flightless bird endemic to NZ) were also hunted for meat until their extinction. A wide range of fowls was caught including weka (flightless bird), kererū (wood pigeons), and tūī (endemic bird to NZ). Sow thistle or puha (*souchus oleraceus*), wild roots, cabbage tree or ti (*Cordyline terminalis*), karaka berries (*Corynocarpus laevigatus*), hinau fruit (*Elaeocarpus dentatus*) were some of the typical traditional vegetation and fruits also common among pre-colonised Māori diet (74, 76).

While participants frequently expressed their belief that their ancestral way of eating is healthier, participants demonstrated a misunderstanding of what foods their pre-colonised ancestors ate. Participants often assumed that Paleo and LCHF diets were similar to tīpuna kai, when in fact there are clear differences (Table 5). Participants commonly identified post-colonial foods such as butter, coconut products, and whole milk, along with fatty meat (pork, bacon, lamb, chicken and beef) as tīpuna kai in addition to foods that were likely to have been eaten in pre-colonial times including kai moana (blue cod, cockles, pāua, kina) and bird life (kererū). The belief that butter, coconut milk, and fatty meats are traditional foods led to the idea that Māori tīpuna (ancestors) consumed diets high in saturated fat and protein from animal sources. This may explain why LCHF diets were viewed positively by participants in this study.

<table>
<thead>
<tr>
<th>Carbohydrates</th>
<th>LCHF</th>
<th>Tīpuna kai</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limit most fresh fruits. Seasonal fruits (except banana and grapes) appear to be acceptable in limited amounts.</td>
<td>Fernroot</td>
</tr>
<tr>
<td></td>
<td>Avoid most starchy vegetables. Carrots and beetroot appear to be acceptable root vegetables.</td>
<td>Kūmara</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Taro</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yam</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cabbage tree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hinau fruit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Karaka (berries)</td>
</tr>
<tr>
<td>Fat</td>
<td>Butter</td>
<td>Kiore</td>
</tr>
<tr>
<td></td>
<td>Whole milk</td>
<td>Kurī</td>
</tr>
<tr>
<td></td>
<td>Cream</td>
<td>Moa</td>
</tr>
<tr>
<td></td>
<td>Cheese</td>
<td>Fish</td>
</tr>
<tr>
<td>Coconut oil</td>
<td>Olive oil</td>
<td>Nuts and seed</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Other*</td>
<td>Green leafy vegetables (spinach, lettuce)</td>
<td>Brussel sprouts</td>
</tr>
</tbody>
</table>

*Macronutrient content is neither high in fat or carbohydrate.

### 6.3 Main barriers of LCHF diets

As previously discussed Māori view processed foods as unhealthy. It is assumed that LCHF diets which limit processed foods would be seen as favourable and exploited. It would seem however that Māori also take issue with the fat in LCHF diets. A qualitative study with 24 adult participants sought to investigate the dietary perceptions of adults in New Zealand with prediabetes and type 2 diabetes. The results showed that many participants expressed concerns regarding the fat content of animal fat and dairy foods. Overall, participants perceived dietary fat as fattening and subsequently not acceptable in a healthy diet (53). Regarding processed foods, my Māori participants were well aware of risks associated with processed foods. Despite this, the Māori population in New Zealand report relatively high intakes of nutrient-poor processed foods. The 2008/2009 Adult Nutrition Survey (ANS) showed Māori also eat diets high in processed meats, sugary beverages, prepared foods and takeaways (36). Thus awareness of the adverse effects is not sufficient to change the behaviour of eating processed foods, but fat is fixed in the Māori perception as unfavourable.
The cost of foods required for the LCHF diet is a significant barrier for all participants. Foods found in LCHF diets such as eggs, red meat, chicken, fish, avocado, green leafy vegetables, fruit, cheese, nuts and seeds (77) are perceived by participants to be more expensive than foods found in their typical diets. Participants who had never tried an LCHF diet were wary of the impact the diet would have on their budget. Additionally, financial barriers also prevented participants who had previously attempted variants of LCHF diet from maintaining the diet for an extended period.

Estimated food cost for the average size (four) Māori household (78) consisting of two adults and two children living in Dunedin is $271 per week (79). In 2015, the average weekly wage for Māori over the age 15 years was $455 (80). This is $166 less than the average NZ wage of $621 (81). With weekly food costs estimated to be more than half a weekly wage for Māori, it is understandable participants would be apprehensive about the cost of LCHF diets.

LCHF diets, while perceived to be high in cost, can be made to work in a low-income household according to some sources (2). However, upon further investigation of these sources, it was noted that these total comparative costs were not averages and therefore may not be an accurate reflection of what participants may expect upon switching to an LCHF diet (see Appendix E). Other sources that compared averages of food prices found LCHF diets to live up to expectations of being high cost (82). Furthermore, a study aimed to quantify and compare the costs incurred by subjects undertaking one of four commercially available weight loss programmes. Out of the four commercial weight loss diets, the Atkins diet was the only diet to increase food expenditure (83). Nevertheless, participants in this study who had tried LCHF diets had found them financially unsustainable.

Māori often encounter challenging socioeconomic circumstances (poverty, drugs, alcohol, abuse, and family violence). From the viewpoint of participants who struggle with these
challenges and other challenges, making radical changes to their diets for health often takes a back seat and is viewed as an unnecessary complication.

Long-term compliance with low carbohydrate fad diets has shown to be difficult (84). Despite an extensive variety of LCHF meals displayed in food books, magazines, and the internet that attempt to ease the complexity of adhering to LCHF diets (2, 85), participants still were put off due to difficulty and inconvenience. For most Māori, LCHF diets may require more effort, energy, time and money. Consideration of dietary advice that requires an investment of skills, knowledge, time and finances above that which Māori can sustain is unlikely to be suitable for Māori with this viewpoint.
7 Conclusion

Dietary interventions for the treatment and prevention of non-communicable disease amongst Māori may vary depending on the needs of the individual. Results from this study indicate that there are opportunities for modest nutritional interventions that would improve Māori health before hastily advising on an overhaul of traditional dietary behaviours. Interventions should include reinforcing and providing nutritional education on current healthy eating guidelines, the benefits of certain processed foods, differentiating between sources of healthy and unhealthy carbohydrates and fats and then stressing the importance of the quality of carbohydrates and fats versus the quantity. The importance of such nutritional messages may be overlooked by Māori due to its simplicity and frequent use. Therefore, the challenge lies with nutritional educators to communicate and present the information in a unique and culturally acceptable way that will inspire Māori to make smaller, less radical, changes that may not seem as exciting as changes seen in fad diets but will have a higher chance of compliance in the long run.

Additionally, it is essential that health experts remain open-minded and supportive to Māori who choose to follow an LCHF diet and work with them to apply healthy eating principles that are associated with LCHF diets. Suitable advice might include limiting intake of refined carbohydrate foods and drinks and pre-prepared meals and takeaways and increasing consumption of non-starchy vegetables, fish, nuts, and seeds. This mana-enhancing approach will help develop strong relationships that will enable nutrition experts to further educate on other healthy eating principles that do not align with LCHF diets.

My research showed that Māori encounter multiple challenges that impact on their ability to eat healthily. These challenges include, but are not limited to, financial, mental health, lack of access to quality nutritional support, vulnerability to fad diets messages, and lack of
nutritional knowledge and food preparation/cooking skills. This suggests that a narrow approach that focuses on changing foods and eating patterns often seen in fad diets is not an appropriate strategy to overcome barriers to healthy eating. Strategies that may have more impact in Māori populations would seek to overcome these barriers and could include financial advice, budgeting skills, awareness of healthy cost-effective food options, meal planning support, effective nutritional education, meal preparation/cooking workshops, and creating social networks with other community members, these strategies may help to facilitate healthy eating practices. In this study, the cost of eating healthy was identified as a significant barrier for Māori.
8 Application of Research to Dietetic Practice

The Māori term *Hauora* is a Māori philosophy of health and well-being that encompasses multiple facets of the human experience. Tending to physical, emotional, mental, social and spiritual needs, it requires health in all aspects to have total health. Although participants did not specifically mention this philosophy, throughout this study, its importance was evident as topics such as friends and family, every-day living with meal prep and budget requirements, Mauri, long-term health, self-confidence, and weight loss were spoken about and can be incorporated into the dimensions of Hauora.

Understanding this, dietitians need to address more than just what to eat. It is important for dietitians to provide practical strategies that are acceptable for individuals and family. One of the main concerns for Māori having tried the LCHF diet was their lack of ideas for new meals to avoid meal fatigue. It is essential to provide meals that are nutritionally balanced and acceptable. It is also important to keep the cost of meals in mind as many Māori are concerned about the impact a change in meals would have on their weekly finances. Social gatherings and annual celebrations involving food can be a major issue for Māori trying to make healthy food choices. For Māori, trying to limit starchy carbohydrates was a challenge. It is important for dietitians to provide ideas and strategies to help individuals manage consumption of starchy carbohydrates during social gatherings.

Because Māori have a strong desire to follow the traditional way of life, specifically that of cultivating their fruit and vegetables and eating organic, unprocessed foods, it is important for dietitians to understand what types of foods pre-colonised Māori ate so they can educate and clear up incorrect beliefs for Māori interested in the LCHF diet. Also, because many Māori may have a different world view it is important for dietitians to have an understanding of this
view. This is an essential part of cultural competent practice among dietitians, both at an individual level, but also in the profession. If dietitians and the health community are to contribute to reducing health inequities among Māori, better understanding of Maori perspectives would help to create effective and useful programmes, nutritional information tools and other nutritional interventions than currently available. This is in line with the Government’s Maori Health strategy (He korowai Oranga).

Dietitians need to assess Māori understanding and perception of nutritional knowledge thoroughly and to provide culturally and socially acceptable education that is supported by scientific evidence. Another important aspect this research highlights is the substantial amount of misinterpretation and confusion there is regarding nutritional knowledge. It is important that dietitians feel comfortable asking questions and conduct a thorough assessment of individual knowledge and perceptions, thus enabling them to provide nutritional education that is sustainable, effective and leads to optimal health and well-being for individuals, whānau, and communities. Doing so can also help clear up any misinformation Māori may have that is hindering their ability to make lasting healthy changes.

These uncertainties in nutritional knowledge may have arisen because nutritional messages have no regulations regarding who can print, advertise or produce media on the subject resulting in a plethora of messages left to confuse the well-meaning public who are trying to live healthier lives. Regulations could be put in place requiring nutritional messages to undergo an assessment before being released that could ensure the information being presented to the public was clear and not purposefully misleading or confusing.

From a dietitian’s perspective, it would be appropriate to discover ways in which healthy foods can be purchased within their budget. Although the financial status of patients is considered in dietary assessments, it is usually scanned over and not discussed in any detail. However, seeing as low income can be a significant barrier to healthy eating for many Māori
whānau, it will be beneficial for dietitians to be aware of local opportunities for lower cost healthy food organisations/programmes (eg local food share schemes) that could provide additional support for whānau struggling to afford healthy foods.

On a personal level, this research provided me with opportunities to learn and develop valuable skills and tools that will help me to be an effective dietitian. During the recruitment and interviewing process, I was able to learn and develop communication skills such as asking effective questions, active listening, and building relationships of trust that enables open and honest dialogue. Other important skills I have gained are an improved ability to search and critique the literature as well as write coherent thoughts and ideas. These are valuable because most radical nutritional messages claim to be supported by research, and as dietitians, it is important to be able to critique studies so that nutritional information given to other people is based on the best evidence available.
References

4. Calihan J. Take Back Your Plate. TEDxYouth@Shadyside; 2017. p. 20 min.


Appendix A

Ethics Approval

Dear Dr Te Morenga,

I am writing to confirm for you the status of your proposal entitled “Low Carbohydrate diets for Maori and Pasifika people”, which was originally received on August 27, 2015. The Human Ethics Committee’s reference number for this proposal is D15/294.

The above application was Category B and had therefore been considered within the Department or School. The outcome was subsequently reviewed by the University of Otago Human Ethics Committee. The outcome of that consideration was that the proposal was approved.

Approval is for up to three years from the date of HOD approval. If this project has not been completed within three years of this date, re-approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

Yours sincerely,

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz
Appendix B

Participant Information Sheet

Low carbohydrate diets for Maori and Pasifika people

What is the Aim of the Project?

The aim of our research is to learn what Maori and Pasifika people think about low carbohydrate, high fat diets. Low carbohydrate diets are currently receiving huge publicity and coverage on TV and on social media and are often promoted as the healthiest option people with diabetes or at high risk of developing diabetes such as Maori and Pasifika people – but we need better research to find out whether they really are best.

The findings of this research project will help us to develop information and resources on low carb diets for Maori and Pacific people participating in future research to test whether low carb diets are a good strategy for preventing diabetes.

This project is being undertaken as part of a summer research internship by undergraduate students studying Human Nutrition at the University of Otago.

What Types of Participants are being sought?

We are looking for 10 Maori and 10 Pacific people over 18 years, living in or around Dunedin.

What will participants benefit from this?

This is a great chance for researchers to understand what Maori and Pasifika people think about Low Carbohydrate diets. It is a chance for Pacific voices to be heard, rather than just be seen as a negative statistic. A koha/gift of a fruit basket will be provided for your time.
What will Participants be asked to do?

Should you agree to take part in this project, you will be asked to meet face-to-face with two student researchers once to tell us what you think about low carbohydrate diets. You will be asked some general questions but you don't have to know anything about low carbohydrate diets – we want to find out what you do know and what you don’t know.

Interviews will take no more than one hour and will be arranged to happen at a time and place that is convenient for you.

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind. You may choose not to answer any of the questions in the survey.

What happens with the information collected?

Only the Student Researchers and Supervisors will have access to this data. Audio recordings will be destroyed once the project is finished.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact:

Theresa Fitzpatrick (Student Researcher)
Division of Health Sciences
University Telephone Number: 0221082159
Email Address: treezaf@hotmail.co.nz

Jury Arthur (Student Researcher)
Department of Human Nutrition
University Telephone Number:
Email Address:

Dr. Lisa Te Morenga (Main Supervisor)
Department of Human Nutrition
University Telephone Number: 03-479-3978
Email Address: lisa.temorenga@otago.ac.nz

This project has been reviewed and approved by the Department of Human Nutrition, University of Otago
Appendix C

Consent Form for Participants

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My participation in the project is entirely voluntary;

2. I am free to withdraw from the project at any time without any disadvantage;

3. Personal identifying information (contact details and audio-recordings) will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for at least five years;

4. This project involves an open-questioning technique. The general line of questioning includes:
   - What do you think of as a low carb, high fat diet?
   - Would you ever try a low carb, high fat diet?
   - What sort of foods could you eat?
   - What would make it difficult to follow a low carb, high fat diet?
   - What would your family think if you starting following a low carb diet?

The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops and that in the event that the line of questioning develops in such a way that I feel hesitant or uncomfortable I may decline to answer any particular question(s) and/or may withdraw from the project without any disadvantage of any kind.

5. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve my anonymity.

I agree to take part in this project.

.................................................................................................................
(Signature of participant) ............................................................................
(Date)

.................................................................................................................
(Pedited Name)
Appendix D

Participant Questionnaire

Interview ID #

Low Carbohydrate Diets for Pacific People

Age

18-25  26-35  36-45  46-55  56-65  66+

Ethnicity

Gender  M/F

Number of people in household

Range of ages in Household

Who is mainly responsible for cooking in your household?

Who is mainly responsible for food shopping in your household?

Does anyone in your house have Diabetes?

Have you ever been to see a Dietician?

Do you or anyone in your household have any major medical conditions such as Cancer, Diabetes or Heart Disease?

What type of work do you do?

Would you be interested in further research within the University?  Yes  No  Maybe
### Appendix E
#### Australian Government Recommendations

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<thead>
<tr>
<th>Morning break</th>
<th>Weight/portion size</th>
<th>Cost</th>
<th>Kilojoules</th>
<th>Carbs</th>
<th>Sugar</th>
</tr>
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<tbody>
<tr>
<td>Coffee with milk</td>
<td>200ml</td>
<td>$0.02</td>
<td>75</td>
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<td>1.7</td>
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<th>Weight/portion size</th>
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<th>Sugar</th>
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<tr>
<td>Sandwich with salad and chicken and an apple</td>
<td>2 slices bread, 40g chicken, 1 tsp. margarine, 1 cup salad vegetables, 1 medium apple</td>
<td>$2.67</td>
<td>1,784</td>
<td>60.0</td>
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<th>Weight/portion size</th>
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<th>Sugar</th>
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<tr>
<td>Unsalted nuts</td>
<td>30g almonds</td>
<td>$0.65</td>
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<tr>
<td>Coffee with milk</td>
<td>200ml</td>
<td>$0.02</td>
<td>75</td>
<td>1.9</td>
<td>1.7</td>
</tr>
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<th>Evening snack</th>
<th>Weight/portion size</th>
<th>Cost</th>
<th>Kilojoules</th>
<th>Carbs</th>
<th>Sugar</th>
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<tbody>
<tr>
<td>Plums and reduced fat yoghurt</td>
<td>1 cup stewed plums, 500g yoghurt</td>
<td>$1.70</td>
<td>753</td>
<td>21.3</td>
<td>19.7</td>
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<th>Weight/portion size</th>
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<th>Kilojoules</th>
<th>Carbs</th>
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<tr>
<td>$13.51</td>
<td>7,797</td>
<td>205.2</td>
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### Lower carbohydrate alternative

#### Breakfast

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<tr>
<th>Break and Eggs</th>
<th>Weight/portion size</th>
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<th>Kilojoules</th>
<th>Carbs</th>
<th>Sugar</th>
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<tbody>
<tr>
<td>Bacon and eggs</td>
<td>10g bacon, 50g baby spinach, 1 egg, 5g cheese, 5g butter, Fresh parsley</td>
<td>$2.25</td>
<td>1,551</td>
<td>0.8</td>
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<th>Weight/portion size</th>
<th>Cost</th>
<th>Kilojoules</th>
<th>Carbs</th>
<th>Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green tea</td>
<td>200ml</td>
<td>$0.00</td>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lunch</th>
<th>Weight/portion size</th>
<th>Cost</th>
<th>Kilojoules</th>
<th>Carbs</th>
<th>Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken salad</td>
<td>10g chicken, 1 tsp. macadamia oil, 60g baby spinach, 20g Dennis feta, 15g pumpkin kernels</td>
<td>$2.18</td>
<td>1,126</td>
<td>0.6</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Afternoon break</th>
<th>Weight/portion size</th>
<th>Cost</th>
<th>Kilojoules</th>
<th>Carbs</th>
<th>Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsalted nuts</td>
<td>30g almonds</td>
<td>$0.69</td>
<td>768</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Green tea</td>
<td>200ml</td>
<td>$0.00</td>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evening snack</th>
<th>Weight/portion size</th>
<th>Cost</th>
<th>Kilojoules</th>
<th>Carbs</th>
<th>Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zucchini noodles with beef mince</td>
<td>1/2 medium zucchini, 100g cooked mince, 1 medium tomato, 2 button mushrooms, 5g onion, 10g baby spinach, 10g butter</td>
<td>$4.02</td>
<td>1,492</td>
<td>5.9</td>
<td>5.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOTAL</th>
<th>Weight/portion size</th>
<th>Cost</th>
<th>Kilojoules</th>
<th>Carbs</th>
<th>Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10.30</td>
<td>6,048</td>
<td>9.3</td>
<td>9.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>