Development and testing of a population-based electronic diabetes nutritional education tool

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To view the diabetes nutritional education resource, please go to the following websites:

Introductory video (40 seconds)

https://www.youtube.com/embed/scYIdNk_bP8?

Nutrition for type 2 diabetes and pre-diabetes – full video (20 minutes)

https://www.youtube.com/embed/zzq4ISB1aU?

Online questionnaire and nutrition quizzes

https://otago.au1.qualtrics.com/jfe/form/SV_6J1BfjWURfqpRb
Abstract

Nutritional education for pre- and type 2 diabetes empowers individuals to make positive dietary and lifestyle choices. As the world migrates to digital devices, opportunities arise for education resources that have a wide reach in society to ease the pressure on over-stretched healthcare services.

The objective was to develop and test the effectiveness of an electronic nutritional education resource for pre- and type 2 diabetes suitable for the multi-ethnic New Zealand population.

This PhD project consists of five parts: A literature review (part one), examining the effectiveness of conventional and electronically delivered diabetes education. A needs assessment (part two), of ethnic-specific groups using focus groups (Māori, Pacific Island, European, East Asian and Indian) involving 29 people with pre- and type 2 diabetes. Focus group discussions were transcribed and analysed using inductive and deductive techniques. An online survey (part three), assessing nutritional knowledge, sources of information and preferred ways of receiving information responded to by 64 people with pre- and type 2 diabetes, 312 people interested in diabetes and 72 health professionals. Two satiety crossover trials (part four), in which a). the satiating qualities of rice, pasta and potato-based meals were tested (n=14); and b). how replacing starchy carbohydrate (rice or pasta) with non-starchy vegetables affected satiety (n=77). Both studies used validated visual analogue scales and area-under-the (satiety)-curves (AUC). Testing of an educational resource (part five), developed using information gathered in previous parts and with input from a focus group of ten
diabetes dietitians. The resource was pre-validated in 93 individuals and its effectiveness was tested in 156 people (17 with pre- and type 2 diabetes, 118 people interested in diabetes, and 21 health professionals) using pre- and post-video quizzes. Ethics approvals were obtained for parts two to five.

Lack of diabetes nutritional knowledge, confusion, and a desire to learn was apparent in all ethnic focus groups. The need for nutritional education was confirmed by diabetes dietitians. The survey result showed health professionals had better nutritional knowledge than other respondents, and a diagnosis of diabetes was not predictive of improved nutritional knowledge in terms of which foods affect blood glucose. In the satiety studies, potato meals had a higher satiating effect than rice and pasta meals (AUC_hunger for potato, rice and pasta meal; 2635, 3745 and 4445 mm · min respectively, P<0.05 between potato and the other meals). Replacing 50 grams of rice or pasta with an equal weight of non-starchy vegetables did not affect satiety. After viewing the educational resource, the accuracy of identifying foods that increase blood glucose improved by 17.4% (P=0.013) in people with pre- and type 2 diabetes, 12.8% (P=0.003) in health professionals, and 16.3% (P<0.001) in people interested in the condition, including an improvement among ethnic minority participants of 14.1% (P=0.003); with participants signalling intentions to make positive dietary and lifestyle choices.

The electronic nutritional education resource is an effective means for delivering education. It has potential to bridge the gap between the limited supply of healthcare resources and the increasing demand for diabetes nutritional education.
Preface

The aim to develop an educational resource was conceived of by the Doctor of Philosophy (PhD) candidate Zhuoshi Zhang. The candidate, Dr Bernard Venn (supervisor) and Dr John Monro (supervisor) discussed the approach to achieving the aim through information gathering (focus groups, survey and satiety studies), and the format for the educational resource.

Specifically, the candidate was responsible under supervision for the following:

- Contacting medical centres, primary care organisations, Best Care Whakapai Hauora Charitable Trust, Bhartiya Samaj Charitable Trust for recruiting focus group participants
- Arranging focus group venues and conducting focus groups of people with pre- and type 2 diabetes and diabetes dietitians
- Transcribing and coding all voice recordings and conducting qualitative analysis
- Developing the information-gathering survey and distributing it through emails and social media
- Obtaining the agreement of Diabetes Auckland to distribute the survey to members
- Collecting and analysing the survey data
- Conceiving the two satiety studies
- Analysing the satiety data
• Developing the electronic nutritional educational resource including video recording and editing
• Pre-testing the resource among dietitians, endocrinologists and diabetes nurse specialists; and by Diabetes New Zealand and Diabetes Projects Trust
• Developing pre- and post-education questionnaires and nutritional quizzes
• Developing and undertaking validation of the education resource
• Liaising with Diabetes New Zealand, Diabetes Projects Trust, Best Care Whakapai Hauora Charitable Trust, and Bhartiya Samaj Charitable Trust and professional colleagues to promote the education resource study
• Analysing the data arising from the education resource
• Writing this thesis

The focus group study (Chapter 3) and the first satiety study (Chapter 5) were presented as posters at the 17th International Congress of Dietetics (ICD) in Granada, Spain 2016. The former was also the winning “People’s Choice Poster” in the 2017 Waitemata Health Excellence Award, where the candidate was awarded “Emerging Researcher of the year, 2017”. The focus group study was presented at the New Zealand Society for the Study of Diabetes (NZSSD) dietitian study day (2nd May, 2017). A copy of the poster and the award certificate are attached in Appendix 13 and Appendix 14.
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I would like to give my appreciation to all the participants for their time contributed to this research. I wish to acknowledge Diabetes New Zealand, Diabetes Auckland, Mairangi Bay Medical Centre, Best Care Whakapai Hauora Charitable Trust (Dr Carole Ann Fernandez), Bhartiya Samaj Charitable Trust, Nivedita Sharma Vij, and Teresa Cleary for their assistance in recruiting participants in the focus groups, information-gathering survey and the later resource testing study.

I appreciate Dr Jill Haszard for her professional guidance in statistical analysis and Dr Suman Mishra for her assistance in the first satiety study.

Pursuing a doctoral degree while working part time is challenging. I appreciate the encouragement and laughter that my friends and work colleagues brought into my life. I am especially thankful to my professional supervisor Roslyn Norrie, who gave me ideas and suggestions for my PhD research and presentations, and Kaye Dennison who had confidence in me from the start of my PhD, and supported my projects for many years.
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Last but not least, I will forever thank my family for all their love and encouragement, my parents who have raised me and supported me in all my pursuits; my New Zealand homestay parents, Dr Norman Castle, and Fleuri (Daisy) Castle who encouraged me to pursue this doctoral degree; and my partner Shuhan Zhang for his faithful support and assistance throughout my PhD research.

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# Table of Contents

Abstract........................................................................................................................................ iii  
Preface........................................................................................................................................... v  
Acknowledgements.................................................................................................................... vii  
Table of Contents ....................................................................................................................... ix  
List of Tables ................................................................................................................................ xi  
List of Figures ........................................................................................................................... xii  
List of Abbreviations .................................................................................................................. xiii

Chapter 1.  Introduction .................................................................................................................. 1

Chapter 2.  Literature Review - Electronic Resources in Diabetes Education ......................... 7
    Introduction ................................................................................................................................. 8
    Methods ....................................................................................................................................... 11
    Conventional diabetes education ............................................................................................. 12
    Online diabetes self-management education .......................................................................... 16
    Effectiveness of providing diabetes education using electronic resources ...................... 20
    Conclusion ................................................................................................................................ 42

Chapter 3.  Nutritional Knowledge, Education and Online Engagement for Pre- and Type 2 Diabetes in New Zealand Multi-ethnic Population: A Qualitative Study .................. 44
    Introduction ................................................................................................................................. 45
    Methods ....................................................................................................................................... 47
    Results ......................................................................................................................................... 51
    Discussion ................................................................................................................................... 66

Chapter 4.  Information-gathering Survey .................................................................................. 74
    Introduction ................................................................................................................................. 75
    Methods ....................................................................................................................................... 77
    Results ......................................................................................................................................... 78
    Discussion ................................................................................................................................... 87

Chapter 5.  Effect of Carbohydrate Portions on Appetite .......................................................... 90
    Introduction ................................................................................................................................. 91
    Participants and Methods – Satiety Study One ...................................................................... 94
    Results – Satiety Study One ..................................................................................................... 98
    Participants and Methods – Satiety Study Two .................................................................... 100
    Results – Satiety Study Two .................................................................................................. 106
    Discussion .................................................................................................................................. 109
List of Tables

Table 2-1 Summary of study characteristics ................................................................. 22
Table 2-2 Summary of main outcomes ........................................................................ 33
Table 3-1 Baseline characteristics of study participants ........................................ 51
Table 3-2 Foods identified as increasing blood glucose concentration .................. 55
Table 3-3 Use of electronic devices ........................................................................... 63
Table 3-4 Experiences and expectations for diabetes care in different ethnic groups 64
Table 4-1 Participants’ characteristics ...................................................................... 78
Table 4-2 Participants’ age distribution (n = 393) ....................................................... 79
Table 4-3 Years of diabetes since diagnosis ................................................................. 79
Table 4-4 Diabetes medications ................................................................................. 79
Table 4-5 Foods consumed by participants in the past week ..................................... 81
Table 4-6 Foods & beverages correctly identified as increasing blood glucose ......... 82
Table 5-1 Test meal composition (cooked) ................................................................. 95
Table 5-2 Comparison of postprandial satiety responses between three test meals ...... 98
Table 5-3 Test meal components (cooked) ................................................................. 101
Table 5-4 Nutritional composition for the test meals ................................................ 103
Table 5-5 Participants’ characteristics .................................................................... 106
Table 5-6 Comparison of postprandial satiety responses between three test meals ...... 107
Table 6-1 Characteristics of participants who met inclusion criteria (n = 156) ......... 132
Table 6-2 Sub-groups of participants who met inclusion criteria (n = 156) .............. 133
Table 6-3 Diabetes management in participants with pre- and type 2 diabetes (n = 17) 134
Table 6-4 Numbers of food items correctly identified in the validation study ........... 135
Table 6-5 Numbers of food items correctly identified pre- and post-watching the video 137
Table 6-6 Comparison of meal composition to healthy plate model ....................... 139
List of Figures

Figure 2-1 Flowchart of literature selection process and the main outcomes........................................... 21

Figure 4-1 Sources for diabetes nutritional information .................................................................................. 84

Figure 5-1 Satiety levels after consuming three test meals ............................................................................. 99

Figure 5-2 Test meal components (plate size diameter = 21 cm) ................................................................... 102

Figure 5-3 Postprandial satiety responses ...................................................................................................... 108

Figure 6-1 Structure of the resource .............................................................................................................. 118

Figure 6-2 Example of a nutritional quiz (items from vegetable and fruit category) ...................................... 120

Figure 6-3 Video screenshot - pathology of pre- and type 2 diabetes ............................................................. 124

Figure 6-4 Video screenshot - what foods and beverages increase blood glucose ......................................... 125

Figure 6-5 Video screenshot - meal portions and healthy plate model .......................................................... 125

Figure 6-6 Video screenshot - meal and snack ideas ........................................................................................ 126

Figure 6-7 Video screenshot - exercise and nutritional tips for managing pre- and type 2 diabetes .......... 126

Figure 6-8 Example of perceived behaviour change assessment .................................................................. 127

Figure 6-9 Enrolment and participation results flowchart ............................................................................ 131

Figure 6-10 Perceived knowledge in nutrition and diabetes at baseline ......................................................... 136

Figure 6-11 Participants who perceived they knew what foods increase blood glucose ............................ 136

Figure 6-12 Proportion of carbohydrate, vegetables and protein at main meals ........................................... 138
## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>AI/AN</td>
<td>American Indians and Alaskan Natives</td>
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<tr>
<td>AUC</td>
<td>Area-under-the-curve</td>
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<tr>
<td>BG</td>
<td>Blood glucose</td>
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<td>BP</td>
<td>Blood pressure</td>
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<td>CASM</td>
<td>Computer-assisted diabetes self-management</td>
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<td>CHD</td>
<td>Coronary heart disease.</td>
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<td>CHO</td>
<td>Carbohydrate</td>
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<tr>
<td>CI</td>
<td>Confidence interval</td>
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<tr>
<td>DBP</td>
<td>Diastolic blood pressure</td>
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<td>DSME</td>
<td>Diabetes self-management education</td>
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<tr>
<td>FTE</td>
<td>Fulltime equivalent</td>
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<td>GDM</td>
<td>Gestational diabetes mellitus</td>
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<td>GI</td>
<td>Glycaemic index</td>
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<tr>
<td>GP</td>
<td>General practitioner</td>
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<tr>
<td>HbA1c</td>
<td>Glycated haemoglobin A1c</td>
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<tr>
<td>HDL</td>
<td>High-density lipoprotein</td>
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<tr>
<td>HON</td>
<td>Health on the Net</td>
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<tr>
<td>ICD</td>
<td>International Congress of Dietetics</td>
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<tr>
<td>IDSMP</td>
<td>Internet-based diabetes self-management program</td>
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<tr>
<td>KAP</td>
<td>Knowledge-assessment program</td>
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<tr>
<td>L</td>
<td>Large portion</td>
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<tr>
<td>LDL</td>
<td>Low-density lipoprotein</td>
</tr>
<tr>
<td>M</td>
<td>Medium portion</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>NZSSD</td>
<td>New Zealand Society for the Study of Diabetes</td>
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<tr>
<td>PI</td>
<td>Pacific Islander</td>
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<tr>
<td>Pre/T2</td>
<td>Pre- and type 2 diabetes mellitus</td>
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<tr>
<td>RCT</td>
<td>Randomised controlled trial</td>
</tr>
<tr>
<td>RN</td>
<td>Registered nurses</td>
</tr>
<tr>
<td>S</td>
<td>Small portion</td>
</tr>
<tr>
<td>SBP</td>
<td>Systolic blood pressure</td>
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<tr>
<td>SE</td>
<td>Self-efficacy</td>
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<tr>
<td>T1DM</td>
<td>Type 1 diabetes mellitus</td>
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<tr>
<td>T2DM</td>
<td>Type 2 diabetes mellitus</td>
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<tr>
<td>TAG</td>
<td>Triglyceride/ triacylglycerol</td>
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<tr>
<td>VAS</td>
<td>Visual analogue scale</td>
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Chapter 1. Introduction
Diabetes is one of the largest global health concerns (International Diabetes Federation, 2015b; World Health Organization, 2016). In 2014, an estimated 422 million adults were living with diabetes compared to 108 million in 1980 (World Health Organization, 2016). The prevalence of diabetes in New Zealand is currently increasing by an average of 7% per year (Ministry of Health, 2015). There were over 240,000 people diagnosed with diabetes as at December 2016 (Ministry of Health, 2017), with estimates of another 2% of the population being undiagnosed (University of Otago and Ministry of Health, 2011).

A higher prevalence of diabetes has been found among ethnic minorities and indigenous people compared with the majority ethnic group living in predominantly Caucasian countries (International Diabetes Federation, 2015b). In New Zealand, Indian people had the highest prevalence of diabetes (11%) followed by Pacific Islanders (9.6%) (Ministry of Health, 2014a). Māori were more likely to develop type 2 diabetes and diabetes complications compared with non-Māori (Ministry of Health, 2014b). South Asian and Pacific Islanders were four times as likely to be on treatment for diabetes as Europeans (Scragg, 2010). Similar situations have been found in indigenous Australians (Minges et al., 2011), Canadian Metis & Inuit (Public Health Agency of Canada, 2011), American Indians, Latin and African Americans (American Diabetes Association, 2017c). Prevention and management of diabetes is a high priority for individuals and healthcare systems.

One form of management is education to encourage ongoing self-care by individuals with diabetes (Bruce et al., 2003; Deakin et al., 2005; Ku & Kegels, 2014; Norris et al., 2001; Steinsbekk et al., 2012; Wang et al., 2014). Education has been found to positively influence dietary habits (Heinrich et al., 2010; Huang et al., 2010; Norris et al., 2001; Wang et al., 2014) and glycaemic control (Deakin et al., 2005; Huang et al., 2010; Jones et al., 2003; Ku & Kegels, 2014; Norris et al., 2001; Odgers-Jewell et al., 2017; Osborn & Egede,
Traditionally, such education has been delivered face-to-face through either one-to-one consultations or group sessions. However, patients’ ability to access these services is varied due to geographic locations, referral criteria, referral waiting time, work commitments, language and cultural barriers (Diabetes UK, 2009; Hsu et al., 2006; Parker et al., 2011). Also, patients who are not fluent in English or come from a minority background have less diabetes knowledge (Bruce et al., 2003) and are less engaged with diabetes services (Ferguson & Candib, 2002; Kristensen et al., 2007) than the ethnic majority. Health providers are under resourcing pressure and facing disparities in education access and understanding among ethnic groups, coupled with an increasing prevalence of diabetes across all population groups.

To provide the best diabetes care, the New Zealand Ministry of Health proposed a minimum of 4.0 fulltime equivalent (FTE) diabetes dietetic positions per 10,000 persons in secondary care (Ministry of Health, 2014b). The University of South Australia and the Australian Department of Health & Aging proposed a 3.3 FTE for dietary advice per 1,000 persons in primary care (Segal et al., 2013). In reality, there are far fewer dietetic positions than these recommendations. Insufficient diabetes dietary knowledge has been reported as a problem among patients in New Zealand and overseas (Breen et al., 2015; Lawrenson et al., 2010). This lack of dietary knowledge in people with diabetes, regardless of years of diagnosis, has been noted by the candidate, herself a registered dietitian in diabetes secondary care. Anecdotally, patients report having received advice from primary care providers and sourcing nutritional information from their families, friends and the Internet; despite acknowledging the quality of that advice being questionable. To overcome some of the reliability of information and resourcing issues, studies have been carried out to assess the effectiveness of diabetes education delivered
via videoconferencing, phone calls, text messages, and emails. Smart phone apps also provided new approaches to help people manage their diabetes (Chavez et al., 2017; Cui et al., 2016). These remote services not only reduced patients’ travel costs, but also improved their glycaemic control, self-care and knowledge (de Jongh et al., 2012; Pal et al., 2014; Polisena et al., 2009; Ramadas et al., 2011; Saffari et al., 2014; Verhoeven et al., 2010). However, extensive clinician input is still required in many of these applications, impacting the feasibility of services that are already under resourced.

As the world moves to electronic devices, there have been increasing numbers of people seeking health information online (Fox & Duggan, 2013b). In 2013, 82% of New Zealand Internet users searched for online health information (Gibson et al., 2013). There are few ethnic differences associated with this behaviour when comparing Europeans with non-Europeans including Hispanic, African Americans, American Indian, Asian, Hawaiian, and Mexican Americans (Kind et al., 2005; Lustria et al., 2011; Reininger et al., 2013). A survey in Waikato showed similar Internet access rates between Māori and non-Māori with diabetes (Reti et al., 2011). Results of systematic reviews have found Internet based diabetes education to improve patients’ knowledge and diabetes control to various degrees (Pal et al., 2014; Ramadas et al., 2011). With minimal patient-clinician interaction, keeping individuals engaged is crucial (Ramadas et al., 2015; Weymann et al., 2015a). Participants’ post-learning knowledge and glycaemic control have been shown to positively correlate with education content satisfaction, website usability, and frequency of using that resource (Ramadas et al., 2015; Rice et al., 2017). Hence, programmes use goal setting, interactive feedback and online support groups to enhance patients’ engagement (Ramadas et al., 2011). However, the education content has largely been derived from text books, existing group programmes or clinicians’ experiences rather
than being based on what patients wanted to know (Gerber et al., 2005; Glasgow et al., 2012; Lorig et al., 2010; Rice et al., 2017). Moreover, nearly all studies were designed for people with diabetes with few targeted at diabetes prevention (Reininger et al., 2013; Wijdenes et al., 2013).

In order to prevent and manage type 2 diabetes, diabetes education should be targeted at the general public, with or without pre- and type 2 diabetes (Glasgow et al., 1999; Hu et al., 2014; International Diabetes Federation, 2015b) and even at healthcare providers for whom nutrition is not a speciality (Gossain et al., 1993; Parker et al., 2011; Rubin et al., 2007; Vetter et al., 2008). One in four adults living in New Zealand has pre-diabetes and one in three is overweight or obese, which puts them at a high risk of developing type 2 diabetes (Coppell et al., 2013; Ministry of Health, 2013; Tabák et al., 2012). The New Zealand prevalence of obesity is increasing in all age groups including children and young adults, putting them at risk of developing type 2 diabetes and pre-diabetes at a young age (Timlin, 2015). Education focusing on dietary and lifestyle modifications and weight loss is therefore essential in slowing the progression to pre-and type 2 diabetes (American Diabetes Association, 2017b; International Diabetes Federation, 2015b; World Health Organization, 2016). Satiety plays an important role in the regulation of energy intake and weight loss (Blundell et al., 1994); and compliance to dietary modification (Fedoroff et al., 2003; Papies et al., 2007). Hence, an individual’s satiety response should be addressed when giving dietary advice.

Also, including families and caregivers in diabetes education further supports patients making dietary and lifestyle changes (American Diabetes Association, 2017b; Glasgow et al., 1999; Lawrenson et al., 2010; Teufel-Shone et al., 2005), especially when patients are
living in multi-generation households or not in charge of food preparation (Hu et al., 2014; Lawrenson et al., 2010; The Ministry of Social Development, 2004). Online information can be accessed at any time and any place by unlimited users, providing a potential solution for educating growing numbers of patients as well as the general public, without over-stretching the healthcare system.

Therefore, the overall aim of this PhD research was to develop and test the effectiveness of a population-based electronic nutritional education resource for caregivers, those interested in diabetes, and people with pre- and type 2 diabetes.
Chapter 2. Literature Review - Electronic Resources in Diabetes Education
**Introduction**

Diabetes is one of the fastest growing chronic conditions in the world (International Diabetes Federation, 2015b; Whiting et al., 2011; Wild et al., 2004). In 2015, one in eleven adults had diabetes, costing 12% of global health expenditure (International Diabetes Federation, 2015b). It is predicted to increase for at least the next 20 years, further burdening the healthcare system (Guariguata et al., 2014; Segal et al., 2013). Poorly controlled diabetes is a leading cause of heart attack, stroke, kidney failure, blindness and lower limb amputation (International Diabetes Federation, 2015a), all of which impairs individuals’ quality of life, household income, and work productivity (Seuring et al., 2015). The debilitating outcomes of poorly controlled diabetes highlight the need for management strategies at all stages encompassing prevention, early medical intervention and initiation of diabetes self-management (Seuring et al., 2015).

Diabetes knowledge is an essential component of diabetes care (Beaser et al., 1994). It empowers individuals to take responsibility for their condition (Funnell & Anderson, 2004; Hernandez-Tejada et al., 2012). Misconceptions related to diabetes pathology, diet and medication lead to reluctance to seek professional advice and treatment; and poor adherence to medical and dietary therapy (Al-Qazaz et al., 2011a; Badruddin et al., 2002; Benroubi, 2011; Breen et al., 2015). There is confusion among individuals with type 2 diabetes in understanding which type of macronutrients affect blood glucose levels, with that uncertainty impacting individuals’ food choices and interpretation of food labels (Breen et al., 2015). The misunderstanding that foods containing any sugar must be avoided, has been found to lead not only to lower sugar intakes, but also lower intakes of
fruits and vegetables and higher intakes of starchy foods with high glycaemic index, as noted in a study of Irish people with type 2 diabetes (Breen et al., 2015).

Inadequate nutritional and diabetes knowledge is associated with ethnic minority populations in developed countries, especially those with low income, low health literacy, and language difficulties (Aikens & Piette, 2009; Bruce et al., 2003; Mann et al., 2009; Rai & Kishore, 2009). The Fremantle Diabetes Study in Australia showed patients who were not fluent in English or who came from an indigenous background tended to have received less diabetes education and to have been less engaged with diabetes services (Bruce et al., 2003). Similar ethnic and racial disparities have been reported in Denmark and the United States (Ferguson & Candib, 2002; Kristensen et al., 2007). Compared to the majority population, it has been found that ethnic minority groups have higher diabetes rates and poorer diabetes outcomes (International Diabetes Federation, 2015b; Ministry of Health, 2014a; Ministry of Health, 2014b). However, once culturally appropriate diabetes education has been provided in a familiar language, ethnic minorities have been able to achieve similar improvements in glycaemic control compared with the majority population (Attridge et al., 2014; Brown et al., 2002; Hawthorne et al., 2010). Diabetes control amongst ethnic minorities is positively correlated with knowledge and perceived health status (Bains & Egede, 2011; Bruce et al., 2003).

In an electronic age, audio-visual education materials have been created to improve patients’ diabetes knowledge and self-management (Gerber et al., 2005; Glasgow et al., 2011). Indeed, compared to traditional print material, individuals who interact with electronic devices tend to have better knowledge gain and self-care (Farmahini Farahani
et al., 2016; Khan et al., 2011; Park et al., 2016), even in ethnic minorities and those with low health literacy levels (Fleming et al., 1995; Gerber et al., 2005). This literature review summarises the effectiveness of conventional diabetes education and evaluates the results of various electronic diabetes education initiatives.
Methods

An electronic literature search was conducted using PubMed® as the primary online database. Science Direct® and ProQuest® were used as secondary reference sources. Articles published in English from 1986 to 2017 involving human adult participants are included. Key search terms were: “diabetes”, “education”, “Internet”, “pre-diabetes”, “computer”, “smartphone”, “website”, “knowledge”, “learning”. Relevant citations were sourced from the reference lists of eligible articles.
Conventional diabetes education

Patient education provides individuals with information enabling them to understand and manage the condition (Diabetes UK, 2009; Norris et al., 2001). Diabetes self-management education not only improves patients’ diabetes knowledge (Bruce et al., 2003; Deakin et al., 2005; Ku & Kegels, 2014; Norris et al., 2001; Steinsbekk et al., 2012; Wang et al., 2014) and self-efficacy for managing diabetes (Ku & Kegels, 2014; Norris et al., 2001; Osborn & Egede, 2010; Steinsbekk et al., 2012), but also their dietary habits (Heinrich et al., 2010; Huang et al., 2010; Norris et al., 2001; Wang et al., 2014), and glycaemic control (Deakin et al., 2005; Huang et al., 2010; Jones et al., 2003; Ku & Kegels, 2014; Norris et al., 2001; Odgers-Jewell et al., 2017; Osborn & Egede, 2010; Steinsbekk et al., 2012). Diabetes education is usually provided in one of the following forms:

1. **Individual consultations**

Information delivered by healthcare professionals face-to-face is regarded as the most trusted source by patients. It provides patients with an opportunity to discuss their personal concerns and to seek specific advice (Diabetes UK, 2009). Medical nutritional therapy delivered by registered dietitians has been found to improve diabetes control with a reduction in glycated haemoglobin A1c (HbA1c) of 5-20 mmol/mol (0.5-2%) together with improvements in cardiovascular risk markers including lipids and blood pressure (Evert et al., 2014; Franz et al., 2010; Pastors et al., 2002). However, despite the evidence of benefit arising from best practice, the reality in many countries is a general lack of human resources to cater to the growing numbers of people with diabetes, leading
to a long waiting time with short consultations (Diabetes UK, 2009; Guariguata et al., 2014).

2. Diabetes printed materials

To encourage informed diabetes self-care, print materials are given to individuals to supplement professional consultations. Hardcopy materials provide an effective way to deliver diabetes information with some resources translated into multiple languages (Diabetes Australia, 2015; Diabetes New Zealand, 2016; Diabetes UK, 2016). However, the information tends to be generic and may not provide the specifics that patients are seeking. Moreover, the effectiveness of using the information can be compromised in those with poor health literacy especially among indigenous populations and ethnic minorities (Brega et al., 2012; Hosey et al., 1990; Kutner et al., 2006; Sarkar et al., 2006; Schillinger et al., 2002). Additionally, inconsistent quality of translation and lack of consideration of cultural needs has been identified (Hamrosi et al., 2014; McKenna & Doward, 2005). Print materials are prone to becoming outdated, resulting in patients having material that may not reflect current thinking (Coulter et al., 1999; Marshall & Williams, 2006).

3. Diabetes group education

The direction given in group-based diabetes self-management education (DSME) programmes are often based on individual consultations (Heinrich et al., 2010; Norris et al., 2001). Diabetes self-management education is regarded as an effective way to improve patients’ diabetes knowledge, dietary habits, glycaemic control, systolic blood pressure,
body weight and the need for diabetes medication (Deakin et al., 2005; Heinrich et al., 2010; Krebs et al., 2013; Norris et al., 2001; Odgers-Jewell et al., 2017). An observational study in New Zealand showed group-based DSME among Europeans, Māori, Pacific Islanders and Indians improved confidence and performance of diabetes self-management, physical activity, smoking rates, glycaemic control, and blood pressure at six months (Krebs et al., 2013). A refresher course at six months was also recommended by the authors due to attenuation of these improvements after this period (Krebs et al., 2013). Diabetes UK members consider access to structured diabetes education to be an important component of ongoing care, with a waiting list of patients wanting to engage with the service (Diabetes UK, 2009). However, despite expressions of interest, attendance at some diabetes education classes has been poor (Diabetes UK, 2009; Steinsbekk et al., 2012). In Ontario, although all patients newly diagnosed with diabetes were offered the DSME programme, only one in five patients took up the offer within six months of diagnosis (Cauch-Dudek et al., 2013). The proportion of patients attending the programme barely increased after extending the follow-up to 8 months, indicating the low attendance rate was caused by barriers such as low health literacy, financial or occupational barriers (Cauch-Dudek et al., 2013). Also, although increasing numbers of people with diabetes had been offered courses, there were still geographical areas that had no established programme (Diabetes UK, 2009). In 2009, just over one third of Diabetes UK members had attended a course since diagnosis and half of those who had not attended wished to attend (Diabetes UK, 2009).

Clearly there is a need for diabetes education. For those able to attend DSME courses, benefits have been found. Nevertheless, only a proportion of people with diabetes receive such assistance. Lack of transportation, work commitments, language barriers and
financial cost were found to be the main barriers preventing patients from accessing diabetes care in a traditional face-to-face setting (Attridge et al., 2014; Cauch-Dudek et al., 2013; Coonrod et al., 1994; Diabetes UK, 2009). Digital resources on the other hand may help overcome some of the problems identified with conventional diabetes self-management education.
Online diabetes self-management education

Online diabetes self-management education has advantages over conventional face-to-face sessions in that it allows individuals access to diabetes education and supporting services at their convenience. A pilot study conducted at Stanford University found that an Internet diabetes self-management workshop provided effective and culturally appropriate education sessions to American Indians and Alaskan Natives (Jernigan & Lorig, 2010). Participants communicated online in a culturally friendly and relaxed environment. This online workshop was highly valued by participants living in rural and tribal settings as it reduced time constraints and overcame geographic barriers (Jernigan & Lorig, 2010). Together with rapidly growing Internet usage and limited healthcare resources, patients’ preference has shifted from acquiring traditional paper-based or face-to-face information to web- or app-based information (Fox & Duggan, 2013b).

1. Predictors of using health information online

Searching health information online has been positively associated with individuals’ education level and their access to the Internet (Kind et al., 2005; Lustria et al., 2011). It is also associated with ethnicity but to a lesser degree. The proportion of ethnic minorities using the Internet to search for health information was only slightly less or almost the same as for ethnic majorities. (Kind et al., 2005; Lustria et al., 2011; Reininger et al., 2013). In 2016, 88% of American adults used the Internet as opposed to 52% in 2000 (Pew Research Center, 2017). Over the past sixteen years, Internet usage has proportionally increased the most among older adults (14% to 64%), low-income households (34% to 79%), people who are black (38% to 85%) and people who had less than a high school
education (19% to 68%) (Pew Research Center, 2017). Concurrently, increasing numbers of patients use the Internet to seek health information. In 2013, 72% of the Internet users in the United States sought health information online and 59% used the Internet specifically to seek information on a medical condition, symptoms or treatment for themselves or someone else (Fox & Duggan, 2013b). A similar uptake has been found in New Zealand with higher Internet access by Māori with diabetes (70%) compared to Māori without diabetes (46%) (Gibson et al., 2013; Reti et al., 2011).

Convenience, anonymous access and the extensive range of health information are the main motivators for searching online (Rainie & Fox, 2000). In a study conducted in the United States, African Americans, Caucasians and Mexican Americans discussed their experiences of searching diabetes information online (Reininger et al., 2013). Participants in the study reported frequent Internet use to search for detailed health information if they had family members or friends with diabetes. There was no significant difference between these ethnic groups in how they searched for health information, but there were differences in where the search was conducted and what type of devices were used (Reininger et al., 2013). Most Mexican American participants accessed health information online via desktop computers as opposed to phones, laptops or tablets, devices which Caucasian participants were more likely to use. African American participants were more inclined to use public facilities (i.e. libraries) for online health information than the other two ethnic groups (Reininger et al., 2013). Similarly in New Zealand, 99% of the Internet users have Internet access at home in 2015, and searching for health information online has risen from 65% in 2007 to 87% in 2015 (Smith et al., 2016). Although Asians tend to engage more and Pacific Islanders tend to engage less with Internet, the digital divides between ethnicities have lessened over the years (Smith et al., 2016).
2. Quality of diabetes information online

The Pew Research Centre reported that 56% of American adults with diabetes had used the Internet in 2013 (Fox & Duggan, 2013a). Compared to those without diabetes, they were more likely to have gathered information online about their medical problems, treatment and medications. They were also more likely to have reviewed and shared personal health experiences (Fox & Duggan, 2013a). Exposure to health information online has been found to influence individuals’ health care behaviour and decision-making on medical treatment, but of concern, only 60% of individuals with chronic conditions consulted a medical professional about what they found online (Fox & Duggan, 2013a).

Users of online services value a wide spectrum of health information (Rainie & Fox, 2000; Reininger et al., 2013), but they also have concerns regarding the credibility, usefulness and readability of the information (Eysenbach et al., 2002; Rainie & Fox, 2000; Scullard et al., 2010; Weymann et al., 2015b). In reality, many users may judge the quality and reliability of the information based on the design and the appearance of the website rather than on the scientific credibility of the information (Eysenbach & Köhler, 2002; Sillence et al., 2007). A recent review of the quality of 46 websites for type 2 diabetes confirmed the above findings. Usability (e.g. website design) and formal quality (e.g. disclosure of the ownership of the website) are highly associated with the website traffic. The Health on the Net (HON) Foundation established the Code of Conduct to standardise the reliability and quality of medical and health information on websites (Health On the Net Foundation, 2017). Those with a HON code presented significantly higher quality information than the websites without a HON code (Weymann et al., 2015b). Although the
health condition of interest and its natural causes were described in over 80% of the websites, no website provided “probabilities of outcomes in an unbiased and understandable way” with only one website, a commercial site selling medical supplies, offering support for decision-making. Less than 5% of the websites involved people with diabetes in the development of content and appearance of the websites, reflecting concerns about the ability of the majority of websites to meet patients’ needs. (Weymann et al, 2015b).
Effectiveness of providing diabetes education using electronic resources

From the initial 711 publications retrieved from Pubmed®, 78 human adult interventional studies were identified. Of these, 67 studies were excluded for the following reasons: the interventions were mainly delivered by clinicians via face-to-face, emails or text messages; the intervention did not include diabetes education; the study was unfinished; or the study was a repeat and used the same data. The same literature search was performed in Science Direct® and ProQuest® and an additional five studies were identified (Figure 2-1).

Sixteen interventional studies were included in this literature review investigating the effectiveness of diabetes online education. Of these, eleven were randomised controlled trials (RCT) and five were uncontrolled interventional studies. Study characteristics are summarised in Table 2-1 in chronological order. Seven studies embedded a recording function in their electronic program encouraging participants to track their blood glucose, diet, weight and/or exercise. Four studies incorporated goal setting.
HbA1c, Glycated haemoglobin A1c.

**Figure 2-1** Flowchart of literature selection process and the main outcomes
<table>
<thead>
<tr>
<th>Study</th>
<th>Study design</th>
<th>Duration</th>
<th>Purpose</th>
<th>Language</th>
<th>Subjects (n)</th>
<th>Mean age</th>
<th>Years of diabetes</th>
<th>Ethnic minority</th>
<th>Education/ health literacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wise et al (1986)</td>
<td>RCT</td>
<td>4-6 month</td>
<td>Education</td>
<td>English</td>
<td>174</td>
<td>49.9</td>
<td>9.9</td>
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<tr>
<td>Gerber et al (2005)</td>
<td>RCT</td>
<td>1 year</td>
<td>Education</td>
<td>English &amp; Spanish</td>
<td>183</td>
<td>55.3</td>
<td>5.6</td>
<td>29.1% African American 66.0% Latino 41.4% Spanish speaking only</td>
<td>55% Low health literacy</td>
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<tr>
<td>Wangberg et al (2007)</td>
<td>RCT</td>
<td>1 month</td>
<td>Education + tracking</td>
<td>English</td>
<td>64</td>
<td>39.9</td>
<td>_</td>
<td>_</td>
<td>31.7% 12 years or less education</td>
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<tr>
<td>Porter et al (2009)</td>
<td>Uncontrolled intervention</td>
<td>_</td>
<td>Education</td>
<td>Spanish</td>
<td>9</td>
<td>_</td>
<td>_</td>
<td>100% Hispanic</td>
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<tr>
<td>Lorig et al (2010)</td>
<td>RCT</td>
<td>6 month trial + 18 month follow up</td>
<td>Education + goal setting</td>
<td>English &amp; Spanish</td>
<td>761</td>
<td>54.3</td>
<td>_</td>
<td>76% non-Hispanic white 110 AI/AN</td>
<td>mean of 15.7 years of education</td>
</tr>
<tr>
<td>Glasgow et al (2011)</td>
<td>RCT</td>
<td>4 months</td>
<td>Education + goal setting + tracking</td>
<td>English &amp; Spanish</td>
<td>270</td>
<td>60</td>
<td>_</td>
<td>4.2% AI/AN 1.5% Asian 18.1% Black or African-American 67.4% White 8.9% No information/other 22.3% Latino ethnicity</td>
<td>20.4% High School or less education</td>
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<tr>
<td>Study</td>
<td>Study design</td>
<td>Duration</td>
<td>Purpose</td>
<td>Language</td>
<td>Subjects (n)</td>
<td>Mean age</td>
<td>Years of diabetes</td>
<td>Ethnic minority</td>
<td>Education/health literacy</td>
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<tr>
<td>Heinrich et al (2011)</td>
<td>RCT + survey + interview</td>
<td>2 weeks</td>
<td>Education</td>
<td>English</td>
<td>99 RCT</td>
<td>57</td>
<td>35.5% &lt;2 y</td>
<td>39.5% with low education level</td>
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<td></td>
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<td>564 survey</td>
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<td>28.5% 2-4 y 57.3% &gt; 4 y</td>
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<td>Quinn et al (2011)</td>
<td>Clustered-RCT</td>
<td>1 year</td>
<td>Education + tracking</td>
<td>English</td>
<td>163</td>
<td>52.8</td>
<td>8.2</td>
<td>30.0% High school/trade school or less</td>
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<tr>
<td>Glasgow et al (2012)</td>
<td>RCT</td>
<td>12 months</td>
<td>Education + goal setting + tracking</td>
<td>English &amp; Spanish</td>
<td>463</td>
<td>58.4</td>
<td>_</td>
<td>19.1% High school or less education 5.9% Low to moderate health literacy</td>
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<tr>
<td>McMahon et al (2012)</td>
<td>RCT</td>
<td>12 months</td>
<td>Education + tracking</td>
<td>English</td>
<td>151</td>
<td>60.2</td>
<td>2.1% &lt; 1 y 19.0% 1-5 y 29.6% 6-10 y 49.3% &gt; 10 y</td>
<td>95.0% &lt; High school 28.6% High school 36.1% Some college 25.9% ≥ College</td>
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<tr>
<td>Reininger et al (2013)</td>
<td>Uncontrolled intervention + Interview + Survey</td>
<td>90 min</td>
<td>Education</td>
<td>English &amp; Spanish</td>
<td>71</td>
<td>_</td>
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<td>26.8% African American 38.0% Caucasian 35.2 Mexican American</td>
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<td>11.3% with less than college education</td>
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<tr>
<td>Study</td>
<td>Study design</td>
<td>Duration</td>
<td>Purpose</td>
<td>Language</td>
<td>Subjects (n)</td>
<td>Mean age</td>
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<td>Yu et al (2014)</td>
<td>Uncontrolled intervention + interviews</td>
<td>9 months</td>
<td>Education + tracking</td>
<td>English</td>
<td>81</td>
<td>57.2</td>
<td>31% &lt; 5 y</td>
<td>62% white</td>
<td>15% High school or less education</td>
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<td>20% 5–9 y</td>
<td>30% Asian</td>
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<td>23% 10–14 y</td>
<td>7% African American</td>
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<td>20% 15–20 y</td>
<td>1% Hispanic</td>
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<td>6% &gt; 20 y</td>
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<tr>
<td>Carolan-Olah et al (2015)</td>
<td>Uncontrolled intervention</td>
<td>_</td>
<td>Education</td>
<td>English</td>
<td>21</td>
<td>31</td>
<td>GDM</td>
<td>28.6% Vietnamese</td>
<td>52.4% not complete high school</td>
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<td>23.8% Australian</td>
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<td>23.8% Indian</td>
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<td>14.3% Chinese</td>
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<td></td>
<td></td>
<td></td>
<td>9.5% Other</td>
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<tr>
<td>Weymann et al (2015)</td>
<td>Blinded RCT + parallel design</td>
<td>3 months</td>
<td>Education</td>
<td>German</td>
<td>179 T2DM</td>
<td>52.5</td>
<td>10.8</td>
<td></td>
<td>55.3 % &lt; 10 y education</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>382 chronic back pain</td>
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<tr>
<td></td>
<td>Post study questionnaire</td>
<td>12 months</td>
<td>Education</td>
<td>Bahasa Malaysia &amp; English</td>
<td>66</td>
<td>_</td>
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</tr>
<tr>
<td>Rice et al (2017)</td>
<td>Uncontrolled intervention</td>
<td>3 months</td>
<td>Education</td>
<td>English</td>
<td>19</td>
<td>63.9</td>
<td>Newly diagnosed</td>
<td></td>
<td>_</td>
</tr>
</tbody>
</table>

AI/AN, American Indians and Alaskan Natives. RCT, randomised controlled trials. T2DM, type 2 diabetes.
1. **Effectiveness of electronic diabetes education on diabetes knowledge**

The effectiveness of electronic diabetes education on diabetes knowledge has been examined in four randomised controlled trials (Gerber et al., 2005; Heinrich et al., 2011; Weymann et al., 2015a; Wise et al., 1986) and four uncontrolled interventional studies (Carolan-Olah et al., 2015; Porter et al., 2009; Ramadas et al., 2015; Reininger et al., 2013). Positive learning outcomes were reported by the majority of these studies (Carolan-Olah et al., 2015; Heinrich et al., 2011; Porter et al., 2009; Reininger et al., 2013; Wise et al., 1986).

As early as 1986, Wise et al reported that using an interactive computer teaching program or receiving computer-generated feedback significantly improved participants’ knowledge, whereas no change was found in those who received usual care or knowledge assessments only (Wise et al., 1986). Similarly, Heinrich et al reported that participants’ diabetes knowledge score was significantly higher in those who had used an educational website than those who had received usual care or assessment only (Heinrich et al., 2011). In both studies, the educational materials or the feedback were provided within a week after completing the pre-study assessment. Positive learning outcomes may be due to receiving timely education after an assessment, which is known to promote learning engagement and to consolidate new information (Butler & Winne, 1995).

No difference in diabetes knowledge was found between patients with type 2 diabetes who had received usual care and those who had one-year access to 19 diabetes lessons via computers located in outpatient waiting rooms (Gerber et al., 2005). The only difference was after a one-year intervention patients perceived they had greater risk of
developing eye, kidney or heart disease than control patients, especially among those with low literacy. A reason for the lack of effect may be due to inadequate interaction with the program. Although the intervention group spent thirty minutes longer on the computer than the control group, the actual completion of the lessons was not reported (Gerber et al., 2005; Rice et al., 2017). Another factor may be that an outpatient waiting room is an environment that is not conducive to learning, being full of distractions.

Electronic education resources tailored to ethnic groups have been developed through incorporating ethnic foods and translating into various languages. Three uncontrolled interventional studies explored the effectiveness of ethnic-specific education material (Carolan-Olah et al., 2015; Porter et al., 2009; Reininger et al., 2013). Two studies were carried out in the United States, one with Hispanic participants (n = 9) (Porter et al, 2009) and the other with African Americans, Caucasians, and Mexican Americans (n = 71) (Reininger et al, 2013). The numbers of participants were small in both studies, however significant improvements in knowledge were reported. Although neither study had a control group, participants’ knowledge was assessed immediately before and after an educational intervention (Porter et al., 2009; Reininger et al., 2013). This instant reassessment minimised the effect of other confounding variables, although immediate recall may overestimate learning effects as it requires a greater reliance upon memory than reasoning and practice (Alba & Hutchinson, 2000; Schneider & Laurion, 1993). Without repetition and practice memory declines over time with an accompanying decline in knowledge retention (Alba & Hutchinson, 2000).

Knowledge improvement was also shown in an Australian study with a pre- and post-education test design (Carolan-Olah et al., 2015). In this study, participants attended a
clinic appointment between pre- and post-assessments. However, without a control group it is not possible to evaluate whether the knowledge gain was from using the education website or from attending the clinic. In addition, misinterpretation of some questions was reported in this study, which may have affected the final results towards a null effect.

In a Malaysian study, participants were given twelve web-based lesson plans tailored to their stage of change. The study showed that post-education knowledge was strongly related to content satisfaction, acceptability, and usability of the website, and moderately associated with frequency of use and duration of time spent on the website (Ramadas et al., 2015). Individuals participating in tailored education may be more engaged and interested in completing the course compared with being given general advice. Weymann et al found that participants spent significantly more time and demonstrated higher post-education knowledge after using a tailored web-based resource which sent automated information responding to an individual's message than those who received the same information without tailoring. However, as the study did not measure baseline knowledge, it was unclear if the differences in knowledge were caused by the intervention, by baseline variation, or by the time spent on the resource (Weymann et al., 2015a). The studies above show potential for learning using electronic means, but having a control condition would give more reassurance that the effect was caused by the education resource as opposed to other confounding factors.

Internet literacy level may affect individuals’ learning outcome using an electronic device. Participants with low Internet literacy showed less improvement in their knowledge gain
(Reininger et al., 2013), whereas those with high-literacy were also more likely to find the program was easy to use, and spent longer time with a computer (Gerber et al., 2005).

2. Effectiveness of electronic diabetes education on clinical outcomes

1) Glycated haemoglobin A1c (HbA1c)

The effectiveness of electronic diabetes education on HbA1c has been studied in seven RCTs (Table 2-2) (Gerber et al., 2005; Glasgow et al., 2012; Lorig et al., 2010; McMahon et al., 2012; Quinn et al., 2011; Wise et al., 1986) and two uncontrolled interventional studies (Rice et al., 2017; Yu et al., 2014). Mixed results have been reported. Wise et al (1986) found computer training significantly reduced HbA1c by 0.7 - 0.8% (8 - 9 mmol/mol) in participants with type 1 diabetes from baseline of 9.3% (78 mmol/mol) (P < 0.05) and insignificantly reduced HbA1c by 0.8% (9 mmol/mol) in participants with type 2 diabetes from baseline of 8.7% (72 mmol/mol) (P > 0.1). Frequency of hypoglycaemia and insulin adjustment may impact the intervention effects, which could have explained the insignificant effect in a type 2 diabetes group receiving computer training (Wise et al., 1986). In the same study, participants with type 1 or type 2 diabetes who received computer generated feedback showed significant improvement in HbA1c of 1.2 - 1.3% (13 – 14 mmol/mol) from baseline values of 9.2 - 9.3% (77 – 78 mmol/mol) (Wise et al., 1986). Interestingly, HbA1c significantly improved by 0.7 - 0.8% (8 -9 mmol/mol) among participants who received initial assessment only, whilst no improvement was shown in the no-assessment type 1 and type 2 diabetes control groups. A possible explanation was that the knowledge assessment itself may have
stimulated motivation and awareness to diabetes care leading to some behaviour changes.

An Internet-based diabetes self-management programme (IDSMP) developed by Stanford University (Lorig et al., 2010) provided diabetes training and a 6-month period of monitoring, goal setting, and peer support. Despite this study having had a much more complex intervention design than the study by Wise et al, only a small 0.1% (1 mmol/mol) reduction in HbA1c was found. A lower HbA1c at baseline (6.4%, 46 mmol/mol) compared to the Wise et al participants (8.4 - 9.6%, 68 – 81 mmol/mol) may be a possible explanation. Indeed, the sub-group with initial HbA1c exceeding 7% demonstrated greater improvement in HbA1c (-0.6%, -6 mmol/mol, P = 0.01) compared with the entire cohort (Lorig et al., 2010). A high starting point may be indicative of poor glycaemic control in part attributable to modifiable behaviour. Gerber et al found low-literacy participants with HbA1c ≥ 9.0% (75 mmol/mol) demonstrated a significantly greater reduction in HbA1c in the intervention group than a control group (-2.1 vs. -0.3%, -23 vs. -3 mmol/mol), while again, amongst the whole cohort there was no significant between-group difference (Gerber et al., 2005). McMahon et al also reported a stronger improvement in HbA1c (-2.4%, -26 mmol/mol, P < 0.001) in the subgroup of people with HbA1c ≥ 10.0% (86 mmol/mol) than all subjects.

In the Mobile Diabetes Intervention Study (Quinn et al., 2011), patients who had used a mobile diabetes coaching system received automated real-time educational messages based on their diabetes self-care data; an intervention associated with a significant improvement in HbA1c (-1.6%, -17 mmol/mol, P = 0.027) from baseline as opposed to no change in the usual care group. Also, similar to the studies above, a significantly
greater reduction in HbA1c was shown in the participants with HbA1c ≥ 9.0% (75 mmol/mol) than with HbA1c < 9.0% (-1.3% vs. -0.7%, -14 vs. -8 mmol/mol, P = 0.017) when compared to the usual care group.

Interaction with the resource is key to demonstrating an educational effect. Achieving regular resource use at home may be an issue when interventions are delivered via electronic devices rather than by clinicians providing personalised consultation (Newman et al., 2011). A recent UK pilot study (Rice et al., 2017) comparing participants who had watched diabetes educational films with those who had not, found the HbA1c of those who had watched was significantly less by 9.0 mmol/mol at 3 month follow up. Also, a significant correlation between the improvement in individuals’ HbA1c and numbers of diabetes educational films they had watched online was found. However, only 19 out of 68 people given the link actually watched the films. The reason for this low uptake was not discussed in the study. Hence it is unknown if it was due to limited access to the Internet or lack of interest. Although there was no significant difference in HbA1c at baseline between those who viewed films and those who didn’t, the reduction in HbA1c in participants who watched films may have been due to motivation as well as the content of the film. Without a control group, it is difficult to evaluate if the improvement was caused by motivation, or education, or both.

McMahon et al found telephone support (n = 51) and personal messages (n = 51) did not give additional benefit to web-based education (n = 49). All three groups showed significant reductions in HbA1c (-1.3% to -1.7%, -14 to -19 mmol/mol) from a baseline of 9.6 - 10.1% (81 – 87 mmol/mol) with no between-group difference. Achieving similar effects without extensive human input is encouraging, which was also shown among
participants who used the IDSMP developed by Stanford University (Lorig et al., 2010). However, remote involvement may not always predict benefit, as no improvement in HbA1c was found in a study in which participants were assigned to either a computer-assisted diabetes self-management (CASM) or to a group with CASM, follow-up calls and peer support (Glasgow et al., 2012). The CASM was comprised of diabetes education, goal setting and an action plan with a focus of behaviour change. Again, a relatively good HbA1c (8.1-8.3%, 65 – 67 mmol/mol) at baseline may have limited the ability to detect differences. It suggested a more intensive intervention may be required to show effects in this participant cohort.

2) Lipids, blood pressure and body weight

Lipids and blood pressure control are important for diabetes cardiovascular disease risk management (American Diabetes Association, 2017b). Five studies examined blood pressure change, with most reporting a statistically insignificant result (Table 2-2) (Gerber et al., 2005; Glasgow et al., 2012; McMahon et al., 2012; Quinn et al., 2011; Yu et al., 2014). Glasgow et al and McMahon et al reported participants’ blood pressure was significantly improved after twelve months, however when compared to the usual care group, there was no significant difference (Glasgow et al., 2012; McMahon et al., 2012). The insignificant improvement may have been due to lack of blood pressure and lipids education as well as lack of interaction with the education material. Only two studies (Glasgow et al., 2012; McMahon et al., 2012) provided education on blood pressure and tracked participants’ blood pressure change. Although a web-page about blood pressure was included by Yu et al, only 8% of participants visited the page (Yu et al., 2014).
In the studies discussed above, no significant improvement in lipids were found when comparing the intervention groups to the usual care groups (Glasgow et al., 2012; McMahon et al., 2012; Quinn et al., 2011; Yu et al., 2014). However, education in relation to lowering blood lipids was not documented in any of these studies. Again, lack of education may have skewed the results towards a null effect.

Four RCTs (Gerber et al., 2005; Glasgow et al., 2012; McMahon et al., 2012; Yu et al., 2014) reported electronic diabetes education did not result in any weight change. Weight management education was not mentioned in any of these studies, which possibly led to insignificant improvement.
<table>
<thead>
<tr>
<th>Study</th>
<th>Setting</th>
<th>Clinical</th>
<th>Knowledge</th>
<th>Behaviour change</th>
<th>Ethnic-specific findings</th>
</tr>
</thead>
</table>
| Wise et al (1986) | Group 1: usual care  
Group 2: knowledge-assessment program (KAP)  
Group 3: KAP + feedback + KAP  
Group 4: KAP + interactive computer teaching + KAP | Group 1: no significant change  
Group 2: improved HbA1c of 0.7% (P < 0.05) in T1DM patients and 0.8% (P < 0.05) in T2DM  
Group 3: improved HbA1c of 1.2% (P < 0.05) in T1DM patients and 1.3% (P < 0.05) in T2DM  
Group 4: improved HbA1c of 0.8% (P < 0.05) in T1DM patients and 0.7% (P > 0.1) in T2DM patients | Group 1: no significant change  
Group 2: improved knowledge in T1DM (P > 0.05) and in T2DM (P < 0.05)  
Group 3: significant improvement (P < 0.05)  
Group 4: significant improvement (P < 0.05) | -- | -- |
Intervention: computer based multimedia diabetes lessons + multiple choice quizzes & feedback | HbA1c:  
Intervention & control group: no significant change  
Low literacy subjects with baseline HbA1c ≥ 9.0%: there was a greater decrease in HbA1c in the intervention group than control group (-2.1 vs. -0.3%, P = 0.036)  
BP: no significant change  
BMI: no significant change | Overall knowledge: no significant change in control and intervention group  
Perceived susceptibility to diabetes complications: significantly greater in control than intervention group especially in those with low literacy | Improvement in diet, exercise, smoking cessation, cutting nails, and home glucose monitoring | Nil  
Results were adjusted for age, sex, Latino race, income, insulin therapy, duration of disease, and previous attendance in diabetes class |
<table>
<thead>
<tr>
<th>Study</th>
<th>Control Group Description</th>
<th>Intervention Details</th>
<th>Findings</th>
</tr>
</thead>
</table>
  
  **Group 1:** in people with high self-efficacy (SE)  
  **Group 2:** in people with low SE | Significant improvement on self-care (P = 0.026) in both groups. Greater improvements of self-care in low SE group (P = 0.040) |
  25% increased in carbohydrate-counting skills                                             |
| Lorig et al (2010) | Control: usual care                                                                         | Intervention:  
  **Program group:** receive Internet-based diabetes self-management program (IDSMP) + book  
  **Reinforcement group:** IDSMP + book + discussion group                                  | No significant changes in aerobic exercise minutes per week  
  No significant change in visiting physicians.                                               |
|                  |                                                                                           | HbA1c (6 months): Available cases: significant 0.6% improvement in intervention group (P < 0.05).  
  Intention to treat: insignificant HbA1c improvement (P = 0.060)  
  Participants with HbA1c > 7.0%: significant improvement | At 6 months AI/AN: significant improved in visiting physician (P = 0.019)  
  activity limitation (P = 0.012)  
  Health distress (P = 0.004)  
  No significant improvement in: HbA1c, self-efficacy |
<table>
<thead>
<tr>
<th>Study</th>
<th>Control Group</th>
<th>Intervention</th>
<th>Comparison</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glasgow et al (2011)</strong></td>
<td><strong>Control group</strong>: usual care</td>
<td><strong>Computer-assisted self-management (CASM)</strong>: goal setting, tracking, learning</td>
<td><strong>CASM + social support</strong>: CASM + follow up calls</td>
<td>No significant correlation between the use of CASM and HbA1c, and BMI</td>
</tr>
<tr>
<td><strong>Heinrich et al (2011)</strong></td>
<td><strong>Control group (B)</strong>: usual care</td>
<td><strong>Experiment group (A)</strong>: access to web diabetes education for 2 weeks</td>
<td><strong>Post-test control group (C)</strong>: knowledge test only</td>
<td><strong>Group A</strong>: post-test knowledge scores were significantly higher compared to the baseline ($P &lt; 0.05$). <strong>Group B</strong>: no significant change <strong>Group C</strong>: no significant change</td>
</tr>
<tr>
<td><strong>Quinn et al (2011)</strong></td>
<td><strong>Group 1</strong>: usual care</td>
<td><strong>Group 2</strong>: coach only</td>
<td><strong>Group 3</strong>: coach + primary care providers’ portal</td>
<td><strong>Group 4</strong>: coach + primary care providers’ portal + decision support</td>
</tr>
<tr>
<td>Source</td>
<td>Control: enhanced usual care</td>
<td>Intervention: Computer-assisted self-management (CASM): goal setting, tracking, learning</td>
<td>CASM/CASM+ intervention group improved significantly in:</td>
<td>Intervention group improved significantly in: Eating habits: condition × time chi-square = 9.01, P &lt; 0.05. Fat intake: condition × time chi-square = 6.28, P &lt; 0.05. Physical activity: condition × time chi-square = 6.01, P &lt; 0.05. No significant change in medication adherence</td>
</tr>
<tr>
<td>--------------------------------</td>
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<td>----------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Glasgow et al (2012)</td>
<td></td>
<td>CASM/CASM+: CASM + 2 follow up calls + 3 group visits</td>
<td>HbA1c: condition × time chi-square = 10.54, P &lt; 0.05</td>
<td>HbA1c: significantly improved in all groups</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lipids: condition × time chi-square = 10.21, P &lt; 0.05</td>
<td>Web training: -1.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BP: condition × time chi-square = 11.11, P &lt; 0.05</td>
<td>Telephone care: -1.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10-Year CHD risk: condition × time chi-square = 17.20, P &lt; 0.05</td>
<td>Online care: -1.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BMI: no significant change</td>
<td>Cholesterol &amp; DBP: significantly improved in the online care and web training group</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No significant change in HbA1c, BP, weight and lipids among groups over time</td>
</tr>
<tr>
<td></td>
<td>Diabetes education + tracking every fortnight Communication via website +/- phone call</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Telephone care: BG and BP testing with follow up calls every fortnight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Online care: Usual care + online self-management websites</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reininger et al (2013)</td>
<td>No control group</td>
<td></td>
<td></td>
<td>All groups significantly increased diabetes knowledge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Participants significantly increased intention</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No ethnic differences in the frequency of searching health</td>
</tr>
<tr>
<td>Study</td>
<td>Control Group</td>
<td>Intervention Group</td>
<td>Key Findings</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Yu et al (2014)</td>
<td>No control group</td>
<td>Intervention group: web-based self-management</td>
<td>No significant changes in HbA1c, weight, SBP, DSP and LDL</td>
<td></td>
</tr>
<tr>
<td>Carolan-Olah et al (2015)</td>
<td>No control group</td>
<td>Intervention: web-based gestational diabetes (GDM) education</td>
<td>Percentage of women increased knowledge (or stayed at 100% correct):</td>
<td></td>
</tr>
<tr>
<td>Weymann et al (2015)</td>
<td>Control group: web-based content was delivered without tailoring</td>
<td>Intervention group: web-based content was delivered</td>
<td>Knowledge: improvement in both groups.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No significant difference between control and intervention group in:</td>
<td></td>
</tr>
</tbody>
</table>

Participants in pre-contemplation stage of consuming fruit and vegetables and those with low Internet literacy scores were less likely to show improved diabetes knowledge.

To eat a healthy diet each day in the next 2 months.

Ethnic groups differed by location and type of technology used. Return to use the website: African American 82%, Caucasian 70%, and Mexican American 91%.

The self-care improved by 0.44 (95% CI: 0.23, 0.63; P < 0.001).

Nil

The analysis was adjusted for age, sex, ethnicity, income, education, employment, and health literacy.

The intervention could prove a useful adjunct support for women with GDM from multi-ethnic and low socio-economic backgrounds.

Decisional conflict.
<table>
<thead>
<tr>
<th>Study</th>
<th>Control group</th>
<th>Intervention</th>
<th>HbA1c:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ramadas et al (2015)</td>
<td>Control group: not specified</td>
<td>Intervention: participated in a web-based diabetes education</td>
<td>Significant improved by $-7.1$ mmol/mol compared to baseline and $-9.0$ mmol/mol compared to non-watchers. Significant correlation between numbers of films watch and reduction in HbA1c ($P = 0.01$)</td>
</tr>
<tr>
<td>Rice et al (2017)</td>
<td>No control group</td>
<td>Intervention: watch eleven 5 min films</td>
<td>HbA1c:</td>
</tr>
</tbody>
</table>

AlAN, American Indians and Alaskan Natives. BG, blood glucose. BMI, body mass index. BP, blood pressure. CASM, computer-assisted self-management. CHD, coronary heart disease. DBP, diastolic blood pressure. GDM, gestational diabetes. HbA1c, Glycated haemoglobin A1c. HDL, high-density lipoprotein. KAP, knowledge-assessment program. LDL, low-density lipoprotein. SBP, systolic blood pressure. SE, self-efficacy. TAG, triglyceride. T1DM, type 1 diabetes mellitus. T2DM, type 2 diabetes.
3. Effectiveness of electronic diabetes education on behaviour change

1) Healthy eating and physical activity

Four RCTs (Gerber et al., 2005; Glasgow et al., 2011; Glasgow et al., 2012; Reininger et al., 2013) investigated dietary changes in relation to the use of an electronic diabetes education program (Table 2-2). All studies reported a positive result including improved eating habits (Gerber et al., 2005; Glasgow et al., 2012), fat intake (Glasgow et al., 2012), and intention to eat a healthier diet (Reininger et al., 2013). Glasgow et al reported that visiting the website, generating action plans and self-monitoring promoted this dietary change (Glasgow et al., 2011). Five RCTs explored the effectiveness of electronic diabetes education on physical activity, however the results were inconsistent (Gerber et al., 2005; Glasgow et al., 2011; Glasgow et al., 2012; Lorig et al., 2010; Reininger et al., 2013). Glasgow et al found a significant correlation between improved physical activity and self-monitoring exercise and healthy eating (Glasgow et al., 2011; Glasgow et al., 2012). In the study by Gerber et al, participants self-reported a greater level of exercise after using the program. On the other hand, the study by Lorig et al showed no significant difference in the length of aerobic exercise assessed using an exercise log (Lorig et al., 2010). Reininger et al found that using the education website did not enhance participants’ intention to increase physical activity (Reininger et al., 2013).
2) Medication intake and self-care

Four studies (Table 2-2) investigated the effectiveness of electronic diabetes education for medication compliance (Glasgow et al., 2011; Glasgow et al., 2012) and performance of self-care, such as blood glucose self-monitoring, visiting physicians and decision making (Gerber et al., 2005; Lorig et al., 2010; Wangberg, 2008; Weymann et al., 2015a; Yu et al., 2014). Significantly improved self-care from baseline has been reported in some studies (Gerber et al., 2005; Wangberg, 2008; Yu et al., 2014), whereas Glasgow et al reported no significant improvement in medication adherence after using a computer-assisted self-management program (Glasgow et al., 2011; Glasgow et al., 2012). Weymann et al found a tailored educational program did not assist in self-care decision making (Weymann et al., 2015a). Also, no significant difference in physician visiting was found when comparing between usual care groups (Lorig et al., 2010).

In summary, the impact of electronic diabetes education on behaviour change such as dietary intake, physical activity, medication compliance and self-care is inconsistent. Making sustained behaviour change is crucial to achieving an optimal long term health outcome, however adopting a new behaviour or changing the existing one requires not only sufficient knowledge, but also motivation, and ongoing support (Rollnick et al., 2008). The latter two were less likely to be obtained via interacting with an electronic resource than a face-to-face consultation, which may lead to this inconclusive result.
4. Effectiveness of electronic diabetes education for ethnic minority groups

Seven studies reviewed the effectiveness of electronic diabetes education for ethnic minority groups (Table 2-2) (Carolan-Olah et al., 2015; Glasgow et al., 2011; Glasgow et al., 2010; Glasgow et al., 2012; Lorig et al., 2010; Porter et al., 2009; Reininger et al., 2013). The intervention worked equally well (Glasgow et al., 2011; Glasgow et al., 2010; Glasgow et al., 2012; Reininger et al., 2013) or even better for ethnic minority groups (Glasgow et al., 2012; Lorig et al., 2010) in studies comparing ethnic minority and majority groups. Lorig et al reported after receiving IDSMP, the American Indian and Alaskan Native group significantly improved in physician visiting, ability to perform daily activities and health distress as opposed to no significant improvement in all participants (Lorig et al., 2010). Reininger et al discovered that although ethnic groups differed by the location and types of electronic devices they used to access the Internet, no ethnic difference in frequency of searching health information, reactions to electronic devices, or behaviour change was found (Reininger et al., 2013). In a study with Hispanic people, Porter et al found 39% of participants increased diabetes knowledge and 25% increased carbohydrate counting skills (Porter et al., 2009). In a study conducted by Carolan-Olah et al with predominantly Asian participants, 70.6%, 50.0% and 36.8% of participants improved or maintained correct knowledge of gestational diabetes, food knowledge, and self-management, respectively (Carolan-Olah et al., 2015).
Conclusion

With an increasingly high prevalence of diabetes and demands for specialist care, providing diabetes self-management education upon diagnosis is crucial. Time, cost, location and availability of the healthcare services were often identified as barriers for patients to access diabetes care and obtain diabetes information. As a result, many patients turned to the Internet to search for information. However, without a medical background patients were often unable to distinguish high-quality from low-quality information. Cultural beliefs and language difficulties may hinder ethnic minority patients from achieving optimal glycaemic control. When culturally appropriate diabetes education was provided in a patient’s own language, improvements in glycaemic control were achieved.

The effectiveness of electronic diabetes education has been found to be variable among studies. Some positive results in diabetes knowledge, HbA1c, and eating behaviour have been reported. Environmental distractions, baseline HbA1c, inconsistent use of the resource and comprehensiveness of the information may all impact the final result. No ethnic differences were reported as an outcome of using an online education program when the program was designed to cater for specific ethnic needs. Some studies even showed greater improvement in diabetes self-care in those ethnic minority patients.
Most of the validated educational resources were developed for research purposes and are not readily available to the general public. All education was delivered via text, pictures and/or video. Participants were not given an option to choose their preferred learning style. Additionally, there has been no indication in the work to date that the resources were developed with input from the intended recipients. Assessing peoples’ knowledge gap and desires and incorporating these ideas into a resource will likely encourage engagement.

To our knowledge, there is no electronic educational resource for diabetes nutrition designed and tested in the New Zealand population which has a multicultural makeup. With the rapid increase in access to the Internet, there is a need for high quality online education resources to be produced in collaborations between health professionals and patients.
Chapter 3. Nutritional Knowledge, Education and Online Engagement for Pre- and Type 2 Diabetes in New Zealand Multi-ethnic Population: A Qualitative Study
Introduction

To provide best practice for diabetes care, structured multidisciplinary team input is required for diabetes education to reduce acute and long-term complications. (Diabetes UK, 2010; Ministry of Health, 2014b; Segal et al., 2013). Despite evidence of benefit from best-practice, the reality for many countries is a general lack of resources to cater to the growing numbers of people with diabetes (Guariguata et al., 2014). The global prevalence of diabetes reached 8.3% in 2014 and is predicted to continue to increase in the next 20 years (Guariguata et al., 2014; International Diabetes Federation, 2015b).

Poorly controlled glycaemia increases the risk of diabetes complications and reduces quality of life and life expectancy (Stratton et al., 2000). The situation is more challenging for indigenous and ethnic minority individuals living in predominantly Caucasian countries. In New Zealand, Māori and Pacific people with diabetes experience earlier onset and more complications than Europeans (Ministry of Health, 2014b). For Māori aged 46-64 years, diabetes related death rates were nine times higher than non-Māori of the same age (Ministry of Health, 2014b). It has been found that ethnic minorities receive less diabetes education (Bruce et al., 2003), have less diabetes knowledge (Hawthorne et al., 2008), have less engagement with diabetes services (Ferguson & Candib, 2002; Kristensen et al., 2007) and have higher emotional distress (Delahanty et al., 2007; Spencer et al., 2006) than the ethnic majority. Compounding these inequalities is a
tendency for ethnic minority groups to have a higher prevalence of type 2 diabetes and to have poorer health outcomes compared with the majority ethnic group (Bruce et al., 2003; Diabetes UK, 2010; Lanting et al., 2005; Mukhopadhyay et al., 2006).

Identifying barriers to education and access to diabetes services is important if ethnic inequalities are to be addressed. One strategy arising from this digital age has been the development of electronic health related resources. The research described herein was conducted using ethnic-specific focus groups in New Zealand. It was aimed at exploring experiences and emotions amongst Māori, European, Pacific Island, Indian, and East Asian people living with diabetes or pre-diabetes. It was also aimed at ascertaining their knowledge and cultural beliefs pertaining to diabetes, to gather their opinions as to the acceptability of participating in diabetes education online, and to identify ethnic-specific needs.
Methods

1. Ethics and recruitment

This focus group study was promoted through general practitioners’ practices, primary health organisations and community health support services. All adults with pre- and type 2 diabetes who expressed interest were asked for their consent to be telephoned about the study. Additionally, advertisements were placed on noticeboards in local medical centres, libraries, community centres, sports facilities, and supermarkets. Eligible participants were invited to attend one focus group based on their ethnicity. The inclusion criteria were: diagnosis of pre-diabetes or type 2 diabetes, New Zealand residence, and ability to communicate in English. The exclusion criteria were people with severe speech or hearing difficulties, unable to speak English or over age 79 years. The Ngāi Tahu Research Consultation Committee was consulted (Appendix 2) and the study was approved by the University of Otago Human Ethics Committee (Reference no. 14/179) (Appendix 1).

Interested participants were followed up with a 15-20 minute phone call to ensure they fitted the inclusion criteria and to provide them with detailed information about the study. Of the 71 referrals and respondents (19 Europeans, 10 Māori, 11 Pacific Islanders, 14 East Asian and 17 Indian), 13 people could not be contacted and 22 declined. Of the remaining
36 people, seven declined before the first visit. Thus, 29 participants (six Europeans, five Māori, four Pacific Islanders, eight East Asians, and six Indians) attended separate ethnic-specific focus groups. Although five ethnic-specific focus groups each with seven participants were originally planned, additional Māori and Pacific Island focus groups were conducted due to last minute drop outs.

Prior to the focus group, a written information sheet (Appendix 3) was given to each participant, reiterating the study requirements and risks, together with telephone numbers and email addresses if queries were forthcoming. Participants were asked to provide written informed consent and to fill out a short questionnaire about their demographics (age, gender, ethnicity), duration of diabetes, medication and baseline knowledge of nutrition and diabetes. They also had chance to ask questions about the study which were answered verbally.

2. Procedures

The focus groups were designed and conducted in accordance with Stewart et al’s recommendations (David W. Stewart, 2007). The focus groups were delivered face-to-face in Auckland apart from one conducted in Palmerston North with Māori participants, using Skype® to overcome geographic barriers (Janghorban et al., 2014). The duration of each focus group was approximately one hour, conducted in a safe and comfortable
environment with each session audio-recorded. An interviewer guide was used to conduct each focus group.

The focus group questions were arranged in a logical order, with the most important questions towards the beginning (Appendix 4). The questions were open-ended and designed to avoid wording suggestive of a ‘correct’ answer. All participants were encouraged to speak freely, whilst the facilitator (ZZ) ensured that the discussion moved at an appropriate pace and finished on time. Discussion aids such as sentence completion exercises and brainstorming on a whiteboard were used during discussion. At the end of the session, the purpose of the focus groups was repeated. Participants were thanked for giving up their time to participate in the session, and additional questions from participants were answered.

3. Data Analysis

A published thematic approach involving deductive and inductive techniques was used (Fereday & Muir-Cochrane, 2006). A priori, the broad code categories of knowledge, experience and desire were selected. All audio recordings were transcribed verbatim by the facilitator (ZZ) and checked by a second investigator (BV). Photographs were taken to record notes written on a whiteboard during focus group discussion. Two researchers (ZZ and BV) independently coded the transcript. Potentially important words and phrases
were identified through both inductive and deductive analysis. These two sets of coding phrases were compared. Any discrepancies were discussed through reviewing the transcript and the meaning of a code until consensus was reached. Coding phrases were further developed into themes through creating a coding manual.
Results

1. Participants’ characteristics

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>European</th>
<th>Māori</th>
<th>PI</th>
<th>East Asian</th>
<th>Indian</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 29)</td>
<td>(n = 6)</td>
<td>(n = 5)</td>
<td>(n = 4)</td>
<td>(n = 8)</td>
<td>(n = 6)</td>
</tr>
<tr>
<td>N, pre-diabetes</td>
<td>9</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>N, type 2 diabetes</td>
<td>20</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Mean years of pre-diabetes</td>
<td>2.6</td>
<td>4.3</td>
<td>2.0</td>
<td>-</td>
<td>2.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Mean years of type 2 diabetes</td>
<td>13.7</td>
<td>3.3</td>
<td>27.3</td>
<td>10.8</td>
<td>14.0</td>
<td>11.2</td>
</tr>
<tr>
<td>Gender, male n (%)</td>
<td>11 (37%)</td>
<td>1 (17%)</td>
<td>3 (60%)</td>
<td>1 (25%)</td>
<td>2 (25%)</td>
<td>4 (67%)</td>
</tr>
<tr>
<td>Age, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45 – 54 years</td>
<td>3 (10.3%)</td>
<td>0 (0%)</td>
<td>1 (20%)</td>
<td>0 (0%)</td>
<td>2 (25%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>55 – 64 years</td>
<td>10 (25%)</td>
<td>2 (33%)</td>
<td>1 (20%)</td>
<td>2 (50%)</td>
<td>3 (38%)</td>
<td>2 (33%)</td>
</tr>
<tr>
<td>65 – 74 years</td>
<td>15 (52%)</td>
<td>4 (67%)</td>
<td>3 (60%)</td>
<td>2 (50%)</td>
<td>3 (38%)</td>
<td>3 (50%)</td>
</tr>
<tr>
<td>74 – 79 years</td>
<td>1 (3%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (17%)</td>
</tr>
<tr>
<td>Diabetes medication, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>6 (21%)</td>
<td>3 (50%)</td>
<td>1 (20%)</td>
<td>0 (0%)</td>
<td>2 (25%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Metformin</td>
<td>19 (67%)</td>
<td>3 (50%)</td>
<td>3 (60%)</td>
<td>3 (75%)</td>
<td>5 (63%)</td>
<td>5 (83%)</td>
</tr>
<tr>
<td>Sulfonylureas</td>
<td>8 (28%)</td>
<td>0 (0%)</td>
<td>2 (40%)</td>
<td>1 (25%)</td>
<td>2 (25%)</td>
<td>3 (50%)</td>
</tr>
<tr>
<td>Insulin</td>
<td>4 (14%)</td>
<td>1 (17%)</td>
<td>2 (40%)</td>
<td>0 (0%)</td>
<td>1 (13%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (3%)</td>
<td>1 (17%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

PI, Pacific Islander.

Participant characteristics are given in Table 3-1. The average time since diagnosis of the nine people with pre-diabetes was 2.6 years and for those with type 2 diabetes, 13.7 years. Of 29 participants, six participants were not on any diabetes medication. Of those on
medication; nineteen were prescribed metformin, eight on sulfonylureas, one took a different oral diabetes medication (Sitagliptin), and four were using insulin with or without oral medications.

2. **Diabetes care behaviours**

General practitioners (GPs) and registered nurses (RNs) were identified as the two main sources providing diabetes dietary advice across all focus groups. Being unaware of, and having limited access to diabetes services, was emphasised by several Māori, Pacific Island and Indian participants. All groups voiced a strong need for adequate consultation time and frequency to discuss their queries and concerns regarding diabetes control.

“You don’t really have a lot time, you go in there, and you just don’t have time to ask some questions.” – European group

“So far the lecture from diabetes centre was the only one come and discuss something [sic]. We have not heard from anybody else. It will help a long way if there are more dietitian lectures.” – Indian group

All ethnic groups wanted to have ongoing support and reminders to achieve and maintain a healthy diet and to increase compliance with medication. Peer support was valued by
several Māori, Pacific Islanders and Europeans who found sharing their experiences with other people with diabetes helpful and reassuring.

“Diabetes, diet is the main issue. Required to be reminded it again and again.” – Indian group

“Being around with people got the same illness as myself, it's like a support group [sic]. What they said was exactly what I am going through. And I think, none of us has been perfect. We all did the same thing.” – Pacific Island group

3. Diabetes knowledge

Apart from three people who had recently attended diabetes education classes, participants struggled when asked to describe pre- and type 2 diabetes, what the risk factors were of developing type 2 diabetes, and the reasons for pharmaceutical and lifestyle intervention. European, Māori and East Asian groups commented on the inconsistency of medical and nutritional information obtained from the Internet, and of more concern, between health professionals. Confusion due to lack of diabetes knowledge or being exposed to conflicting information was apparent across all ethnic groups. Animated discussions on suitable food and beverage options, and how to interpret laboratory test results, occurred in all focus groups.
“It’s more peace of mind, actually explaining what the medication is, instead of, go it’s one of these.” – Māori group

“You go on to the Internet and you can find that this is good. Do this and do that, and you can also go to another parts and it says this is all wrong.” – European group

Identifying “good” and “bad” dietary choices was another key discussion point in all ethnic groups. Most participants were restricting foods and beverages that were perceived by them to be bad for diabetes whilst increasing the intake of so-called good foods. Although all participants understood foods and drinks with added sugar increased blood glucose concentrations, the majority failed to recognise or understand that other carbohydrate in food has blood glucose raising potential. Misunderstanding and false impressions around diet and medication were apparent in participants of Māori, Pacific Island and Indian ethnicities (Table 3-2). These participants also appeared to have greater difficulty in understanding and retaining information containing medical terminology.

“Less eat potatoes, we are not allowed to eat potatoes, only once a week.” – Indian group

“These three fruits are deadly for diabetes. They are very high in sugar.” – Māori group
"Metformin is it to help breakdown the food or something like that? I've been told, but you know I don’t remember." – Pacific Island group

“I am a type 2 and on type 2 insulin. I used to be type 1, but it is leading up to type 2.” – Māori group

### Table 3-2 Foods identified as increasing blood glucose concentration

<table>
<thead>
<tr>
<th>Europeans</th>
<th>Māori</th>
<th>PI</th>
<th>East Asian</th>
<th>Indian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacon</td>
<td>Banana</td>
<td>Chocolate</td>
<td>Alcohol</td>
<td>Alcohol</td>
</tr>
<tr>
<td>Bakery food</td>
<td>Corn</td>
<td>Fatty foods</td>
<td>Cheese muffins</td>
<td>Beetroot</td>
</tr>
<tr>
<td>Biscuits</td>
<td>Fruit</td>
<td>Lollies</td>
<td>Fruit</td>
<td>Cola</td>
</tr>
<tr>
<td>Butter</td>
<td>Pineapple</td>
<td>Rice</td>
<td>Instant noodles</td>
<td>Rice</td>
</tr>
<tr>
<td>Cakes</td>
<td>Refined sugar</td>
<td>Sugar</td>
<td>Takeaways (e.g. sweet and sour)</td>
<td>Soft drinks</td>
</tr>
<tr>
<td>Chocolate</td>
<td>Rice</td>
<td>Takeaways</td>
<td>Instant noodles</td>
<td>Rice</td>
</tr>
<tr>
<td>Nuts</td>
<td>Sprite</td>
<td>Rice cakes</td>
<td>Rice cakes</td>
<td>Sugar</td>
</tr>
<tr>
<td>Pasta</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processed foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sausages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PL, Pacific Islander

4. **Negative emotions**

Complex emotions were a common theme in the discussions. All participants were fearful and worried about diabetes complications, medication side effects, eating unhealthy foods and having inappropriate portion sizes. Suspicion regarding the credibility of
information obtained from health professionals and other sources was expressed by all except the Indian focus group. The feeling among the Indian focus group was one of trust and reliance upon the information supplied by health professionals. Lacking control over their diabetes management due to limited understanding of diabetes and treatment plans left the majority of Māori and Pacific Island, and one Indian participant, feeling powerless over their own health destiny. One Māori and one East Asian also described feelings of embarrassment in discussing their diabetes with friends and family.

“How do you know that we got diabetes? Because I don't know I have diabetes, until I had a stroke.” – Pacific Island group

“It says it affect the heart, kidneys, eyes and foot. We've told it starts with eyes, heart, kidney and sensation of the foot. Sensation of the foot starts lose, any disease on the foot is difficult to get cured.” – Indian group

Participants of all ethnicities, except Indian, expressed aversion to a top-down nutrition consultation style that placed restrictions on their dietary intake. Frustration with medication being lifelong, doctors prescribing a new medication without the patient’s consent or awareness until dispensed by the pharmacist, and receiving conflicting dietary advice; was reported by participants within European, Māori and Pacific Island groups. One European, one Pacific Islander, one East Asian, and the majority of Indian participants
felt annoyed at having to provide ongoing self-care and monitoring for diabetes management. One Pacific Islander and one Indian participant were angry with themselves for relapsing into unhealthy eating habits and not paying enough attention to their own health.

“You tend to not like suddenly a whole lot of restrictions coming from middle of nowhere, telling you that you can’t eat this bread roll, you can’t drink this, you can’t do this, you can’t do that. And you rebel, so I’m not going to put on that crap.” – European group

5. Positive emotions and patients’ goals

Although negative emotions were expressed by all focus groups, there were some positive thoughts. All ethnic groups stated an interest in understanding diabetes, diabetes medications, diet, lifestyle, and how to make changes. Several participants in the European, Māori and Pacific Island groups expressed strong desires to halt the progression of diabetes and to stay healthy. Several participants from each ethnic group described feeling satisfied and even delighted when achieving goals such as achieving recommended blood glucose and maintaining dietary change. Some participants described their sense of gratitude towards families, friends, healthcare professionals, and other people with diabetes for psychosocial and medical support. Although this was
mentioned in all group discussions, appreciation of family involvement was specifically highlighted by the majority of the Pacific Island participants.

“Sometimes, I get frustrated. I didn't want to take any more medicine, but my wife talk me out of it. That's why I need my family, because they are the part taking care of you when you are at home.” – Pacific Island group

Recognising the need for good diabetes control and the setting of life goals, such as preventing diabetes complications and spending quality time with families, served as inspiration. Many participants expressed satisfaction from having discovered ways to change diet and lifestyle, being able to sustain these changes, avoiding temptation, and ultimately improving blood glucose control. This sense of achievement seemed to be lacking in the Indian focus group, with those participants expressing determination rather than celebration.

“I felt really good now. I said I feel I have to do something for myself, and I will see a real change, even up until now, I am a really changed person.” – Pacific Island group

“You need to have a reason to want to live in a long healthy life. For me, I want to see my grandchildren.” – East Asian group
“I realise in the end it is the weight. I just concentrated on the quantity that I eat, and when I eat. I stopped the night snacking. I love chocolate, but I can now go to the fridge and look at the chocolate and then just walk away.” – European group

6. Desired advice

Half of the participants felt that they had not received adequate nutrition advice. They expressed a strong desire for simple explanations regarding appropriate food choices. A pictorial or video format illustrated with ‘hands’ and ‘plate’ models were favoured over text-based advice, particularly if text incorporated scientific jargon. Some European, East Asian and Indian participants were also receptive to advice in numerical form for ease of compliance, for example thirty minutes of exercise.

“Dietitian said I could have enough potatoes like 3 small eggs, so that’s how I used to measure my carbohydrate portions. It’s like 3 small egg size.” – East Asian Group

“Plate is plate. Half, quarter, quarter simple (for vegetables, protein and carbohydrate).” – Māori Group

Participants wanted advice to be practical, especially around home cooking methods and dietary patterns. This increased their confidence for trialling and maintaining dietary and
lifestyle changes. Being culturally appropriate was also highlighted by East Asian and Pacific Island groups. Although European, Māori and Indian groups felt comfortable with English-language based education, being able to receive information in their own language was preferred by some participants in East Asian and Pacific Island groups.

“With diabetes, I want to know how to cook from what you have in your cupboards rather than buy all these lovely things, which is not realistic for your diabetes.” – Māori group

“Beans, corn, and nuts... See we’ve never eaten these good foods. We weren’t brought up with it.” – Pacific Island group

“It will nice if you can speak Samoan.” – Pacific Island group

7. Desired Diabetes Care

Māori, Pacific Island and Indian participants expressed a willingness to make lifestyle changes but felt overly dependent on treatment plans assigned by health professionals. Several participants described their frustration at the lack of involvement in decision-making around their own diabetes care citing poor communication with their healthcare provider. All groups indicated reluctance in making dietary and lifestyle changes because
they felt inadequately informed as to the need for change as well as perceived difficulties in avoiding temptation and fitting additional self-monitoring tasks into their life.

“Doctors now ask me what meds you take. I will tell them you work it out. You are the doctor. I’m just doing what I am told.” – Māori group

“The chemist said, Oh! You don’t need this medication anymore. It is not on the prescription. You are on this. I turned around and said, what do you mean? It isn’t inside of what I have been taking? They’ve changed that, and I never knew.” – Pacific Island group

Most participants supplemented the advice of their health professionals by taking initiatives to improve their diabetes knowledge by reading books, searching online, attending diabetes classes, making dietary changes, and self-monitoring blood glucose. In some cases, this lead to self-adjustment of diabetes medications. The main drivers for self-education were doubt about their understanding of best practice and fear of diabetes complications.

“You would look it on the computer, because the information is there.” – Māori group

“I read all about the diabetes myself from library books.” – East Asian group
Most participants felt delighted and satisfied with self-imposed lifestyle changes, whereas concern was expressed in the Māori, Pacific Island and Indian groups regarding self-adjustment of medication and treatment for hypoglycaemia.

“I started to feel shaking of my hands. Then I take some sugar or any foods. Once I okay with it, I stop. If I am outside, the best thing I do is buy bananas, two or three bananas, and one or two lollies.” – Indian group

“Knowing that the insulin should have not been starting at two units. I raised it up myself to straight up to 20, 30 units. My sugar level was too high and I can sense things going wrong in the eyes. I’ve just started to deal with it myself.” – Māori group

8. Desire for online diabetes information

The use of new technology to search for health-related information and recipes, and to create meal plans was clearly shown in all focus groups. Convenience and immediate information feedback were highly regarded attributes, although reliability of this information was a major concern. Only five out of 29 participants said they would probably not use online learning resources, with cost and age identified as barriers. Use of electronic devices is shown in Table 3-3.
Table 3-3 Use of electronic devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Total (n = 29)</th>
<th>European (n = 6)</th>
<th>Māori (n = 5)</th>
<th>PI (n = 4)</th>
<th>East Asian (n = 8)</th>
<th>Indian (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regular use</td>
<td>No/seldom use</td>
<td>Regular use</td>
<td>No/seldom use</td>
<td>Regular use</td>
<td>No/seldom use</td>
</tr>
<tr>
<td>Computer, n (%)</td>
<td>19 (66%)</td>
<td>10 (34%)</td>
<td>6 (100%)</td>
<td>4 (80%)</td>
<td>1 (25%)</td>
<td>5 (62%)</td>
</tr>
<tr>
<td></td>
<td>14 (48%)</td>
<td>5 (38%)</td>
<td>3 (60%)</td>
<td>3 (75%)</td>
<td>3 (38%)</td>
<td>3 (50%)</td>
</tr>
<tr>
<td>Tablet, n (%)</td>
<td>12 (41%)</td>
<td>17 (59%)</td>
<td>3 (50%)</td>
<td>3 (60%)</td>
<td>2 (50%)</td>
<td>6 (75%)</td>
</tr>
<tr>
<td></td>
<td>10 (34%)</td>
<td>15 (52%)</td>
<td>4 (67%)</td>
<td>2 (40%)</td>
<td>3 (75%)</td>
<td>3 (38%)</td>
</tr>
</tbody>
</table>

PI, Pacific Islanders

"When we went on the Internet, we have to depend on it. Sometimes there is different information on one topic.” – Indian group

"You cut back on the portions of your meal and then finish with a piece of fruit. You don’t really know if it is the right thing or not. If you have a website that you could look at would be quite good.” – European group
9. Summary of themes

Table 3-4 lists coding phrases derived from the transcription analysis. These coding phrases describing experiences and expectations of diabetes care in different ethnic groups are summarised in the following themes: goals, diabetes care behaviours, knowledge, positive attitude, negative emotions, desired advice, desired diabetes care and desired online information.

Table 3-4 Experiences and expectations for diabetes care in different ethnic groups

<table>
<thead>
<tr>
<th>Theme</th>
<th>Code</th>
<th>Ethnic groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals</td>
<td>Prevent diabetes progressing and complications</td>
<td>East Asian and Indian</td>
</tr>
<tr>
<td></td>
<td>Spend quality time with families</td>
<td>East Asian, Indian and Māori</td>
</tr>
<tr>
<td></td>
<td>Pass diabetes knowledge to younger generations</td>
<td>Māori</td>
</tr>
<tr>
<td>Diabetiscare behaviours</td>
<td>Consult general practitioners and registered nurses</td>
<td>All ethnic groups</td>
</tr>
<tr>
<td></td>
<td>Consult diabetes specialists</td>
<td>European, Māori and East Asian</td>
</tr>
<tr>
<td></td>
<td>Diabetes group education</td>
<td>All ethnic groups</td>
</tr>
<tr>
<td></td>
<td>Consult diabetes specialists</td>
<td>European, Māori and East Asian</td>
</tr>
<tr>
<td></td>
<td>Search online</td>
<td>All ethnic groups</td>
</tr>
<tr>
<td></td>
<td>Discuss with others with diabetes</td>
<td>Māori, PI and Indian</td>
</tr>
<tr>
<td></td>
<td>Read books</td>
<td>European, Māori and East Asian</td>
</tr>
<tr>
<td></td>
<td>Modify diet</td>
<td>European, Māori, East Asian and Indian</td>
</tr>
<tr>
<td></td>
<td>Test and track blood glucose</td>
<td>European, East Asian and Māori</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Insufficient knowledge</td>
<td>All ethnic groups</td>
</tr>
<tr>
<td></td>
<td>Misunderstanding and confusion</td>
<td>All ethnic groups</td>
</tr>
<tr>
<td>Positive attitude</td>
<td>Eager to learn</td>
<td>All ethnic groups</td>
</tr>
<tr>
<td></td>
<td>Sense of resilience</td>
<td>European, Māori, PI and East Asian</td>
</tr>
<tr>
<td>Theme</td>
<td>Code</td>
<td>Ethnic groups</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Appreciation of support from clinicians and/or families</td>
<td>All ethnic groups</td>
<td></td>
</tr>
<tr>
<td>Sense of achievement</td>
<td>All ethnic groups</td>
<td></td>
</tr>
<tr>
<td>Negative emotion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear and worry</td>
<td>All ethnic groups</td>
<td></td>
</tr>
<tr>
<td>Doubt</td>
<td>European, Māori, PI and East Asian</td>
<td></td>
</tr>
<tr>
<td>Feeling deprived</td>
<td>European, Māori, PI and East Asian</td>
<td></td>
</tr>
<tr>
<td>Feeling powerless</td>
<td>Māori, PI and Indian</td>
<td></td>
</tr>
<tr>
<td>Frustration</td>
<td>European, Māori and PI</td>
<td></td>
</tr>
<tr>
<td>Annoyance</td>
<td>PI and Indian</td>
<td></td>
</tr>
<tr>
<td>Self-blame</td>
<td>PI and Indian</td>
<td></td>
</tr>
<tr>
<td>Desired advice</td>
<td>Simple, practical and easy accessible</td>
<td>All ethnic groups</td>
</tr>
<tr>
<td>Culturally appropriate</td>
<td>Māori, PI, East Asian and Indian</td>
<td></td>
</tr>
<tr>
<td>Specific</td>
<td>European, East Asian, Indian</td>
<td></td>
</tr>
<tr>
<td>Desired diabetes care</td>
<td>Adequate consultation time</td>
<td>All ethnic groups</td>
</tr>
<tr>
<td>Self-lead diabetes care</td>
<td>European, Māori, East Asian</td>
<td></td>
</tr>
<tr>
<td>Clinician-led diabetes care</td>
<td>Māori, PI and Indian</td>
<td></td>
</tr>
<tr>
<td>Frequent diabetes classes</td>
<td>Māori, PI and Indian</td>
<td></td>
</tr>
<tr>
<td>Family support</td>
<td>Māori and PI</td>
<td></td>
</tr>
<tr>
<td>Peer support</td>
<td>Māori, PI and Indian</td>
<td></td>
</tr>
<tr>
<td>Desired online information</td>
<td>Search diabetes information</td>
<td>All ethnic groups</td>
</tr>
<tr>
<td>Liked its instant feedback</td>
<td>European, Māori and East Asian</td>
<td></td>
</tr>
<tr>
<td>Uncertain information quality</td>
<td>European, Māori, East Asian and Indian</td>
<td></td>
</tr>
<tr>
<td>Rely on diabetes information online</td>
<td></td>
<td>Indian</td>
</tr>
<tr>
<td>Want to use diabetes online education</td>
<td></td>
<td>All ethnic groups</td>
</tr>
</tbody>
</table>

PI, Pacific Islanders
Discussion

There was a strong desire to stay healthy and stop diabetes progression in all ethnic groups. Every participant was interested in understanding diabetes, medications, diet and exercise. At least one participant in each group described a sense of achievement when they met the target blood glucose level or when they maintained a healthy diet. Many expressed their gratitude for the support given by families, friends, and healthcare professionals, as well as others with diabetes. Some Māori and most Pacific Island participants expressed appreciation for family involvement. However, fear and worry was present in all groups especially around diabetes complications, medication side effects, eating unhealthy foods or eating inappropriate portion sizes. All except the Indian group expressed concern over the accuracy of the information from health professionals, and all groups complained of inconsistent information online. Lacking control over diabetes management due to limited understanding of diabetes and its treatment left the majority of Māori and Pacific Island, and some Indian participants, feeling powerless over their own health destiny. Participants of all ethnicities except Indian, disliked a top-down consultation style that placed restrictions on their dietary intake and did not promote self-control. Frustration regarding taking medication lifelong, non-agreed medication changes and receiving conflicting dietary advice was mentioned by European, Māori and Pacific Island participants. A few Pacific Island and most Indian participants felt annoyed at having to provide ongoing self-care and monitoring for diabetes management.
However, they also felt angry at relapses into unhealthy eating habits and not paying enough attention to their own health.

These findings were similar to the results of the second Diabetes Attitudes, Wishes and Needs study, in which the main negative emotions associated with diabetes were anxiety, fear, depression, hopelessness, and discrimination (Stuckey et al., 2014). Main emotional states associated with adaptation were positive outlook, sense of resilience, and receiving psychosocial support (Stuckey et al., 2014). Emotional distress worsens with increased disease severity and self-care burdens (Delahanty et al., 2007), leading to poorer medication adherence, dietary management, and quality of life (Lustman & Clouse, 2005). Therefore, health professionals need to explore any potential emotional distress affecting diabetes self-care and glycaemic control. The differences among ethnic groups should also be addressed to help eliminate the ethnic disparities in diabetes management and outcome.

Lack of communication and trust with health professionals is concerning, but is not unique to this study. A qualitative study among Canadian clinicians summarised limited consulting time, excessive workload and insufficient trust in physicians’ advice, as leading to patients having poor motivation and compliance (Brez et al., 2009). Therefore, health professionals need to ensure they communicate safe and effective treatment plans. Patient-centred education should be designed to answer patients’ queries and to fit in
with their goals, culture, and lifestyle (Bains & Egede, 2011; Funnell & Anderson, 2004). This will not only create trust in the patient-clinician relationship, but also enhances patients’ adherence to medical and dietary advice (Funnell & Anderson, 2004; Varming et al., 2015).

In contrast, Indian participants in this study presented deep respect and trust toward clinicians’ knowledge and judgment. This is similar to British Indian patients interviewed by Lawton et al (Lawton et al., 2005; Lawton et al., 2006). These findings are in agreement with a recent systematic review that Indian patients favoured relying on clinicians’ guidance over self-care (Sohal et al., 2015). However self-management augments clinician advice, therefore health professionals should encourage Indian patients to take an active role in their diabetes care (Sohal et al., 2015).

Familial support has been found to have a positive effect on diabetes control (Glasgow et al., 2001) and eating behaviour in ethnic minority groups (Mau et al., 2001). Results from this study show strong family links and involvement in diabetes care in Māori and Pacific Island participants, who are more likely to live in multi-generational households (The Ministry of Social Development, 2004). Hence, when consulting with Māori and Pacific Island patients, it is prudent for health professionals to take account of family situations and engage with family members and caregivers to assist in the promotion of sustainable lifestyle changes.
Many developed countries have started tackling ethnic disparities by promoting equal-access to health care through providing financial incentives to physicians, using language interpreter, and cultural support services (Department of Health UK, 2009; Ellison-Loschmann & Pearce, 2006; Millett et al., 2007; Nelson, 2002). However, higher type 2 diabetes prevalence and poorer clinical outcomes still exist in ethnic minority groups in many developed countries (Chow et al., 2012; Coppell et al., 2013; Joshy et al., 2010; Joshy et al., 2009; Robinson et al., 2006; Tomlin et al., 2006). The Fremantle Diabetes Study found that people who were not fluent in English, from indigenous Australian background, or had less education, demonstrated lower diabetes knowledge and were significantly less likely to have received diabetes education, dietetic advice or performed self-monitoring blood glucose than other participants (Bruce et al., 2003). A similar result was found in this study. A large percentage of Māori, Pacific Island and Indian participants reported being unaware of, or having limited access to diabetes specialist care. This led to low self-efficacy and a feeling of powerlessness towards their diabetes control. Māori, Pacific Island and Indian participants also showed a higher reliance on referrals to diabetes specialist appointments. However, in reality often a long waiting time could occur in the public hospital system which weakens the initial engagement with the diabetes service, especially in Māori and Pacific patients (Milne et al., 2014). In addition, economic deprivation, limited transportation, cultural beliefs and language barriers further contribute to disparities in accessing diabetes support and education (Attridge et al., 2014; Cauch-Dudek et al., 2013; Coonrod et al., 1994).
Diabetes self-management education can have positive effects on patients’ diabetes knowledge, self-monitoring behaviour, dietary intake, and glycaemic control (Norris et al., 2001). Diabetes education holds an essential role in improving patients’ self-efficacy and participation in their diabetes care (Bartlett, 1986). Benefits were found for ethnic minority groups when advice had been accurately tailored (Attridge et al., 2014; Sarkar et al., 2006). Although some diabetes resources have been translated into multiple languages, most resources are generic in order to accommodate a wide spectrum of diabetes needs (Branchadell & West, 2005; Hall et al., 2016; Wolz, 2015). The effectiveness of a resource could be limited by translation quality, availability, frequency of updates and patients’ health literacy levels (Wolz, 2015). Māori, Pacific Island, East Asian and Indian groups preferred video-based education, which is dynamic and can be enhanced by having voiceover animated pictorial illustration. This could be difficult to achieve with traditional paper-based resources. Diabetes education using multimedia and Internet could be a suitable long-term solution.

The results among participants of this study are consistent with other work in which the quality and safety of online diabetes information has been found to be variable (Chomutare et al., 2011; Greene et al., 2011; Weitzman et al., 2011). Misinformation, advertisements, poor readability, lack of evidence-based recommendations and lack of medical disclaimers were of concern (Weitzman et al., 2011). Despite reservations about the reliability of information, almost all participants described a willingness to study
diabetes online. High acceptance of online education could be attributed to increased exposure to online health information over recent years (Fox & Duggan, 2013b; Fox & Jones, 2009; Statistics New Zealand, 2012b). Almost all participants in this study had Internet access. This was similar to the 95% Internet usage in New Zealand population aged between 40-64 years (Smith et al., 2016).

**Strength and Limitations**

To our knowledge, this is the first research in which the experiences and expectations of diabetes management has been compared among five New Zealand ethnic groups. This study further explored disparities in emotions and experiences related to diabetes control and engagement with clinicians. This study may be a useful reference for other developed countries with East Asian, Indian and Polynesian immigrants. A strength of the study was that all focus groups were conducted by the same New Zealand registered dietitian who had been actively working with patients from different ethnic backgrounds in diabetes clinics.

Care must be taken not to over-generalize the results. Only participants who spoke English and who were interested in their diabetes management were involved. All participants were recruited in the North Island of New Zealand, with the majority resident in Auckland, a city that has diabetes specialist clinics at various locations, some providing
ethnic-specific diabetes educational programmes. Also, participants who attended the focus groups were motivated to do so. Their efforts in researching diabetes self-care may not represent the population’s. Although all participants were encouraged to provide their opinions, there was overrepresentation of the views of more vocal individuals (Stewart & Shamdasani, 2014). Moreover, the number of participants in each focus group was small and may not fully represent ethnic minorities, those with low social economic status, limited English or living in rural locations (Bruce et al., 2003). Hence, the results limit interpretation of between-group differences.

In conclusion, this study provides insight into potential promoters and inhibitors of diabetes care among different ethnic groups. Further research is required to address how diabetes training can be provided in effective and culturally appropriate ways. In terms of online learning, it appears that there is willingness for people to engage with electronic devices offering reliable diabetes information. This may bridge the gap between the need for diabetes knowledge in the community and the limited resources available in primary and secondary diabetes care in the longer term.
Summary of key points raised by focus groups:

- There was confusion and lack of diabetes nutritional knowledge across all ethnic groups.
- All participants wanted to learn more about diabetes and nutrition. Māori, Pacific Island and Indian participants were less likely to have accessed diabetes services or received formal diabetes education.
- All groups preferred diabetes education to be simple, visual, practical, and culturally appropriate.
- All ethnic groups have searched diabetes nutritional information online and exhibited a high willingness for future online education.
Chapter 4. Information-gathering Survey
Introduction

One purpose of providing nutrition knowledge to people with pre- and type 2 diabetes is to empower them with an understanding of ways that diet affects glycaemic control. It enables informed decision making and encourages individuals to take responsibility for their own condition (Funnell & Anderson, 2004; Hernandez-Tejada et al., 2012). Insufficient dietary knowledge and misconceptions may result in unnecessary food avoidance causing imbalanced dietary intake (Breen et al., 2015; Spronk et al., 2014). Breen et al reported patients with type 2 diabetes with less nutritional knowledge were more likely to limit their sugar intake, resulting in lowered consumption of fruit, vegetables and dairy products than those with good knowledge (Breen et al., 2015). A recent systematic review also showed a positive association between nutrition knowledge and consumption of fruit and vegetables in the general population (Spronk et al., 2014).

In Chapter 2, the focus group study results highlighted gaps in the nutritional knowledge of participants with pre- and type 2 diabetes in all ethnic groups in New Zealand. Several participants reported that they were avoiding foods including fruits and starchy vegetables, believing these foods would be detrimental to their health. There was a strong desire among participants to improve their nutritional knowledge. The most commonly raised questions across all ethnic groups were: “what foods are suitable for people with
diabetes?” and “how much should we eat?”. Many participants reported that inadequate consultation time with health professionals led to unresolved issues, resulting in participants seeking answers from the Internet despite their concerns about the quality of the online information.

The aim of this online information-gathering survey was to collect information from a wider New Zealand population sample than the focus groups in order to explore participants’ dietary habits, nutritional knowledge, sources of nutritional information, experience of diabetes care, and preferred ways of receiving nutritional education, including online education.
Methods

An online survey was developed using SurveyMonkey®. The study was promoted through Diabetes Auckland, social media, emails, and contacts within primary and secondary health organisations in New Zealand. To view the survey, please go to the link https://www.surveymonkey.com/r/GVTFLMV

**Inclusion criteria:** The survey was open to all adults residing in New Zealand with an interest in pre- and type 2 diabetes.

**Exclusion criteria:** Inability to read and write English.

All participants who completed the survey were invited to provide feedback on the potential usefulness of an electronic diabetes nutritional education resource. Those who were interested were asked to leave their name and contact details.

The survey questions were developed by the candidate based on the information obtained from the focus group participants and the candidate's experience as a diabetes dietitian working in a diabetes secondary care service for people with pre- and type 2 diabetes in Auckland, New Zealand. This study was approved by the University of Otago Human Ethics Committee, reference D15/077 (Appendix 5).
Results

1. Participants’ characteristics

A total of 448 participants answered the survey with a completion rate of 88%. Table 4-1 provides a summary of respondents and Table 4-2 lists the age distribution of those whose age was provided.

**Table 4-1 Participants’ characteristics**

<table>
<thead>
<tr>
<th>Overall n = 448</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes (n = 64, 14%)</td>
<td></td>
</tr>
<tr>
<td>Type 2 diabetes</td>
<td>40</td>
</tr>
<tr>
<td>Pre-diabetes</td>
<td>24</td>
</tr>
<tr>
<td>Interested (n = 312, 70%)</td>
<td></td>
</tr>
<tr>
<td>Caregiver</td>
<td>41</td>
</tr>
<tr>
<td>Personal interest</td>
<td>196</td>
</tr>
<tr>
<td>Researcher</td>
<td>23</td>
</tr>
<tr>
<td>Risk</td>
<td>52</td>
</tr>
<tr>
<td>Professionals (n = 72, 16%)</td>
<td></td>
</tr>
<tr>
<td>Dietitian</td>
<td>40</td>
</tr>
<tr>
<td>Diabetes dietitian</td>
<td>11</td>
</tr>
<tr>
<td>Diabetes midwife</td>
<td>2</td>
</tr>
<tr>
<td>Diabetes physician</td>
<td>1</td>
</tr>
<tr>
<td>Nutritionist</td>
<td>2</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>1</td>
</tr>
<tr>
<td>Practice nurse</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
</tbody>
</table>
Table 4-2 Participants’ age distribution (n = 393)

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-24</td>
<td>23</td>
<td>6</td>
</tr>
<tr>
<td>25-34</td>
<td>87</td>
<td>22</td>
</tr>
<tr>
<td>35-44</td>
<td>78</td>
<td>20</td>
</tr>
<tr>
<td>45-54</td>
<td>101</td>
<td>26</td>
</tr>
<tr>
<td>55-64</td>
<td>86</td>
<td>22</td>
</tr>
<tr>
<td>65-75</td>
<td>18</td>
<td>5</td>
</tr>
</tbody>
</table>

For those people with pre- and type 2 diabetes, the years since diagnosis are given in Table 4-3. Diabetes medication used by the participants is given in Table 4-4.

Table 4-3 Years of diabetes since diagnosis

<table>
<thead>
<tr>
<th>Years</th>
<th>Pre-diabetes (n = 24)</th>
<th>Type 2 diabetes (n = 40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2 years</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>2 - 4 years</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>5 - 9 years</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>10 - 19 years</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>20 + years</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4-4 Diabetes medications

<table>
<thead>
<tr>
<th>Medication</th>
<th>Pre-diabetes (n = 24)</th>
<th>Type 2 diabetes (n = 40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>Metformin</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>Sulphonylureas</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Insulin</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Dipeptidyl peptidase IV inhibitor</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
The majority of participants identified as being of European descent (82%), followed by East & Southeast Asian (7%), South Asian (5%), Māori (3%), Pacific Islanders (2%) and other ethnicities (2%). Respondents tended to be well educated, with over 80% having completed a tertiary qualification.

2. Dietary intake

Participants were asked to select the carbohydrate foods that they had consumed in the past week from a list of 43 foods and beverages. A total of 425 participants answered this question. Health professionals tended to eat more wholegrain bread, muesli, rice crackers, wholegrain crackers and yoghurt than other respondents (Table 4-5). People with pre- and type 2 diabetes tended to avoid eating muesli, white pasta, noodles, rice crackers and fruit, compared with lay participants without these conditions. There was no significant difference among the three groups in the proportion of participants consuming white bread, oat porridge, Weet-bix®, rice bubbles, bran flakes, breakfast cereals, wraps, pita bread, chapatti, naan, roti, brown rice, sushi, couscous, wholemeal pasta, dumplings, steamed buns, boiled & roasted potato, hot chips, potato salad, taro, yam, corn, green banana, cassava, crackers, biscuits, chips, nuts & seeds, milk, and soy milk.
Table 4-5 Foods consumed by participants in the past week

<table>
<thead>
<tr>
<th></th>
<th>Pre/T2 (n = 55)</th>
<th>Interested (n = 300)</th>
<th>Professional (n = 70)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholemeal bread</td>
<td>35% (^a)</td>
<td>39% (^a)</td>
<td>19% (^b)</td>
<td>0.006</td>
</tr>
<tr>
<td>Wholegrain bread</td>
<td>60% (^a)</td>
<td>64% (^a)</td>
<td>89% (^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Muesli</td>
<td>16% (^a)</td>
<td>32% (^c)</td>
<td>50% (^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>White rice</td>
<td>55% (^{ab})</td>
<td>64% (^b)</td>
<td>46% (^a)</td>
<td>0.011</td>
</tr>
<tr>
<td>White pasta</td>
<td>20% (^a)</td>
<td>37% (^b)</td>
<td>36% (^a)</td>
<td>0.045</td>
</tr>
<tr>
<td>Noodles</td>
<td>13% (^a)</td>
<td>28% (^b)</td>
<td>16% (^a)</td>
<td>0.009</td>
</tr>
<tr>
<td>Rice crackers</td>
<td>13% (^a)</td>
<td>26% (^b)</td>
<td>34% (^b)</td>
<td>0.023</td>
</tr>
<tr>
<td>Wholegrain crackers</td>
<td>20% (^a)</td>
<td>19% (^a)</td>
<td>47% (^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Almond milk</td>
<td>4% (^{ab})</td>
<td>10% (^b)</td>
<td>0% (^a)</td>
<td>0.011</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>55% (^a)</td>
<td>60% (^a)</td>
<td>89% (^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Fruit</td>
<td>78% (^a)</td>
<td>92% (^b)</td>
<td>97% (^b)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

\(^{a,b,c}\) Numbers within the same row with a different superscript were significantly different (P < 0.05). Pre/T2, pre- and type 2 diabetes.

3. Identify foods and beverages that effect blood glucose

Participants were asked to select from a list of 30 foods and beverages, those items they perceived to increase blood glucose. A total of 435 participants answered this question, including 57 with pre- and type 2 diabetes, 306 interested in diabetes and 72 health professionals. There was no significant difference among the three groups in the number and percentage who correctly identified whether broccoli, grilled fish, steak, cheese, egg, avocado, jam, ice cream, chocolate, muffins, muesli bars, fruit juice and white bread increased blood glucose or not.
Table 4-6 shows significant differences among three groups in accurately identifying those foods and beverages which increase blood glucose.

<table>
<thead>
<tr>
<th>Food item</th>
<th>Pre/T2 (n = 57)</th>
<th>Interested (n = 306)</th>
<th>Professionals (n = 72)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>88%(^a)</td>
<td>74%(^b)</td>
<td>88%(^a)</td>
<td>0.006</td>
</tr>
<tr>
<td>Bacon</td>
<td>81%(^a)</td>
<td>88%(^a)</td>
<td>96%(^b)</td>
<td>0.028</td>
</tr>
<tr>
<td>Corned beef</td>
<td>79%(^a)</td>
<td>88%(^a)</td>
<td>94%(^b)</td>
<td>0.028</td>
</tr>
<tr>
<td>Butter</td>
<td>75%(^a)</td>
<td>86%(^b)</td>
<td>93%(^b)</td>
<td>0.016</td>
</tr>
<tr>
<td>Coconut cream</td>
<td>53%(^a)</td>
<td>62%(^a)</td>
<td>78%(^b)</td>
<td>0.009</td>
</tr>
<tr>
<td>Peanut butter</td>
<td>70%(^{ab})</td>
<td>61%(^b)</td>
<td>75%(^a)</td>
<td>0.047</td>
</tr>
<tr>
<td>Orange</td>
<td>58%(^a)</td>
<td>65%(^a)</td>
<td>93%(^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Banana</td>
<td>68%(^a)</td>
<td>70%(^a)</td>
<td>92%(^b)</td>
<td>0.001</td>
</tr>
<tr>
<td>Kumara</td>
<td>44%(^a)</td>
<td>52%(^a)</td>
<td>88%(^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Potatoes</td>
<td>63%(^a)</td>
<td>60%(^a)</td>
<td>92%(^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Rice</td>
<td>70%(^a)</td>
<td>60%(^a)</td>
<td>92%(^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Pasta</td>
<td>70%(^a)</td>
<td>64%(^a)</td>
<td>90%(^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Taro</td>
<td>47%(^a)</td>
<td>43%(^a)</td>
<td>86%(^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Wholegrain bread</td>
<td>37%(^a)</td>
<td>45%(^a)</td>
<td>86%(^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Milk</td>
<td>28%(^a)</td>
<td>33%(^a)</td>
<td>81%(^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>39%(^a)</td>
<td>51%(^a)</td>
<td>89%(^b)</td>
<td>0.000</td>
</tr>
<tr>
<td>Soy milk</td>
<td>10%(^a)</td>
<td>22%(^a)</td>
<td>68%(^b)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

\(^{a,b,c}\) Numbers within the same row with a different superscript were significantly different (P < 0.05).

Pre/T2, pre- and type 2 diabetes.

Generally, the health professionals were better at identifying the effect of a food on blood glucose compared to the people with pre- and type 2 diabetes. Among all groups, almost 90% of the participants identified high sugar foods (jam, ice cream, chocolate, muffins, muesli bars and fruit juice) as increasing blood glucose. In the pre- and type 2 diabetes,
and the Interested group, over three quarters knew that non-starchy vegetables (broccoli and tomatoes) and protein foods (bacon, grilled fish, corned beef, steak, cheese, and egg), and over half knew fats (butter, avocado, peanut butter, and coconut cream) do not increase blood glucose. Only about half of them understood starchy foods increase blood glucose and about one third understood milk, yoghurt, soymilk and wholegrain bread increase blood glucose.

4. **Sources for diabetes nutritional information**

Participants with pre- and type 2 diabetes were asked to recall from where they had received diabetes nutritional education. The results are presented in Figure 4-1. A total of 58 participants answered this question, 23 participants with pre-diabetes and 35 with type 2 diabetes. All with type 2 diabetes reported they had received some nutritional education in the past, whereas 13% of those with pre-diabetes reported they had received no nutritional information.
General practitioner (GP), Registered nurse (RN), Television (TV). *P < .05

**Figure 4-1** Sources for diabetes nutritional information
There was no significant difference in where participants had received nutritional education apart from one exception. A significantly higher proportion of participants with type 2 diabetes had received nutritional information from a diabetes dietitian compared to those with pre-diabetes (37\% vs 9\%, P < 0.05).

5. **Diabetes knowledge**

All participants were asked to rate their diabetes knowledge in nutrition, medication, complications, exercise and symptoms. Most participants with diabetes selected having “some” to “good knowledge” of the five topics, whereas most participants in the Interested group selected having “very little” to “some knowledge”, and most of the health professionals selected “good” to “excellent knowledge”. Topics important to participants were: “What foods increase blood glucose?”, “How to choose healthy carbohydrates?”, “How exercise affects diabetes?”, “How to estimate carbohydrate portion size?”, “New diabetes medications or treatment in New Zealand”, “New research on diabetes” and “How diabetes medications work”.

Accessing trusted diabetes nutritional information online was rated as the most favourable way to answer nutritional queries by all groups. Other methods of obtaining information were reading books and articles about diabetes, visiting doctors or nurses, contacting Diabetes New Zealand, being referred to the diabetes services and attending a DSME course. Some discrepancies in preference amongst groups were noticed. Over 70\% of health professionals believed attending a DSME course would be beneficial for patients, however only 41\% of participants with pre- and type 2 diabetes preferred this option. Respondents with pre- and type 2 diabetes had a preference for receiving nutritional
education from their GPs or RNs, but only 37% of the health professionals preferred patients to do so. Asking families, friends and pharmacists were the least preferred options (less than 20%) by participants from all groups.

6. **Acceptance of diabetes online education programmes**

There was high use of computers (≥98%), smart phones (≥76%) and tablets (≥49%) among the respondents, with the majority indicating that they would be willing to use an online education tool either as a one-off education exercise (those interested in diabetes), or on a regular weekly or monthly basis (those with diabetes).

Respondents perceived that an online education program would provide flexible learning time, written information, nutritional tips, useful pictures, videos and practical approaches. The majority of respondents mentioned they would be more likely to use an education programme if it had received positive feedback or if it had been recommended by a health professional.
Discussion

The aim of this survey was to identify individuals’ carbohydrate choices, nutritional knowledge, expectation of diabetes care and acceptance of online diabetes education. This survey generated a large amount of interest among the public. Over 300 lay individuals without pre- and type 2 diabetes completed the survey, indicating that they were interested in learning about nutrition and diabetes. Over half of the participants with type 2 diabetes had been diagnosed five years ago or longer. Despite the duration, they felt there was still a need to further increase their nutritional knowledge for managing their condition. Among the health professionals, around 70% were dietitians. This was a consequence of notifying the survey to all members of the Dietitian New Zealand diabetes special interest group.

The survey results showed that health professionals were more likely to consume healthy foods such as wholegrain bread and crackers, yoghurt and fruit; whereas people with pre- and type 2 diabetes tended to avoid certain types of carbohydrates such as muesli, white pasta, rice crackers and fruit. Fruit avoidance is possibly a result of participants with diabetes believing that fruit is an unsuitable food for their disease (Breen et al., 2015). This is consistent with the feedback obtained from the focus group participants, in which they reported fruit avoidance because they were “deadly for diabetes” (Chapter 2).

Similar to previous research, most participants understood that sugary foods increase blood glucose (Breen et al., 2015). Compared to the health professionals, a significantly lower proportion of participants in the pre- and type 2 diabetes group and the Interested group knew that starchy vegetables, fruit and dairy products increased blood glucose
whereas fats do not. Less than 40% of participants with pre- and type 2 diabetes knew milk, yoghurt and soy milk increase blood glucose. Again, this maybe a result of using sugar content and sweet taste to decide whether a food increases blood glucose or not (Breen et al., 2015).

Despite the majority of respondents with pre- and type 2 diabetes reporting that they had “some” or “good” nutritional knowledge, having pre- and type 2 diabetes was not associated with better understanding of carbohydrate foods than those without this condition. A lack of knowledge regarding the effect of carbohydrate-rich foods on blood glucose response is surprising given the emphasis placed on glycaemic control in the treatment of pre- and type 2 diabetes. This knowledge gap was also found during the focus group discussion (Chapter 2), and from personal observations in diabetes clinics run by the candidate. Consistency among the methods of information gathering indicates a strong need for improving nutritional education among people with pre- and type 2 diabetes and catering for the low rate of diabetes education, even when the condition is longstanding.

General practitioners, registered nurses and the Internet were reported as the three main nutritional information sources for people with pre- and type 2 diabetes. Only 37% of the participants with type 2 diabetes and 9% with pre-diabetes had seen a diabetes dietitian. This suggests a need for online nutritional education, not only for those diagnosed with type 2 diabetes but also for those at risk, with participants rating the Internet as the most preferred nutritional information source.
The results of this study show a strong need in respondents for developing an online diabetes nutritional education program. How generalizable this need is among a larger population is questionable. A strength is that the results had some commonality among people with diverse backgrounds including people diagnosed with diabetes; carers and interested parties; and health professionals including dietitians. However, there were limitations to generalizability arise from underrepresentation of some ethnic minority groups, the restriction to English speakers, and participants with higher income and education compared with the general population.

Nevertheless, this survey provided a unique platform for individuals to report on what they wanted to know about nutrition for diabetes, how they preferred the education to be delivered and where their knowledge gaps were. The results of this study enabled development of an electronic patient focused nutritional education program that is specific for the New Zealand population. The survey was distributed and conducted online. Hence the survey respondents represent the wider population who are early adopters of online diabetes education.
Chapter 5. Effect of Carbohydrate Portions on Appetite
Introduction

Type 2 diabetes is caused by a combination of insulin resistance and deficiency (American Diabetes Association, 2017b). The focus of dietary management for type 2 diabetes is to balance the amount of carbohydrate intake with available insulin to optimise postprandial glycaemic control (American Diabetes Association, 2017b; Franz et al., 2010), and to encourage moderate weight loss for those who are overweight or obese (American Diabetes Association, 2017b). This can be achieved through energy restriction, carbohydrate, protein and fat redistribution, increased vegetable consumption, and lifestyle modification. Concerns about increased hunger may negatively impact compliance with such dietary advice (Fedoroff et al., 2003; Papies et al., 2007). Satiety therefore plays an important role in the regulation of energy intake, wellbeing and weight loss (Blundell et al., 1994). Hence, there is a strong need to include information about the impact of carbohydrates and energy on satiety in the electronic nutritional resource for people with type 2 diabetes and pre-diabetes.

The glucostatic theory (Mayer, 1953) proposed low blood glucose concentration triggers hunger whereas consumption of carbohydrate raises blood glucose and postprandial satiety. However, blood glucose is not the sole determinant of satiety, especially when foods or meals have mixed nutritional composition (Foster-Schubert et al., 2008; Holt et al., 1995; Latner & Schwartz, 1999; Rolls et al., 1988; Stubbs et al., 2001). In studies involving a wide range of foods, there appears to be an inconsistent relationship between satiety and blood glucose concentration (Anderson & Woodend, 2003; Erdmann et al., 2007; Holt et al., 1995). Holt et al tested 38 foods in isoenergetic servings across categories of fruit, bakery products, snack foods, carbohydrate-rich foods, protein-rich
foods and breakfast cereals (Holt. et al., 1995). Overall satiety correlated positively with the serving weight of food, the protein, fibre and water content; and negatively with fat content and palatability (Holt. et al., 1995).

There is little research on how satiety is affected by the proportion of different types of foods on a plate (Chang et al., 2010). The American Diabetes Association and Diabetes New Zealand recommend a healthy plate model comprising half vegetables, a quarter protein and a quarter carbohydrate (American Diabetes Association, 2017a; Diabetes New Zealand, 2014). However, many people are either unaware of this recommendation (personal communications with patients) or suggest that they will not be satisfied unless they eat their usual amount of carbohydrate staples such as rice or potato (Fedoroff et al., 2003; Papies et al., 2007). The general recommendation for people with type 2 diabetes is to have regular meals, including some carbohydrate at each meal (Diabetes New Zealand, 2014; Franz et al., 2010). Many registered dietitians and nutritionists use 45 to 60 g carbohydrate per meal as a starting point and adjust it based on individual needs and preferences (Academy of Nutrition and Dietetics, 2015; American Diabetes Association, 2016).

For some people, diet modification can be recommended to achieve the desired food proportions (Temple et al., 2017). Restraining the intake of food often raises concerns about hunger and increased subsequent food intake (Fedoroff et al., 2003; Papies et al., 2007). As a means of maintaining satiety, people may be advised to eat more non-starchy vegetables which have a high water content and low carbohydrate and energy content (Tohill, 2005).
Some patients reported it was easier to eat less of certain carbohydrate foods than others while feeling equally satisfied. However, the role of personal food preferences, the presence of other macronutrients, the reduced volume of carbohydrate food or simply being restricted from eating liberally in the above finding is unclear (Blundell et al., 1994; Fedoroff et al., 2003; Papies et al., 2007; Stubbs et al., 2001). Also people who were overweight or obese as well as those with pre- and type 2 diabetes may have a diminished satiety response (Suzuki et al., 2012). Very few studies compared satiety of different proportions of carbohydrate and vegetables in a realistic mixed meal setting (Chang et al., 2010). Two satiety studies were therefore conducted, the first to assess the difference between different carbohydrate foods in their satiating potential on an equal carbohydrate basis, and the second to determine the effect on satiety of progressively substituting non-starchy vegetables for a starchy meal component.
Participants and Methods – Satiety Study One

In the first satiety study, the aim was to compare the satiating effects of meals composed of different types of carbohydrate foods (Jasmine rice, white pasta and Agria potatoes), with each meal containing equal amounts of carbohydrate, protein, fat and calories.

1. Recruitment

Fourteen Plant & Food Research Limited (Palmerston North, New Zealand) staff volunteers were recruited using a flyer, then sent an information sheet (Appendix 8). The study inclusion and exclusion criteria were:

Inclusion criteria: Aged between 18 and 70 years, with no history of gastrointestinal dysfunction that could have an impact on appetite in the three hours after consuming the meal and in good health as gauged by self-assessment.

Exclusion criteria: Intolerance to any of the meal components.

2. Ethics

Ethics approval was obtained from the Ministry of Health, Health and Disability Ethics Committees (Approval number: 15/CEN/71) (Appendix 6). This study was registered on the Australian New Zealand Clinical Trials Registry (trial ID: ACTRN12615000721505). All participants were volunteers. They were each required to read the information sheet and to sign a consent form.
3. Test meals

All meals were prepared in advance, frozen in 300 g portions and reheated before consumption. Meal preparation methods are detailed in (Appendix 7). The carbohydrate foods were cooked and served in equal carbohydrate and calorie portions and consumed with a standardised portion of meat and vegetable sauce, and 250 ml glass of water (Table 5-1). All three meals had very similar protein, fat and dietary fibre profiles.

<table>
<thead>
<tr>
<th>Meal</th>
<th>Mince + sauce (g)</th>
<th>Vegetables (g)</th>
<th>Starchy staple (g)</th>
<th>Total CHO (g)</th>
<th>Total energy (kJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasta</td>
<td>200</td>
<td>200</td>
<td>138</td>
<td>112</td>
<td>3010</td>
</tr>
<tr>
<td>Potato</td>
<td>200</td>
<td>200</td>
<td>337</td>
<td>112</td>
<td>3010</td>
</tr>
<tr>
<td>Rice</td>
<td>200</td>
<td>200</td>
<td>142</td>
<td>112</td>
<td>3010</td>
</tr>
</tbody>
</table>

CHO, carbohydrate.

4. Protocols

A crossover design was used, in which participants ate each of the three lunchtime meals in randomised order. Each meal was comprised of either white Penne pasta, peeled Agria potato, or white Jasmine rice with a standardised portion of mixed frozen vegetables (peas, carrots and corn kernels) and lean beef mince Bolognase sauce (Appendix 7). Subjects were asked to keep breakfast consistent on each of the three test days; to avoid consuming any additional food between breakfast and lunch and to avoid any food intake for three hours after finishing the test meal.
Satiety was measured using a 100 mm visual analogue scale (VAS) in accordance with a validated protocol (Flint et al., 2000). Four questions were used, anchored at either end with the following statements (Flint et al., 2000):

- How hungry do you feel? (I am not hungry at all – I have never been more hungry)
- How satisfied do you feel? (desire to eat) (I am completely empty – I cannot eat another bite)
- How full do you feel? (Not at all full – Totally full)
- How much do you think you can eat? (Nothing at all – A lot)

Participants were asked to mark the scales at a point that best represented his or her feelings of satiety immediately before lunch, immediately after lunch and at 1 hour, 2 hours and 3 hours after lunch. The VAS rating for each time was on a separate sheet and participants were instructed not to refer back to their previous ratings.

5. **Sample size calculation**

Flint et al’s validation study (Flint et al., 2000) shows 13 subjects is a sufficient number to detect a 10% difference in hunger, with 80% power at the 0.05 significance level for a paired design.

6. **Statistical Analysis**

All appetite ratings were recorded on a spreadsheet using Microsoft Excel for Macintosh (Microsoft® Excel®, Version 15.31. Microsoft Corporation 2017). Area under the curve
(AUC) was calculated by computer program using the trapezoid rule and used to measure satiety responses (Blundell et al., 2010). Results were expressed as means with standard deviation. Microsoft Stata/MP 14.0 for Macintosh (Stata Corporation, Texas, USA) was used for the regression analysis. Model residuals were checked for homogeneity of variance and normality. P-value of less than 0.05 was set as the cut-off for statistical significance in all analyses.
Results – Satiety Study One

Fourteen subjects participated in the study, including 5 males and 9 females. Mean (SD) baseline scores for hunger were 7.74 (2.19) cm; 7.71 (1.02) cm; and 7.29 (1.98) cm before consumption of pasta, potato and rice, respectively; with no significant difference in score among treatments (P = 0.76). Similarly, there were no differences at baseline for any of the other questions. Satiety scores over time are represented by AUC. As shown in Table 5-2, the AUC for hunger was significantly lower after participants consumed the potato meal compared with the rice and pasta meals. The potato meal also generated a significantly higher AUC for the sense of fullness; and a significantly lower AUC for the desire to eat and for the perceived quantity of food to consume, compared with the other two test meals. The pasta and rice meal had similar AUCs for hunger, fullness, desire to eat and quantity to eat. This indicated no significant differences in satiety responses between rice and pasta consumed in the same carbohydrate portion in a mixed meal.

Table 5-2 Comparison of postprandial satiety responses between three test meals

<table>
<thead>
<tr>
<th>AUC</th>
<th>Pasta (mm•min)</th>
<th>Potato (mm•min)</th>
<th>Rice (mm•min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunger</td>
<td>4445 (2543)a</td>
<td>2635 (2229)b</td>
<td>3745 (2374)a</td>
</tr>
<tr>
<td>Fullness</td>
<td>12772 (2931)a</td>
<td>15239 (2137)b</td>
<td>13413 (2672)a</td>
</tr>
<tr>
<td>Desire to eat</td>
<td>4190 (2201)a</td>
<td>2139 (1896)b</td>
<td>3648 (2183)a</td>
</tr>
<tr>
<td>Quantity to eat</td>
<td>4446 (2310)a</td>
<td>2645 (2287)b</td>
<td>3845 (2214)a</td>
</tr>
</tbody>
</table>

a,b Numbers within the same row with a different superscript letter are significantly different (P < 0.05).
AUC, area-under-the-curve.
Postprandial satiety responses are shown in Figure 5-1. There was an immediate increase in a feeling of fullness and a decrease in the feeling of hunger, desire to eat and quantity to eat following consumption of the test meals. The satiating effect slowly diminished over the following 180 minutes, with the potato meal providing a more sustained effect compared with the rice and pasta meals.

**Figure 5-1 Satiety levels after consuming three test meals**

VAS, visual analogue scale.
Participants and Methods – Satiety Study Two

In the second satiety study, the aim was to examine changes in satiety when replacing carbohydrate food (rice and pasta) with an equal weight of non-starchy vegetables.

1. Recruitment

Email invitations were sent to Human Nutrition students at the University of Otago.

**Inclusion criteria:** Healthy adults aged between 18 and 60.

**Exclusion criteria:** Allergy or intolerance to any of the meal components or dietary restrictions that were unable to be catered for.

2. Ethics

This study was approved by the University of Otago Human Ethics Committee, reference: 14/204) (Appendix 9) and the Ngāi Tahu Research Consultation Committee (Appendix 11). This research was registered with the Australian New Zealand Clinical Trial Registry (trial ID: ACTRN1261600692437). An information sheet was provided (Appendix 10) and consent forms were signed by all participants prior to the study.
3. Test meals

All meal components apart from rice were prepared in advance, frozen and reheated prior to the study. Rice was cooked on the study day. All test meals were served in equal 550 g portions with standardised mince and Bolognaise sauce (Table 5-3 & Figure 5-2) and 250 ml water. The portion of rice and pasta reduced in 50 g decrements through carbohydrate-large (CHO-L) to carbohydrate-medium (CHO-M) to carbohydrate-small (CHO-S) meals. The reduced amount of rice and pasta was replaced with the same weight of non-starchy vegetables.

<table>
<thead>
<tr>
<th>Meal type</th>
<th>Starchy staple (g)</th>
<th>Vegetables (g)</th>
<th>Mince (g)</th>
<th>Bolognaise sauce (g)</th>
<th>Total weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHO-L</td>
<td>Pasta-L 200</td>
<td>150</td>
<td>100</td>
<td>100</td>
<td>550</td>
</tr>
<tr>
<td></td>
<td>Rice-L 200</td>
<td>150</td>
<td>100</td>
<td>100</td>
<td>550</td>
</tr>
<tr>
<td>CHO-M</td>
<td>Pasta-M 150</td>
<td>200</td>
<td>100</td>
<td>100</td>
<td>550</td>
</tr>
<tr>
<td></td>
<td>Rice-M 150</td>
<td>200</td>
<td>100</td>
<td>100</td>
<td>550</td>
</tr>
<tr>
<td>CHO-S</td>
<td>Pasta-S 100</td>
<td>250</td>
<td>100</td>
<td>100</td>
<td>550</td>
</tr>
<tr>
<td></td>
<td>Rice-S 100</td>
<td>250</td>
<td>100</td>
<td>100</td>
<td>550</td>
</tr>
</tbody>
</table>

CHO, carbohydrate. L, large portion, M, medium portion, S, small portion.

The rice and pastas portion for CHO-L, CHO-M, and CHO-S meals were chosen based on the general recommendation of 45-60 grams of carbohydrates per meal (Academy of Nutrition and Dietetics, 2015; American Diabetes Association, 2016) and the healthy plate model (American Diabetes Association, 2017a; Diabetes New Zealand, 2014). Rice and pasta were chosen because they have similar energy contents and carbohydrate densities whilst having different glycaemic indices (GI) (Atkinson et al., 2008), which potentially has an impact on postprandial satiety (Holt et al., 1992). The first satiety study showed
no significant difference in postprandial satiety between rice and pasta meals when served in equal carbohydrate portions despite of their different GI properties. This second study also provided an opportunity to confirm these findings from the first satiety study.

Figure 5-2 Test meal components (plate size diameter = 21 cm)

4. Nutritional composition analysis

The nutritional composition was calculated using food label nutrition information panel data and the New Zealand Food Composition Database (Sivakumaran et al., 2014). Table
**Table 5-4** Nutritional composition for the test meals

<table>
<thead>
<tr>
<th>Meal type</th>
<th>Energy (kJ)</th>
<th>Energy density ¹ (kJ/g)</th>
<th>Available CHO ² (g)</th>
<th>Dietary fibre (g)</th>
<th>Protein (g)</th>
<th>Fat (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasta-L</td>
<td>2316</td>
<td>4.2</td>
<td>73.7</td>
<td>9.2</td>
<td>41.3</td>
<td>10.5</td>
</tr>
<tr>
<td>Rice-L</td>
<td>2255</td>
<td>4.1</td>
<td>75.4</td>
<td>8.5</td>
<td>37.4</td>
<td>9.9</td>
</tr>
<tr>
<td>CHO-L</td>
<td>2286</td>
<td>4.2</td>
<td>74.6</td>
<td>8.9</td>
<td>39.4</td>
<td>10.2</td>
</tr>
<tr>
<td>Pasta-M</td>
<td>2074</td>
<td>3.8</td>
<td>61.6</td>
<td>9.9</td>
<td>39.6</td>
<td>10.5</td>
</tr>
<tr>
<td>Rice-M</td>
<td>2030</td>
<td>3.7</td>
<td>62.7</td>
<td>9.3</td>
<td>36.3</td>
<td>9.9</td>
</tr>
<tr>
<td>CHO-M</td>
<td>2052</td>
<td>3.7</td>
<td>62.2</td>
<td>9.6</td>
<td>38.0</td>
<td>10.2</td>
</tr>
<tr>
<td>Pasta-S</td>
<td>1832</td>
<td>3.3</td>
<td>49.0</td>
<td>10.5</td>
<td>38.0</td>
<td>10.5</td>
</tr>
<tr>
<td>Rice-S</td>
<td>1804</td>
<td>3.3</td>
<td>50.1</td>
<td>10.1</td>
<td>35.8</td>
<td>9.9</td>
</tr>
<tr>
<td>CHO-S</td>
<td>1818</td>
<td>3.3</td>
<td>49.6</td>
<td>10.3</td>
<td>36.9</td>
<td>10.2</td>
</tr>
</tbody>
</table>

CHO, carbohydrate. L, large portion, M, medium portion, S, small portion.

5. **Protocols**

A randomised crossover design was used. All participants were block randomised by sex to receive either three pasta meals (Pasta-L, Pasta-M and Pasta-S) or three rice meals (Rice-L, Rice-M and Rice-S). Within each treatment group, the order in which the meals were consumed was randomised to each person. For logistical purposes, participants were randomised to attend either a session started at 11:50 or at 13:00 for all visits, and to have an at least one week washout period in between each meal.
Prior to the first visit, participants were furnished with the information sheet for this study (Appendix 10). Participants’ heights were measured by stadiometer (Holtain Limited; United Kingdom), and weights on calibrated scales (Seca Alpha, model 770; Germany) using standardised procedures (Gibson, 2005). Demographic information was collected.

Participants were asked to have their usual breakfast and, or morning tea on test days and to avoid foods and beverages (except water) for 2.5 hours prior to the session. Participants were also asked to maintain the same level of exercise and similar food intake on test days and not to exercise 2.5 hours prior to their laboratory session. On arrival, each participant was given a colour coded test meal and 250 ml water to sip. Participants were asked to finish the meal in their own time and remained seated in the room for the duration of the experiment with the exception of toilet visits.

Satiety was measured using the same protocol as described in the first satiety study.

In addition to the satiety data presented here, three Master of Dietetic students gathered information on postprandial glycaemia, subsequent meal consumption, speed of eating, and food preference.

6. Sample size calculation

Flint et al’s validation study (Flint et al., 2000) showed 24 subjects was sufficient to detect 10% difference in satiety, with 90% power to the 0.05 significance level for a paired design.
7. **Statistical analysis**

All appetite ratings were measured and recorded in the Microsoft Excel for Macintosh spreadsheet (Microsoft® Excel®. Version 15.31. Microsoft Corporation 2017). Area-under-the-curve was calculated as in the first satiety study. Results were expressed as means with standard deviation. Microsoft Stata/MP 14.0 for Macintosh (Stata Corporation, Texas, USA) was used for the regression analysis. Model residuals were checked for homogeneity of variance and normality. P-value of less than 0.05 was set as the cut-off for statistical significance.

Single missing satiety ratings were replaced by the average of the adjacent values at the same test meal consumed by the participant; this interpolation of data was done on 29 occasions out of a total of 4560 data points. Data for six meals were excluded, of these, three due to failing to rate satiety level at two or more consecutive times. The remaining three were excluded due to hunger ratings of less than 10 mm prior to the test meals (indicating he or she was “not hungry at all”), indicative that the person had either not followed the study requirement to fast for 2.5 hours prior to the meal or had misinterpreted the VAS scale system.
Results – Satiety Study Two

1. Participants’ characteristics

Participants’ characteristics are listed in Table 5-5. Thirty-eight participants received the rice meals and 39 received the pasta meals. Most participants were New Zealand Europeans, with over half exercising for 30-60 minutes at least three times a week. The average age was 21.3 years. There were 19 males and 58 females.

<table>
<thead>
<tr>
<th>Table 5-5 Participants’ characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Gender, n (%), Rice (n=38), Pasta (n=39), Total (n=77)</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Ethnicity, n (%), Rice (n=38), Pasta (n=39), Total (n=77)</td>
</tr>
<tr>
<td>New Zealand European</td>
</tr>
<tr>
<td>Chinese</td>
</tr>
<tr>
<td>Māori</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Age, years (SD)</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Height, cm (SD)</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Body mass, kg (SD)</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>BMI, kg/m² (SD)</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
</tbody>
</table>

SD, standard deviation.
2. Satiety results

As shown in Table 5-6 & Figure 5-3, there was no significant difference in postprandial satiety between consumption of CHO-L and CHO-M meals, and between consumption of CHO-M and CHO-S meals. However, participants felt slightly but significantly hungrier (P = 0.033) and less full (P = 0.035) after consuming CHO-S meals than CHO-L meals. The time that the meal was consumed did not affect satiety (P > 0.5). There was also no significant difference between rice and pasta meals in hunger (P = 0.682), satisfaction (P = 0.980), fullness (P = 0.676), and quantity to eat (P = 0.862) within the same carbohydrate portion.

### Table 5-6 Comparison of postprandial satiety responses between three test meals

<table>
<thead>
<tr>
<th>AUC</th>
<th>CHO-L Mean (SD) (mm•min)</th>
<th>CHO-M Mean (SD) (mm•min)</th>
<th>CHO-S Mean (SD) (mm•min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunger</td>
<td>2324 (1219)</td>
<td>2526 (1489)</td>
<td>2639 (1396)</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>6121 (1402)</td>
<td>6027 (1573)</td>
<td>5832 (1491)</td>
</tr>
<tr>
<td>Fullness</td>
<td>6264 (1336)</td>
<td>6141 (1518)</td>
<td>5931 (1551)</td>
</tr>
<tr>
<td>Quantity to eat</td>
<td>2768 (1466)</td>
<td>2878 (1599)</td>
<td>3206 (1691)</td>
</tr>
</tbody>
</table>

Numbers within the same row with a different superscript letter were significantly different (P < 0.05). Numbers with superscripts in common were not significantly different from one another.

CHO, carbohydrate. L, large portion, M, medium portion, S, small portion.

Postprandial satiety responses are shown in Figure 5-3. Immediately after consuming the test meals participants felt fuller, less hungry, more satisfied and less likely to consume more food. These satiation indicators slowly diminished.
Figure 5-3 Postprandial satiety responses

VAS, visual analogue scale.
Discussion

Data from the first study are indicative that the rice and the pasta meals were equally satiating, whilst participants felt fuller and more satisfied after eating the potato meals compared with the rice and the pasta meals. In this experiment, the comparison among different carbohydrate foods was standardised to an equal carbohydrate content. Similar results have been found when testing foods on an isoenergetic basis; in that study, boiled potatoes eaten alone were more satiating than either rice or pasta eaten alone (Holt. et al., 1995). The data from this study in a meal setting, are therefore consistent with differences in satiety found when these foods are eaten alone.

Possible explanations for potato being more satiating than rice or pasta are their differences in energy density. Potatoes have a higher water content and lower energy density than rice or pasta (The New Zealand Institute of Plant & Food Research Limited, 2012). Therefore, a larger volume of potatoes than rice and pasta needed to be consumed when served in equal carbohydrate portions. A large food volume increases gastric distension and stimulates postprandial satiety (Deutsch et al., 1978; Erdmann et al., 2004; Geliebter, 1988; Poppitt & Prentice, 1996). When eaten ad libitum, potato, rice and pasta consumed with a pork steak resulted in satiating effects that were not different between the meals despite the total carbohydrate and calorie intake after eating potatoes being significantly less than after eating rice and pasta (Erdmann et al., 2007). These observations may have practical and clinical relevance because the amount of carbohydrate consumed directly impacts postprandial glycaemia. If satiety can be maintained whilst consuming a smaller portion of potato compared to other starchy staples, this may offset the potential for a larger glycaemic excursion due to potato having
a high GI. A consequence of a smaller portion reduces not only the glycaemic load (= GI x available carbohydrate) but also the energy content of the meal. Cooking methods and meal composition have also been found to attenuate the glycaemic response (Dodd et al., 2011; Foster-Powell et al., 2002). As suggested, potatoes could be a suitable food option to reduce energy intake whilst maintaining satiety and mitigating postprandial glycaemia as less carbohydrate is consumed (Anderson et al., 2013).

In the second study, it was found that replacing a small portion (50g, 25%) of starchy staples with vegetables in equal weight did not affect satiety, whereas replacing a large portion (100g, 50%) significantly decreased satisfaction. The effect on satiety of exchanging carbohydrate with vegetables has also been examined in a Korean study. After consuming rice which was partially replaced by non-starchy vegetables in equal-volume, participants felt significantly less hungry and subsequently consumed less energy than when eating rice alone, despite carbohydrate and calorie content of the vegetable and rice meal being reduced by 40% (Chang et al., 2010).

There is evidence that both soluble and insoluble fibres increase postprandial satiety and impact on subsequent energy consumption (Howarth et al., 2001; Slavin & Green, 2007). When meals were consumed ad libitum, an additional 14 g fibre/day over two days resulted in a 10% reduction in energy intake (Howarth et al., 2001). Protein also plays a crucial role in appetite regulation. Increasing protein from 15% to 30% of total energy was associated with decreased ad libitum energy intake (Weigle et al., 2005). Although there is evidence to suggest that protein and fibre affect satiety, the quantities are relevant. In the first satiety study, all three test meals had almost the same protein, fat, dietary fibre and calorie content. In the second satiety study, there was only a 1-2 g
between-meal difference in fibre and a less than 5% difference in energy derived from protein. These differences would be too small to generate significant alteration to postprandial satiety. There were *circa* 10% energy decrements between CHO-L and CHO-M as well as between CHO-M and CHO-S. However, satiety has been shown to have a greater association with food volume than with calorie content (Holt. et al., 1995). Non-starchy vegetables are filling because they are bulky and also high in water and fibre (Holt. et al., 1995). Thus, it seems likely maintaining the weight of the meal via replacing carbohydrate with vegetables, was the main contributing factor to sustaining satiety.

 Practically, there is likely to be a limit to the amount of carbohydrate that people are willing to exchange for non-starchy vegetables. There are also other considerations because carbohydrate has satiating qualities. Van Amelsvoort et al found increasing carbohydrate from 27.3% to 59.3% of a meal resulted in significantly greater postprandial satiety (Van Amelsvoort et al., 1989). Subjects who consumed carbohydrate-fortified soup were found to eat less in the subsequent *ad libitum* meals than those who consumed the soup without carbohydrate fortification (Blundell et al., 1994). A similar reduction in hunger and subsequent energy intake was found after people consumed glucose sweetened foods and beverages compared with artificially sweetened ones (Blundell & Hill, 1987; Blundell et al., 1988; Rogers & Blundell, 1989; Rogers et al., 1988). Data from the second study are consistent with previous findings. When a large portion (100g, 50%) of the starchy staple was replaced by vegetables e.g. the change from CHO-L to CHO-S meals, participants felt significantly hungrier. They also felt less full and thought they could consume more food. Thus, satiety can be maintained by replacing some starchy food with non-starchy vegetables, in this study it was 50 grams (25%), but satiety may decrease if greater decrements are implemented.
The two satiety studies aimed to understand participants’ immediate satiety feedback after eating meals composed of various types and amounts of carbohydrate foods. Visual analogue scales were sufficiently sensitive to detect different satiation effects between potato, rice and pasta meals. Following the recommended methodology for satiety measurement (Blundell et al., 2010), total AUC was used rather than incremental AUC. This method identified participants’ subjective satiety responses. Subsequent energy consumption and satiety hormone responses could be recorded as objective measurements, and this could make an interesting future research question.

A strength of these two studies was the comparison of white rice and pasta; these foods have similar energy densities but different GI. Despite the considerable variation of GI between rice (GI = 73) and pasta (GI = 49) (Foster-Powell et al., 2002), there was no significant difference in satiety between the meals when served in equal carbohydrate quantities. The effect of GI on satiety is inconclusive. Some short-term studies have found low-GI foods to be associated with increased satiety (Mollard et al., 2011; Rosen et al., 2011; Sakuma et al., 2009; Schroeder et al., 2009) whereas no association has been found in other work (Anderson et al., 2002; Makris et al., 2011; Peters et al., 2011). One argument was that the additional fibre and protein in low-GI foods increases satiety (Blundell et al., 1994; Holt et al., 1995; Latner & Schwartz, 1999; Rolls et al., 1988; Stubbs et al., 2001). However, among 38 foods potato with a high GI was by far the most satiating food on an isoenergetic basis (8).
A further strength of the two studies was that all test meals were realistic in composition and just like in real life, contained starchy staples, a protein source and vegetables. Standardising the rice and pasta in the second study to be equal in weight and carbohydrate allowed direct comparisons to be made. Investigating how varying the carbohydrate and vegetable portion affected appetite added novelty to this study. It provides evidence that can reassure people who are concerned about increased hunger as a result of replacing starchy staples with non-starchy vegetables. A limitation to generalisation of both studies was that they were not conducted in people with pre- and type 2 diabetes, who may have an impaired satiety response (Suzuki et al., 2012). Also, in the second study satiety was only tested for 90 min, so prolonged postprandial responses were not determined. Similar studies undertaken in groups of people with pre- and type 2 diabetes could provide evidence on which to base dietary recommendations.

In summary, on an equal carbohydrate basis, potato meals were more satiating than rice and pasta meals. If serving sizes of potato are kept within the recommended amounts of available carbohydrate, potatoes may be an excellent food choice for people with type 2 diabetes especially among those needing to reduce their carbohydrate intake. Another strategy may be to replace carbohydrate with non-starchy vegetables as an effective way to lower caloric intake while maintaining satiety, which is particularly important for type 2 diabetes management and weight loss.
Chapter 6. The Development and Testing of an Electronic Diabetes Nutritional Education Resource
**Introduction**

Adequate diabetes knowledge enables individuals to make correct decisions for their diabetes care (American Diabetes Association, 2017b; Funnell & Anderson, 2004; Hernandez-Tejada et al., 2012). It also optimises long-term health outcomes and quality of life (Beaser et al., 1994). In New Zealand, there are indications that most people with pre- and type 2 diabetes receive diabetes nutritional advice from GPs and RNs (Chapter 4), while many people are also concerned about insufficient patient-clinician communication, which leads to confusion, frustration, poor compliance and delay in treatment (Al-Qazaz et al., 2011a; Al-Qazaz et al., 2011b; Badruddin et al., 2002; Benroubi, 2011; Breen et al., 2015; Puder & Keller, 2003). Meanwhile cost, transportation, availability of diabetes services, and language difficulties add further barriers to individuals’ access to nutrition and diabetes education (Diabetes UK, 2009; Hsu et al., 2006; Parker et al., 2011).

The above concerns are evident in the focus group results (Chapter 3) across all ethnicities. The majority of participants with pre- and type 2 diabetes were unable to describe what pre- and type 2 diabetes are and what foods increase blood glucose. This lack of knowledge resulted in unnecessary food avoidance and inappropriate diabetes self-care (Chapters 2 & 3). The focus groups and information-gathering survey results also showed that most individuals wanted specific dietary advice on foods suitable for pre- and type 2 diabetes, and on appropriate portion sizes. They preferred diabetes education to be visual, practical and culturally appropriate (Chapters 3&4).
With increasing access to the Internet, many people are referring to online information (Fox & Duggan, 2013b; Statistics New Zealand, 2012a). Searching online is convenient and offers users anonymous access to a wide spectrum of health information (Rainie & Fox, 2000; Reininger et al., 2013), however, there were also concerns about the credibility and accuracy of online information (Eysenbach et al., 2002; Rainie & Fox, 2000; Scullard et al., 2010; Weymann et al., 2015b). Reininger et al found one third of participants at risk of diabetes had looked up diabetes information online (Reininger et al., 2013). People without diabetes but with families or friends with the condition also searched in-depth (Reininger et al., 2013). The information-gathering survey showed almost 40% of individuals with pre- and type 2 diabetes had searched diabetes nutritional information online. Having “access to trusted diabetes nutritional information online” was rated as the most preferred information source by people with pre- and type 2 diabetes after visiting GPs and RNs (Chapter 4).

Dietary advice for people with type 2 diabetes and pre-diabetes often involves carbohydrate modification and energy restriction. Postprandial satiety plays a crucial role for individual’s compliance to such advice. Chapter 5 investigated satiation effects of various types and amounts of carbohydrate foods, the result of which was incorporated into the resource to ensure the dietary advice was practical and did not alter individuals’ experience of meal satiation.

Internet usage will continue to grow, providing impetus for the development of trusted and high quality online health information. The aim of this PhD research was to develop an online diabetes nutritional education resource for the New Zealand population with a multi-ethnic makeup and to test the effectiveness of this online education.
Methods

1. Ethics

This study was approved by the University of Otago Department of Human Nutrition Academic Ethics Committee, reference: D16/374 (Appendix 12). A 40 second introductory video was played to all participants who visited the study website. It explained the purpose of the study, provided an overview of the education and enumerated the video duration. Consent to participate in the study was obtained by clicking an entry icon.

2. Recruitment

This study was promoted via social media, email, Diabetes New Zealand, and contacting people working within primary and secondary health organisations in New Zealand. The study was also advertised to Human Nutrition students at the University of Otago, Dunedin in 2017.

The inclusion criteria were: All adults (age $\geq$ 18 years) of all ethnicities, education and income levels, who were able to read and write English with an interest in pre- and type 2 diabetes, and who had access to the Internet.

The exclusion criteria were: Less than 18 years, an inability to read and write English or having no Internet access.
3. **Study design**

An online diabetes nutritional education resource was developed based on the results of the focus group and information-gathering survey (Chapters 3 & 4). A controlled interventional study was conducted using Qualtrics® to evaluate the effectiveness of this online resource. The resource components and the estimated time needed to complete each section are presented below (Figure 6-1)

![Figure 6-1 Structure of the resource](image)

Green bar represents time required to complete each section.

Participants were considered to have not completed the study if they had spent less than 15 minutes on the online nutritional education resource. This was because they would not have viewed sufficient of the nutritional component of the video to enable learning to take effect.
4. Study population characteristics

Participants’ demographic information was collected, including age, gender, ethnicity, educational history, and country of residence.

Participants were asked to identify whether or not they had pre- and type 2 diabetes and the reasons that they were interested in participating. People who listed more than one reason were prioritised into the following groups: 1. Have diagnosed with pre- or type 2 diabetes, 2. Health professionals, 3. Interested in diabetes (a. Have type 1 diabetes, b. At risk of pre- and type 2 diabetes, c. Research or study in diabetes, d. Caregiver, e. Personal interest). Participants who identified themselves with more than one ethnicity were prioritised into the following ethnic groups: 1. Māori, 2. Pacific Islander, 3. Indian, 4. South East (SE) Asian, 5. Chinese, 6. European and 7. Other. Participants with pre- and type 2 diabetes were asked to select their years since diagnosis, diabetes medications, how well they controlled their diabetes and how important to them good diabetes control was.

Participants’ baseline dietary habits and lifestyle were assessed, including meal regularity, meal composition, attitude to snacking and levels of physical activity. All participants were asked to rate their knowledge of nutrition and diabetes and what foods and beverages increase blood glucose.

5. Pre- and post-video nutritional quiz

Participants were required to complete a nutritional quiz before and after watching the video. The quiz consisted of three blocks of questions, with each block containing six foods
and beverages randomly selected from a pool of 30-39 items within the following categories: 1. Vegetables & fruit, 2. Protein, fats, rice and wheat products, and 3. Processed foods.

![Image of a nutritional quiz]

(Multiple choice) Please select foods you think increase your blood glucose?

- Baked beans
- Coconut
- Parsnip
- Chinese yam
- Cucumber
- Spinach
- None of the above

**Figure 6-2** Example of a nutritional quiz (items from vegetable and fruit category)

The nutritional quiz contained 18 randomised food and beverage items (6 items per category). As a baseline measure prior to watching the video, participants were required to identify all foods and beverages that increase blood glucose levels (values: 1 = correct, 0 = incorrect). A knowledge score was calculated from the correct answers. The same quiz with another randomised 18 food and beverage items was tested after watching the video.
to quantify any knowledge change. To minimise the learning effect from participating in the quiz, answers to the quiz were not provided.

6. Diabetes dietitian focus group

A one-hour focus group for diabetes dietitians was conducted at the end of an Auckland Regional Diabetes Dietitians’ meeting. Both oral and written information about this study was provided and consent forms were signed prior to the focus group commencing. This study was approved by the University of Otago Human Ethics Committee (Reference no. 14/179) (Appendix 1). The aim of this focus group was to identify dietitians’ expectations of an online nutritional diabetes educational resource for people with pre- and type 2 diabetes. The focus group questions were open-ended and arranged in a logical order, with the most important questions towards the beginning (Appendix 4). The focus group was audio recorded and transcribed verbatim by the facilitator (ZZ).

Auckland diabetes dietitians (n=10) working in both primary and secondary care organisations joined the focus group discussion. All dietitians believed there was a strong need for an online educational resource. They expressed preferences for educational information to be simple, visual, focused on carbohydrate education; and in-line with the Ministry of Health, Diabetes New Zealand, and the Heart Foundation existing guidelines. They emphasised the importance of accurate information especially on pathology of pre-diabetes and type 2 diabetes. Additional educational topics identified during the focus group were: what are pre- and type 2 diabetes, what are carbohydrate foods; importance of weight management, healthy food portions, and physical activities for pre- and type 2 diabetes; how to reduce salt and sugar intake; how to choose healthy fats and oils; what
is an appropriate alcohol intake; and the benefits of smoking cessation. Diabetes dietitians wanted to use this resource for basic community diabetes dietetic education and post-clinic knowledge reinforcement. They also suggested designing the resource for people with different depths of knowledge by programming the resource in various educational layers.

7. Educational Video

The candidate designed and self-recorded the educational video, edited using iMovie (© 2001-2017 Apple Inc. Version 10.1.5) and Keynote (© 2003-2017 Apple Inc. Version 7.1.1). Educational topics were identified based on results from the people with pre- and type 2 diabetes (Chapter 3) and diabetes dietitians’ focus groups. The topics were refined following analysis of the online information-gathering survey (Chapter 4) that was completed by respondents with an interest in pre- and type 2 diabetes and by healthcare professionals. The content of the educational video was in line with the New Zealand Ministry of Health Guidelines (New Zealand Guidelines Group, 2011) and the most recent Standards of Medical Care in Diabetes (American Diabetes Association, 2017b). The topics included in the educational video were:

1. Pathology of pre-diabetes and type 2 diabetes
2. What foods and beverages increase blood glucose
3. Meal portions and a healthy plate model
4. Meal and snack ideas
5. Exercise and nutritional tips for managing pre- and type 2 diabetes.
All topics were presented in a combination of videos, animations, audios, pictures and words. A variety of culture-specific foods were included to reflect the diets of ethnic groups in New Zealand. The video was pre-tested with diabetes dietitians providing feedback that was incorporated into the final content. It was also reviewed by diabetes nurse specialists, diabetes physicians, Diabetes New Zealand and the Diabetes Project Trust. The educational video was uploaded and integrated into the online questionnaire. Examples of screens from the video are shown in Figure 6-3 to Figure 6-7.
What is type 2 diabetes and pre-diabetes?

- **Type 2 Diabetes** is:
  - **Insulin resistance**: body cannot use insulin effectively
  - **Insulin deficiency**: body cannot produce enough insulin
- It leads to **high blood glucose (blood sugar) levels**
- **Pre-diabetes** is the initial stage of type 2 diabetes

**Figure 6-3** Video screenshot - pathology of pre- and type 2 diabetes
Figure 6-4 Video screenshot - what foods and beverages increase blood glucose

Figure 6-5 Video screenshot - meal portions and healthy plate model
Snacks

People with diabetes don’t have to eat snacks, even on insulin
If you are snacking to avoid hypos (low blood glucose), it is important to discuss this with your doctor

If you feel like a snack, try to keep the portion as a cupped handful

Figure 6-6 Video screenshot - meal and snack ideas

Plate size matters

• Most of our dinner plates range from 25 to 30 cm (10-12 inches)
• Although the difference between a large and a small dinner plate is only 5 cm, the large plate is 44% bigger.

Figure 6-7 Video screenshot - exercise and nutritional tips for managing pre- and type 2 diabetes
8. **Assessment for perceived knowledge and behaviour change**

After watching the video, participants were asked to re-rate their knowledge of nutrition and diabetes. They were asked to choose whether they had been motivated to make dietary and lifestyle changes based on the video, such as improving meal regularity and meal portions, making healthy food choices, losing weight, increasing physical activity, reducing alcohol intake, taking medications regularly, testing blood glucose and quitting smoking. Participant’s perceived ability to afford healthy eating was also assessed.

![Figure 6-8 Example of perceived behaviour change assessment](image)
9. **Resource feedback**

Participants were asked to comment on the ease of understanding of the video and the perceived value of the information. They were also encouraged to provide feedback on the resource.

10. **Validation study (control group)**

A validation test retest study was conducted prior to the main research. The aims were twofold: to assess whether there was a learning effect from completing a repeated nutritional quiz; and to assess whether randomising the foods caused changes in the difficulty of answering the quiz. A total 93 participants were recruited among the Human Nutrition students at the University of Otago, Dunedin (2017). The validation study was approved by the University of Otago Ethics Committee, reference: D16/374 (Appendix 12).

11. **Statistical analysis**

All data were processed using R for Macintosh (© R Foundation for Statistical Computing, 2016) and analysed using Microsoft Excel for Macintosh (Microsoft® Excel®. Version 15.31. Microsoft Corporation 2017). A P-value of less than 0.05 was set as the cut-off for statistical significance in all analyses.
Participants were asked to identify the proportions of vegetable, protein and carbohydrate they consumed in a meal from a choice of “nil”, “1/8”, “1/4”, “1/3”, “3/8”, “1/2”, “5/8”, “2/3”, “3/4”, “7/8”, and “all”.

Participants’ meal proportions were compared against the recommended healthy meal composition (i.e. ½ meal of vegetables, ¼ meal of carbohydrate, and ¼ meal of protein). Twenty-four was used as a common denominator. Hence the recommended ½ meal of vegetables scored 12 (= ½ × 24), ¼ meal of carbohydrate scored 6 (= ¼ × 24), and ¼ meal of protein scored of 6 (= ¼ × 24). In order to quantify deviation from the recommended proportions, a scoring system was devised based on the common denominator. Using this system, if a person consumed the recommended proportion (½ vegetables: ¼ carbohydrate: ¼ protein), then the deviation score would be zero.

\[
\text{Meal deviation score} = \left| 12 - \frac{1}{2} \times 24 \right| + \left| 6 - \frac{1}{4} \times 24 \right| + \left| 6 - \frac{1}{4} \times 24 \right|
\]

\[
= |12 - 12| + |6 - 6| + |6 - 6| = 0 + 0 + 0 = 0
\]

If the proportions deviated from that recommended, the absolute difference between the proportions selected by the participant and the recommended meal composition was calculated as below.

\[
\text{Meal deviation score} = |12 - \text{proportion of vegetables} \times 24| + |6 - \text{proportion of carbohydrate} \times 24| + |6 - \text{proportion of protein} \times 24|
\]
For example, for a participant who consumed $\frac{1}{3}$ of a meal as vegetables, $\frac{1}{3}$ of a meal as carbohydrate and $\frac{1}{3}$ of a meal as protein, the meal composition score is eight.

$$\Delta \text{Meal composition} = \left| 12 - \frac{1}{3} \times 24 \right| + \left| 6 - \frac{1}{3} \times 24 \right| + \left| 6 - \frac{1}{3} \times 24 \right|$$

$$= |12 - 8| + |6 - 8| + |6 - 8| = 4 + 2 + 2 = 8$$
Results

1. Participants’ characteristics

A total of 291 eligible participants enrolled in the study, with 174 (60%) completing both the pre- and post-video questionnaires and nutritional quizzes, of which 156 (89% of completed) met the participation criterion of having spent at least 15 minutes on the resource (Figure 6-9). Of the 122 participants excluded from analysis, 19 had pre- and type 2 diabetes, 23 were health professionals, and 80 had an interest in pre- and type 2 diabetes.

![Flowchart of enrolment and participation results](Figure 6-9 Enrolment and participation results flowchart)
The mean age of the study participants was 34.3 years, 80.8% were female, 29.9% were non-European, and 85.3% were university educated (Table 6-1).

**Table 6-1** Characteristics of participants who met inclusion criteria (n = 156)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female, n (%)</td>
<td>126 (80.8%)</td>
</tr>
<tr>
<td>Age, mean years</td>
<td>34.3 years</td>
</tr>
<tr>
<td>Ethnicity, n (%)</td>
<td></td>
</tr>
<tr>
<td>European</td>
<td>110 (70.1%)</td>
</tr>
<tr>
<td>Māori</td>
<td>8 (5.1%)</td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>3 (1.9%)</td>
</tr>
<tr>
<td>Chinese</td>
<td>21 (13.3%)</td>
</tr>
<tr>
<td>Indian</td>
<td>8 (5.1%)</td>
</tr>
<tr>
<td>SE Asian</td>
<td>4 (2.5%)</td>
</tr>
<tr>
<td>Other</td>
<td>3 (1.3%)</td>
</tr>
<tr>
<td>Education, n (%)</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>7 (4.5%)</td>
</tr>
<tr>
<td>Polytechnic</td>
<td>9 (5.8%)</td>
</tr>
<tr>
<td>University</td>
<td>133 (85.3%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>7 (4.5%)</td>
</tr>
</tbody>
</table>

Of the 156 participants, 10.9% had pre- and type 2 diabetes and 13.5% were health professionals. The remaining 75.6% were interested in pre- and type 2 diabetes, of whom 4.5% were at risk of pre- and type 2 diabetes, 3.8% taking care of people with pre- and type 2 diabetes, 17.3% studying or researching in diabetes and 48.7% had a personal interest (Table 6-2).
Table 6-2 Sub-groups of participants who met inclusion criteria (n = 156)

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>17</td>
<td>(10.9%)</td>
</tr>
<tr>
<td>Pre-diabetes</td>
<td>5</td>
<td>(3.2%)</td>
</tr>
<tr>
<td>Type 2 diabetes</td>
<td>12</td>
<td>(7.7%)</td>
</tr>
<tr>
<td>Professionals</td>
<td>21</td>
<td>(13.5%)</td>
</tr>
<tr>
<td>Interested</td>
<td>118</td>
<td>(75.6%)</td>
</tr>
<tr>
<td>At risk of Pre/T2</td>
<td>7</td>
<td>(4.5%)</td>
</tr>
<tr>
<td>Caregiver</td>
<td>6</td>
<td>(3.8%)</td>
</tr>
<tr>
<td>Have type 1 diabetes</td>
<td>2</td>
<td>(1.2%)</td>
</tr>
<tr>
<td>Research</td>
<td>27</td>
<td>(17.3%)</td>
</tr>
<tr>
<td>Personal interest</td>
<td>76</td>
<td>(48.7%)</td>
</tr>
</tbody>
</table>

Pre/T2, pre- and type 2 diabetes.

Of those with pre- and type 2 diabetes who met the inclusion criteria, the average years since diagnosis of pre- and type 2 diabetes were 2.7 and 9.1 years respectively. Ten out of twelve with type 2 diabetes were on oral hypoglycaemic agents or insulin, no participant with pre-diabetes had been prescribed diabetes medication. Seventy percent of participants with pre- and type 2 diabetes perceived their diabetes management to be excellent or good, and 100% thought having good diabetes control was extremely important or important to them (Table 6-3).
### Table 6-3 Diabetes management in participants with pre- and type 2 diabetes (n = 17)

<table>
<thead>
<tr>
<th>Diabetes management</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diabetes medication</strong></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>7</td>
</tr>
<tr>
<td>Metformin</td>
<td>9</td>
</tr>
<tr>
<td>Sulfonylurea</td>
<td>3</td>
</tr>
<tr>
<td>Insulin</td>
<td>3</td>
</tr>
<tr>
<td>Pioglitizone</td>
<td>1</td>
</tr>
<tr>
<td><strong>Perceived Management in Pre/T2</strong></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>4</td>
</tr>
<tr>
<td>Good</td>
<td>8</td>
</tr>
<tr>
<td>Average</td>
<td>4</td>
</tr>
<tr>
<td>Poor</td>
<td>1</td>
</tr>
<tr>
<td><strong>Perceived Importance of good diabetes control</strong></td>
<td></td>
</tr>
<tr>
<td>Extremely important</td>
<td>11</td>
</tr>
<tr>
<td>Important</td>
<td>6</td>
</tr>
<tr>
<td>Not very important</td>
<td>0</td>
</tr>
<tr>
<td>Not important at all</td>
<td>0</td>
</tr>
</tbody>
</table>

Pre/T2, pre- and type 2 diabetes.
2. Validation study

Results of the validation study (n = 93) showed completion of two nutritional quizzes without watching the video did not result in any knowledge gain (Table 6-4). Also, randomisation of foods and beverages did not change the number of food items (out of 18 in total) correctly identified.

<table>
<thead>
<tr>
<th></th>
<th>Pre-video</th>
<th>Post-video</th>
<th>Score difference (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Validation (n = 93)</td>
<td>12.7</td>
<td>12.9</td>
<td>5.4% (-1.7%, 12.3%)</td>
<td>0.394</td>
</tr>
</tbody>
</table>

CI, confidence interval.

3. Nutritional knowledge change

Participants were asked to self-rate their knowledge of nutrition and diabetes. Two thirds of the health professionals (66.7%) perceived themselves as knowing “a great deal” or “a lot” about nutrition and diabetes, whereas only 53% of those with pre- and type 2 diabetes and 23.7% with a general interest perceived the same level of knowledge (Figure 6-10).
After watching the video, 62.1% reported that their knowledge of nutrition and diabetes had improved “a great deal” or “a lot”. Peoples perceived ability to identify foods and beverages that affect blood glucose also improved, with 82.4% with pre- and type 2 diabetes, 85.7% health professionals and 49.2% of Interested respondents reporting that they definitely knew what foods and beverages increased blood glucose as opposed to 35.3 %, 47.6% and 7.6% respectively prior to watching the video (Figure 6-11).

Figure 6-10 Perceived knowledge in nutrition and diabetes at baseline

Figure 6-11 Participants who perceived they knew what foods increase blood glucose
The main effect of watching the educational video on nutritional knowledge is presented in Table 6-5. In all three groups, number of food items (out of 18 in total) correctly identified as increasing blood glucose significantly increased after watching the video. In a subgroup analysis, a significant improvement in the number of food items correctly identified was 16.7% (95%CI 11.7%, 21.7%) in European participants and 14.1% (95%CI 5.9%, 22.3%) in all other ethnicities.

Table 6-5 Numbers of food items correctly identified pre- and post-watching the video

<table>
<thead>
<tr>
<th></th>
<th>Pre-video</th>
<th>Post-video</th>
<th>Knowledge gain (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre/T2 (n = 17)</td>
<td>13.2 (73.3%)</td>
<td>15.1</td>
<td>17.4% (5.3%, 29.7%)</td>
<td>0.013</td>
</tr>
<tr>
<td>Professional (n = 21)</td>
<td>14.8 (82.2%)</td>
<td>16.4</td>
<td>12.8% (5.1%, 20.6%)</td>
<td>0.003</td>
</tr>
<tr>
<td>Interested (n = 118)</td>
<td>13.6 (75.6%)</td>
<td>15.2</td>
<td>16.3% (11.1%, 21.5%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total (n = 156)</td>
<td>13.7 (76.1%)</td>
<td>15.4</td>
<td>16.0% (4.3, 20.2%)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

CI, confidence interval. Pre/T2, pre- and type 2 diabetes.

4. **Perceived meal composition change**

Participants reported that at main meals they consumed an average 30.8% carbohydrate, 27.9% protein and 41.3% vegetables pre-video (Figure 6-12). Participants with pre- and type 2 diabetes consumed the least proportion of carbohydrate (24.8%) and the greatest proportion of vegetables (48.3%) among all groups (Figure 6-12).
Figure 6-12 Proportion of carbohydrate, vegetables and protein at main meals
After watching the video, the absolute meal composition difference from recommended was significantly reduced in all groups, showing intended carbohydrate, vegetable and protein intake to be better aligned with the recommended healthy plate model (Table 6-6) than pre-video.

<table>
<thead>
<tr>
<th>Table 6-6 Comparison of meal composition to healthy plate model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Pre/T2 (n = 17)</td>
</tr>
<tr>
<td>Professional (n = 21)</td>
</tr>
<tr>
<td>Interested (n = 118)</td>
</tr>
<tr>
<td>Total (n = 156)</td>
</tr>
</tbody>
</table>

CI, confidence interval. Pre/T2, pre- and type 2 diabetes.

5. Perceived dietary and lifestyle behaviour change

It was shown that health professionals tended to have more regular meals than other sub-groups, with 85.7% rarely skipping a meal as opposed to 63.5% with pre- and type 2 diabetes and 59.3% of Interested people.

Over 85% of all participants believed that people with pre- and type 2 diabetes need or may need to snack. Only 38.1% health professionals, 11.8% with pre- and type 2 diabetes and 9.3% Interested did not think snacks were necessary. Of all groups, an average of 72 minutes of physical activity per day was reported (Pre- and type 2 diabetes: 73 min, Professionals: 82 min, Interested: 70 min).
After watching the video, 92.3% of the participants planned to make some dietary and/or lifestyle change such as “increase vegetable intake” (51.9%), “follow the healthy plate model” (44.9%), “have less sugar” (43.6%), “increase physical activity” (42.9%) and “evenly spread out carbohydrate intake throughout the day” (37.2%), “eat less snacks” (33.3%), “lose weight” (29.5%) and “increase fruit intake” (19.9%). Out of the 57 participants reported not always eating regularly, 54 selected that they wanted to eat meals regularly after watching the video.

6. **Cost barrier to healthy eating**

The cost of healthy eating was a concern to some participants with 12% reporting that they would struggle to eat in a healthy way for more than 50% of the time.

7. **Resource feedback**

Almost all participants felt the video was easy (83%) or moderately easy (16%) to understand. Participants described the resource as being informative and interactive with the quizzes enhancing the learning experience. Some people mentioned that it should be given to everyone newly diagnosed with pre- and type 2 diabetes. One participant was of the opinion that the video was too long, one would have preferred the video to have been delivered by a native English speaker, one person suggested it would be useful to be able to pause the video to go back to questions, and one suggested that healthy cooking could be incorporated into the video.
“This video should be shown to all newly diagnosed people. So nice, clear calmly presented information.”

“Very informative video. Interactive survey using pictures is great!”

“I suggest that introduce some knowledge about ways to cook these foods and tell people which is a more healthier way.”

“Would be useful to be able to pause video or go back to questions.”
Discussion

A diabetes education tool developed by the candidate with input from focus groups, survey respondents and New Zealand registered dietitians, was viewed by 156 people (17 people with pre-diabetes or type 2 diabetes; 118 members of the general public who expressed interest in knowing about diabetes; and 21 health professionals). The main finding was that as a result of viewing the education resource, the ability and confidence of all groups to correctly identify foods and beverages that increase blood glucose significantly increased. The increase in knowledge, assessed by comparing pre- and post-education video responses to a nutritional quiz, is attributed to the education component of the resource because in a validation study there was no learning effect to repeated administration of the quiz without the education video.

The knowledge gain found from viewing the video is consistent with controlled (Heinrich et al., 2011; Wise et al., 1986) and uncontrolled interventional studies (Carolan-Olah et al., 2015; Porter et al., 2009; Reininger et al., 2013). Compared to subjects who received no intervention, Heinrich et al found interacting with a web-based diabetes education program over two weeks resulted in a significant knowledge improvement in patients with type 2 diabetes (Heinrich et al., 2011). Similarly, Wise et al reported that interactive computer teaching (45-60 min), or computer generated feedback, significantly improved participants’ knowledge of type 1 and type 2 diabetes (Wise et al., 1986).

In contrast to previous studies which targeted people with diabetes, the current study was targeted at a wider population of people with pre- and type 2 diabetes, health professionals and members of the general public without the condition. Participants in
the current study were recruited through advertisements to reach a wide population who might be interested. In New Zealand, 34% of the New Zealand adults are overweight and obese, putting them at a high risk of developing pre- and type 2 diabetes (Coppell et al., 2013; Ministry of Health, 2013; Tabák et al., 2012). To halt the rising prevalence of type 2 diabetes, population-based education on healthy eating and lifestyle is essential (American Diabetes Association, 2017b; International Diabetes Federation, 2015b; World Health Organization, 2016). Also, nutritional education should not be restricted to people with the condition. Involving caregivers and family members in the education promotes patients’ behaviour change (American Diabetes Association, 2017b; Glasgow et al., 1999; Lawrenson et al., 2010; Teufel-Shone et al., 2005), especially among ethnic minorities living in multi-generation households (Hu et al., 2014; Lawrenson et al., 2010; The Ministry of Social Development, 2004).

Similar to the result of the previous focus group and information-gathering survey, a general lack of understanding in nutrition for diabetes was found, despite the study population having a relatively high level of education; 85% with a tertiary degree. It is concerning that at baseline only 35% of participants with pre- and type 2 diabetes, 48% of health professionals and 7% of those interested thought that they definitely knew what foods and beverages increase blood glucose. These identified knowledge deficits emphasise the need for a population-based nutritional education resource. A significant knowledge improvement was shown in all groups after viewing the resource. Knowledge gain was even apparent among health professionals who, under similar circumstances, have been found to pass the information to their clients (Gossain et al., 1993; Parker et al., 2011; Rubin et al., 2007; Vetter et al., 2008). People with pre- and type 2 diabetes perceived that they had a better knowledge base than those without the condition.
although, in reality, they did not outperform people without diabetes in the nutritional quiz. Indeed, although people with pre- and type 2 diabetes may have received nutritional information from various sources (Chapters 3 & 4), some information may not have been accurate or even conflicting (Fukuoka et al., 2014; Lawrence et al., 2017). This in turn led to misconception, confusion and mistrusting advice (Breen et al., 2015; Brez et al., 2009; Lawrence et al., 2017).

Participants’ lack of understanding of appropriate meal proportions is not unique to this study (Fukuoka et al., 2014; Lawrence et al., 2017). Participants self-reported meal composition was compared to the recommended plate model using the absolute difference to detect both over and under consumption of a certain food group. Following the video, participants’ intentions as to what proportions they would aim for were assessed. Intention to increase vegetable consumption and reduce carbohydrate and protein intake was found among health professionals and the participants without pre- and type 2 diabetes. Although on average participants with pre- and type 2 diabetes had a baseline intake that was in line with the recommendation, at an individual level there was a large variation of under and over consumption of carbohydrates. Following viewing of the resource, some participants intended to reduce their carbohydrate intake whilst others following a low carbohydrate diet expressed an intention to add carbohydrate back into their meals. The intentions expressed by the participants to comply with the recommended food proportions are evidence of motivation to change.

Motivation and engagement is crucial when the education is delivered by distance via electronic devices. A strength of this study was its strong consumer component. In many studies, resources have been designed without formal recognition of the need for input
from the target audience (Glasgow et al., 2012; Lorig et al., 2010; Weymann et al., 2015a; Wise et al., 1986). In contrast, the content of the current resource incorporated ideas expressed by people with pre- and type 2 diabetes, health professionals and people without diabetes who were interested in the condition. Ease of use and the provision of information specific to peoples’ needs increases consumer satisfaction and promotes learning outcomes (Ramadas et al., 2015; Weymann et al., 2015a). Pre-learning tests further enhance learning engagement and knowledge retention (Butler & Roediger, 2007; McDaniel et al., 2011). Participants found that the nutritional quiz addressed their knowledge gap and aroused their interest. The majority of participants reported they had learnt "a lot" from watching the video, evidence supporting the success of this consumer-focused education. It would be interesting for future studies to investigate whether this knowledge gain and motivation to change will ultimately transfer to sustained behaviour change.

The knowledge gain found by the interaction of participants with the resource provides evidence that diabetes nutritional education can be delivered in a time and cost efficient manner. Watching a one-off 20-minute video at a time and place convenient for participants imposes minimal burden. Participants also rated the educational video as being easy to follow and to understand. The use of video, animation, pictures, text and voice catered for people with different learning styles (Fleming, 2001). In particular, the use of visual aids such as videos and pictures enhances learning and subsequent recall for people with lower health literacy and for those with limited language proficiency (Garcia-Retamero & Dhami, 2011; Houts et al., 2006). Non-European participants specifically requested such features during focus group discussions. The significantly improved
accuracy in identifying foods increasing blood glucose confirmed the effectiveness of the resource among non-European population.

A limitation of the study was a relatively low response rate and a high dropout rate before watching the video. Although the resource was promulgated through social media and health care organisations, the ability to reach a large proportion of the population was restricted due to the limited study timeframe. Also, having to complete a participant characteristic survey and a nutritional quiz before the video may have weakened participants’ motivation. Although the video was only twenty minutes, it might have been too long for some people. A possible solution to this is to split the video into 5-10 minute sessions to lower the initial time requirement. Another limitation was that the resource was only presented in English, limiting comprehension for non-English speakers. However, translating into other languages is possible if it is thought that this would be useful in the future. Generalisability may also be limiting as the study population was relatively young with a high education level. Also, about 80% of the respondents were female suggesting the need to engage and encourage men to participate in these types of activities. Furthermore, although participants’ knowledge was reinforced through immediate knowledge reassessment, this approach may overestimate learning effects. It will be important in the future to reassess in six and twelve months.

Overall, it was found that the electronic nutritional education resource improved participants’ knowledge as well as their intentions toward healthy eating and lifestyle. Further studies can be designed to measure whether short 5-10 minute videos presented in multiple languages may improve participation and also if this learning exercise leads to actual behaviour change and improvement in patients’ diabetes control.
Chapter 7. Conclusion
The objective of this PhD research project was to develop and test a nutritional education resource for pre- and type 2 diabetes that is specifically designed for the New Zealand population. The project was commenced with a comprehensive literature review examining the effectiveness of electronic diabetes education. The use of electronic resources for patient education has increased over the years but a search of the literature revealed a sparsity of information on ethnic-specific needs and a lack of practical education tools for use outside of the research setting. Hence, the first component of this research project was to gather background information from people with pre- or type 2 diabetes through discussion groups as to the gaps in their knowledge and their views on the use of electronic resources. Discussions with New Zealand registered dietitians were conducted to gain perspective from the viewpoint of these health professionals. Following this, a survey was constructed to explore the general level of interest in diabetes education from a wider spectrum of the community who may be involved in caring for friends or family members with diabetes. A theme that emerged from these information-gathering exercises was a lack of knowledge of portion control and concerns that dietary changes might lead to feelings of hunger. Two practical experiments were devised to test satiety in response to meals that a dietitian might advise. Finally, all of the data were used by the candidate to develop and test an electronic educational resource.

The literature review in this thesis focussed on published studies in which diabetes education delivered via the use of electronic devices had been reported on. Various electronic educational programs and their effect on participants’ knowledge and glycaemic control were compared. A better learning outcome was found if the education was carried out in the participant’s own environment rather than in a waiting room (Gerber et al., 2005); if information given was based on what participants wanted to know
rather than based on clinicians’ knowledge (Ramadas et al., 2015; Weymann et al., 2015a); and the provision of translation and visual aids for people with language difficulties (Carolan-Olah et al., 2015; Porter et al., 2009; Reinger et al., 2013).

A need for an electronic diabetes nutritional education resource was identified through published accounts of lack of resources (Diabetes UK, 2009; Guariguata et al., 2014; Segal et al., 2013) and the candidate’s role as a registered New Zealand dietitian working in diabetes clinics. In diabetes clinics, the candidate has encountered a general lack of nutritional knowledge and a variety of misconceptions by people with diabetes. To formalise these anecdotal observations, ethnic-specific focus groups comprised of people with pre- and type 2 diabetes were undertaken. The ideas expressed in these focus groups confirmed that people were unsure about diabetes and its complications, and often unclear and confused by conflicting nutritional messages emanating from a wide range of sources including mass media, the Internet, friends and family members. This uncertainty is not unique to New Zealand, having been found in a number of countries (Al-Qazaz et al., 2011a; Badruddin et al., 2002; Benroubi, 2011; Breen et al., 2015).

Another purpose of these focus groups was to gain insight into the educational content from a consumer point of view. Participants wanted the educational resource to be simple, visual, practical, and culturally appropriate. All groups had researched diabetes nutritional information online and had high acceptance of online education. Regardless of which ethnic group, there was a strong desire to know what foods increase blood glucose, what foods are suitable for diabetes, and appropriate portion sizes. In addition to discussion among people with pre- and type 2 diabetes, a diabetes dietitians’ focus group was undertaken to ascertain practising dietitians’ views as to what people needed to
know about nutrition for pre- and type 2 diabetes, and what information was suitable for lay public. This would ensure that the education provided in the resource would be in line with, and complement, nutritional advice given in primary and secondary care. Feedback received from diabetes dietitians was similar to the feedback received from people with pre- and type 2 diabetes as to the range of educational topics and format.

To slow the rise of pre- and type 2 diabetes, nutritional education should not be limited to patients, but open to the general public (Glasgow et al., 1999; Hu et al., 2014; International Diabetes Federation, 2015b) and to health professionals not specialised in nutrition for diabetes (Gossain et al., 1993; Parker et al., 2011; Rubin et al., 2007; Vetter et al., 2008). To assess the needs of this broader audience, an information-gathering survey was distributed online. A total of 448 people responded to the survey including those with or without the condition and health professionals, highlighting a population-wide interest in learning about nutrition for diabetes. As expected, health professionals were found to have better nutritional knowledge than lay respondents, but among the survey respondents, having a diagnosis of diabetes did not improve nutritional scores. Despite the majority of respondents knowing that foods high in sugar increased blood glucose, many failed to identify starchy vegetables, fruit and dairy products. As with the focus groups, the survey respondents preferred looking up nutrition information online.

As well as a knowledge of foods, part of nutritional management for pre- and type 2 diabetes is to review and modify carbohydrate portions. For some, there is a need to redistribute carbohydrate consumption throughout a day in order to achieve targets for glycaemic variability (Diabetes New Zealand, 2014; Franz et al., 2010; Temple et al., 2017). In consideration of weight loss for people who are overweight or obese, it was
essential to examine the impact that a redistribution of carbohydrate may have on a person’s satiety. Hunger-induced subsequent food intake may be a concern to those needing to restrain oral intake (Fedoroff et al., 2003; Papies et al., 2007). Hence, two satiety studies using realistic meals were conducted. The aim of the first study was to explore the satiating effect of different types of carbohydrate foods in standardised mixed meals; and the second was to examine how replacing carbohydrate foods with non-starchy vegetables affected postprandial satiety. It was found that potato meals had a significantly higher satiating effect than rice or pasta meals despite a nearly identical meal nutritional composition. In the second study, replacing a small amount of starchy carbohydrate with vegetables had no impact on postprandial satiety, whereas replacing a large quantity may lead to reduced postprandial satiety. The results of these two satiety studies provided evidence for dietetic advice on diabetes and weight management that was incorporated into the final educational resource. Based on the interpretation of the literature review, feedback from the focus groups, data from the information-gathering survey, and satiety study results, a 20-minute video titled “Nutrition for type 2 diabetes & pre-diabetes” was developed and pre-tested. This short one-off educational session covered topics raised by people with pre- and type 2 diabetes, health professionals and those interested in this condition. A significant improvement in the nutritional knowledge of all participants was found, even among health professionals looking after people with pre- and type 2 diabetes. Those who watched the educational video achieved higher accuracy in identifying foods and beverages that increased blood glucose and they also showed intention to make healthier dietary and lifestyle choices.

At baseline, about half of the participants with pre- and type 2 diabetes thought they knew “a great deal” or “a lot” about nutrition and diabetes and “definitely knew” what foods and
beverages increased blood glucose, as opposed to less than a quarter of those in the Interested group. The reason for the difference is that people with pre- and type 2 diabetes had likely already received some nutritional information for diabetes (Chapter 4). Despite this perception of increased awareness, people with pre- and type 2 diabetes did not outperform the lay respondents in the nutritional quiz. This uncertainty of nutrition for diabetes indicated that people with pre- and type 2 diabetes may not have received enough nutritional advice, as attested to in other work (Breen et al., 2015; Lawrenson et al., 2010). It explained the confusion and misunderstanding evident in our focus groups.

Despite subtle ethnic differences in educational needs being suggested in this work, overall there is a general lack of nutritional knowledge for diabetes both among the lay public and among people with pre- and type 2 diabetes (Al-Qazaz et al., 2011a; Breen et al., 2015; Lawrenson et al., 2010). An educational resource was developed to address these needs. Of those people who viewed the educational material and completed a knowledge quiz, a significant gain in knowledge was found with just a 20-minute learning exercise. Additionally, the knowledge gain was apparent among the 30% of respondents identifying either as Māori or as an ethnic minority. The results are encouraging and in line with improvements reported elsewhere (Glasgow et al., 2011; Glasgow et al., 2010; Glasgow et al., 2012; Lorig et al., 2010; Reininger et al., 2013).

The literature contains little work describing the needs and expectations of various ethnic groups living within the same country. Consulting a wide variety of ethnic groups and understanding what people wanted to know about nutrition for diabetes is a strength of this work. Furthermore, few published studies explored target audience’s experience and
expectation of diabetes care prior to their resource development, but simply built its content based on text books, existing group programmes or experience of clinicians (Gerber et al., 2005; Glasgow et al., 2012; Lorig et al., 2010; Rice et al., 2017). The diabetes dietitian focus group and peer review of the final resource gives confidence that the education content is both consistent with current clinical practice and New Zealand Ministry of Health guidelines and delivered in a way that is understandable to the lay public.

A positive outcome of the work is that participants reported the educational information as being easy to follow and that the nutritional quiz and video package was fun and engaging. This appreciation may, in part, reflect the input from the end-users that went into developing the resource. A novel factor in this work is the participation of people without diabetes watching the educational resource and improving their knowledge as a result. The inclusion of friends and family members in helping people with type 2 diabetes to manage the condition was strongly advocated for in the focus group discussions. Insight from dietitians into the makeup of the resource was also valuable. Following this research, twelve requests from colleagues ranging from endocrinologists, diabetes nurse specialists, diabetes dietitians, and primary healthcare providers have been received asking to use the video for patient education. This PhD research has generated interest among dietitians from around the world. Two posters were presented at the 17th International Congress of Dietetics, in Spain 2016 (Appendix 14). The focus group poster was also the winning “People’s Choice Poster” in the 2017 Waitemata District Health Excellence Awards, receiving over 400 votes (Appendix 13). During the Awards ceremony, the candidate herself was presented with the “Emerging Researcher” award. The interest and recognition from professional colleagues working in the healthcare
sector is testament to a clear need for diabetes nutritional education in electronic form. The resource developed and tested within this PhD project was effective and inexpensive. The fact that the education had been provided without additional cost of clinicians’ time suggests a cost-effective way to deliver diabetes nutritional education in the future.

A limitation of this work is generalisability, as the study sample underrepresented some ethnic minority groups, people with limited English, and overrepresented those with high income and education. Also, approximately one-third of people who started watching the resource exited part way through. No data were collected to give insight into the reasons for this. Some people may have found the information too basic. Without data, it is difficult to judge whether the level of information might have been a factor. Potentially, a staged education resource advancing in complexity could be considered. Time constraints could be another reason that people opted out of the resource. In this era of Internet browsing, twenty minutes may be a relatively long time to engage with a single website (Guo et al., 2014; Hanson & Haridakis, 2008). The educational resource could be modified in the future by covering various topics in short modules.

In conclusion, the electronic nutritional education resource is an effective approach to deliver education. It offers great potential in this digital age for an effective nutritional education program that is capable of reaching wider society without over-stretching limited healthcare resources.
Key findings:

- There was confusion and lack of diabetes nutritional knowledge across all ethnicities. Māori, Pacific Island and Indian with pre- and type 2 diabetes were less likely to have accessed diabetes services or received formal diabetes education.
- All ethnic groups preferred diabetes education to be simple, visual, practical, and ethnically appropriate.
- Apart from visiting primary care providers, searching online was the most preferred way of obtaining diabetes nutritional information.
- Participants of all ethnicities expressed willingness to engage with online educational material.
- Improvements in nutrition knowledge scores were found as a result of viewing the educational resource in both European and ethnic minority groups.
- Electronic nutritional education was found to be a feasible and effective approach to improving nutritional knowledge in the New Zealand multi-ethnic population.
- The general public, with or without pre- and type 2 diabetes, and health professionals in New Zealand may all benefit from the availability of an electronic diabetes nutritional education resource.
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163


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Appendices
Appendix 1 Focus Group Ethical Approval

Dr B Venn
Department of Human Nutrition
Division of Sciences

Dear Dr Venn,

I am writing to let you know that, at its recent meeting, the Ethics Committee considered your proposal entitled “Development of an electronic resource for people with pre-diabetes or type 2 diabetes: a focus group needs assessment”.

As a result of that consideration, the current status of your proposal is:- Approved

For your future reference, the Ethics Committee’s reference code for this project is:- 14/179.

The comments and views expressed by the Ethics Committee concerning your proposal are as follows:-

While approving the application, the Committee would be grateful if you would respond to the following:

The Committee would be grateful if you could review the Consent Form. Please renumber the Consent Form to ensure the numbers are consecutive. Please delete any template prompts in italics - for example at item 7.

Please provide the Committee with copies of the updated documents, where changes have been necessary.

Approval is for up to three years from the date of this letter. If this project has not been completed within three years from the date of this letter, 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 Wite
Manager, Academic Committees
Tel: 479 8256
Email: gary.wite@otago.ac.nz

c.c. Professor S Samman  Department of Human Nutrition

20 October 2014
Appendix 2 Focus Group Ngāi Tahu Research Consultation Committee consultation

Tuesday, 21 October 2014.

Dr Bernard Venn,
Department of Human Nutrition,
DUNEDIN.

Teā Koe Dr Bernard Venn.

Development of an electronic resource for people with diabetes: a focus group needs assessment

The Ngāi Tahu Research Consultation Committee (the committee) met on Tuesday, 21 October 2014 to discuss your research proposition.

By way of introduction, this response from the Committee is provided as part of the Memorandum of Understanding between Te Rūmanga o Ngāi Tahu and the University. In the statement of principles of the memorandum it states “Ngāi Tahu acknowledges that the consultation process outlined in this policy provides no power of veto by Ngāi Tahu to research undertaken at the University of Otago”. As such, this response is not “approval” or “mandate” for the research, rather it is a mandated response from a Ngāi Tahu appointed committee. This process is part of a number of requirements for researchers to undertake and does not cover other issues relating to ethics, including methodology they are separate requirements with other committees, for example the Human Ethics Committee, etc.

Within the context of the Policy for Research Consultation with Māori, the Committee base consultation on that defined by Justice McGregor:

“Consultation does not mean negotiation or agreement. It means: setting out a proposal not fully decided upon, adequately informing a party about relevant information upon which the proposal is based, listening to what the others have to say with an open mind (in that there is room to be persuaded against the proposal); undertaking that task in a genuine and not cosmetic manner. Reaching a decision that may or may not alter the original proposal.”

The Committee considers the research to be of importance to Māori health.

As this study involves human participants, the Committee strongly encourage that ethnicity data be collected as part of the research project. That is the questions on self-identified ethnicity and descent, these questions are contained in the latest census.

The Committee notes that there was a programme similar to this started by the late Dr Maseka Laws at Te Wananga o Awanui-a-Rangi and suggests the researchers may be able to find useful information from the legacy of that programme’s initiation based on a successful programme in Hawaii.

The Committee suggests dissemination of the research findings to Māori health organisations regarding this study.

The Ngāi Tahu Research Consultation Committee has membership from:

Te Rūmanga o Ōhāriu Incorporated
Kāti Huirua Kāmara Incorporated
Te Rūmanga o Mōna

181
We wish you every success in your research and the committee also requests a copy of the research findings.

This letter of suggestion, recommendation and advice is current for an 18 month period from Tuesday, 21 October 2014 to 21 April 2016.

Nāhaku noa, nā

Mark Brunton
Kaitahakihure Rangahau Māori
Research Manager Māori
Research Division
Te Whare Wānanga o Ōtahi
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Email: mark.brunton@otago.ac.nz
Web: www.otago.ac.nz
Appendix 3 Focus Group Information Sheet for Participants

Development of an electronic resource for people with pre-diabetes or type 2 diabetes: a focus group needs assessment

INFORMATION SHEET FOR PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

This project is being undertaken as part of the requirements for Zhuoshi Zhang’s Doctor of Philosophy degree.
The overall aim of the PhD research is to develop and test an electronic resource designed for diabetes dietary education. The purpose of the focus group is to explore the expectation of this electronic resource in people with type 2 diabetes and pre-diabetes in New Zealand, regarding nutritional content and willingness to use such a resource.

**What Type of Participants are being sought?**

We are seeking people with type 2 diabetes or pre-diabetes of Maori, Pacific, NZ European, East Asian and South Asian ethnicity.

We are also seeking New Zealand registered dietitians experienced in working with people with 2 diabetes or pre-diabetes.

Volunteers will be recruited through general advertisement and through organisations whose services are accessed by people with pre-diabetes or type 2 diabetes.

Inclusion criteria: Adults aged 18–75 y with a diagnosis of type 2 diabetes or pre-diabetes.

**OR**

New Zealand registered dietitians experienced in working with people with type 2 diabetes or pre-diabetes in inpatient, outpatient or group education settings.

Exclusion criteria: People with severe speech or hearing problems

A hot drink and snacks will be provided. Parking for one and a half hours will be reimbursed.

If the electronic resource is found to improve diabetes management, participants will be given this resource after completion of the research.

**What will Participants be Asked to Do?**
Should you agree to take part in this project, you will be asked to consent to take part and then to do two things:

1. Fill out a confidential questionnaire. Your name will not appear on this questionnaire. We will provide you with the questionnaire and after completing it, we will give you an envelope in which to put the questionnaire. Investigators will only access this information after the end of the session and only for the purpose of describing the group characteristics of the population. The information we would like to collect is given below.

2. Participate in a one hour focus group session with 8-12 other people. This will take the format of a discussion led by the researcher.

The discussion topics for people with pre-diabetes or type 2 diabetes will be:

- Current knowledge about diabetes and dietary management
- Sources and trustworthiness of nutritional knowledge
- Barriers to the use of electronic resources

The discussion topics for dietitians will be:

- Approach to dietary management of type 2 diabetes
- Patient knowledge
- Opinions as to the practicality and usefulness of an electronic resource

What Data or Information will be Collected and What Use will be Made of it?

For participants who have been diagnosed with pre-diabetes or type 2 diabetes, we will be collecting data on your age, gender, ethnicity, smoking status, how and
when you were diagnosed, what medications you take, and self-reported height and weight. The purpose of collecting this information is to describe the overall characteristics of the group in our study. There is also some more sensitive information that we would like to collect, again only to describe the characteristics of the group. For these questions on ‘qualifications, occupation and income’ we have provided a “No details given” option if you do not want provide this information.

The information will remain confidential to the study investigators. Paper copies will be kept in a lockable office and electronic data will be stored on a departmental computer. No individual data will be published, only group results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) and every attempt will be made to preserve your anonymity. The data collected will be securely stored in such a way that only the researchers (details below) will be able to gain access to it. Data obtained as a result of the research will be retained for at least 5 years in secure storage. Any personal information held on the participants such as contact details may be destroyed at the completion of the research even though the data derived from the research will, in most cases, be kept for much longer or possibly indefinitely. If you choose not to supply information this may exclude you from taking part in the study. You have rights of access to the personal information that you have given to us and you may correct or change this information. You will be provided with the results of the study.

**Can Participants Change their Mind and Withdraw from the Project?**

*Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.*

**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 either:
This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph +64 3 479 8256 or email gary.witte@otago.ac.nz). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Appendix 4 Focus group discussion topics

Questions for people with pre- and type 2 diabetes:

1. Assess participant’s current nutritional knowledge for pre- and type 2 diabetes:
   - What is your understanding about pre- and type 2 diabetes?
   - What foods do you think are healthy?
   - What foods do you think affect your blood glucose?
   - What foods contain carbohydrate?
   - What are your favourite carbohydrate foods?
   - What foods do you eat?
   - When do you eat (meals and snacks)?
   - What do you think is an appropriate food portion?
   - What types of foods make you feel full?
   - How does the cost of food affect you?

2. Where do you look for diabetes nutritional information? Are those information sources reliable? How accurate is the information?

3. What dietary advice have you received from your doctors and other health professionals?

4. Have you seen a dietitian for pre- and type 2 diabetes?

5. What diabetes nutritional education resources have you come across? What other diabetes nutrition related resources would you like to see?

6. Do you think it will be useful to have an electronic diabetes nutritional education resource?

7. What nutrition for diabetes information do you want to know?

8. How often do you use a computer, cellphone or tablet?

9. What smartphone apps have you used already for your diabetes and nutrition? What functions do you like and what don’t you like?

10. What else do you want the see in the resource?
Questions for diabetes dietitians:

1. What nutritional advice do you give to people with pre- and type 2 diabetes?
2. How do you explain what is pre- and type 2 diabetes?
3. How do you explain what foods affect blood glucose or contain carbohydrate?
4. How do you provide advice on healthy eating, portion size and choosing healthy carbohydrates?
5. What nutritional knowledge do people already have before they see you for the first time? Where do you think the knowledge gaps are?
6. What resources do you give to patients (written and electronic)?
7. What are your experiences in using electronic diabetes resources?
8. How often do you suggest people use smart phone apps for their diabetes management? What are people’s feedback?
9. As I am working on developing an electronic diabetes nutritional educational resource, what information would you like to see in this resource?
10. Would you recommend this resource to your patients and their families? Who else would you recommend this resource to?
11. How do you think this resource can assist your practice?
Appendix 5 Survey Ethnical Approval Letter

Dr B Venn
Department of Human Nutrition
Division of Sciences

17 April 2015

Dear Dr Venn,

I am writing to confirm for you the status of your proposal entitled “A survey to assess what people with pre-diabetes, type 2 diabetes and their caregivers would like to see in an electronic resource designed to enhance everyday dietary choices”, which was originally received on March 23, 2015. The Human Ethics Committee’s reference number for this proposal is D15/077.

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,

[Signature]

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz
Appendix 6 First Satiety Study Ethical Approval

11 June 2015

Dr John Monro
Plant and Food Research
Private Bag 11800
Palmerston North 4442

Dear Dr Monro

Re: Ethics ref: 15/CEN/71
Study title: Satiating effects of different carbohydrate foods within a mixed meal

I am pleased to advise that this application has been approved by the Central Health and Disability Ethics Committee. This decision was made through the HDEC-Expedited Review pathway.

The Committee suggests the exclusion criteria includes participants actively dieting prior to or at the time of the study and also participants who have not had a stable weight (equal to or less than 5% body weight) in the last three months.

Conditions of HDEC approval

HDEC approval for this study is subject to the following conditions being met prior to the commencement of the study in New Zealand. It is your responsibility, and that of the study’s sponsor, to ensure that these conditions are met. No further review by the Central Health and Disability Ethics Committee is required.

Standard conditions:

1. Before the study commences at any locality in New Zealand, all relevant regulatory approvals must be obtained.

2. Before the study commences at any locality in New Zealand, it must be registered in a WHO-approved clinical trials registry (such as the Australia New Zealand Clinical Trials Registry, www.anzctr.org.au).

3. Before the study commences at a given locality in New Zealand, it must be authorised by that locality in Online Forms. Locality authorisation confirms that the locality is suitable for the safe and effective conduct of the study, and that local research governance issues have been addressed.

After HDEC review

Please refer to the Standard Operating Procedures for Health and Disability Ethics Committees (available on www.ethics.health.govt.nz) for HDEC requirements relating to amendments and other post-approval processes.

Your next progress report is due by 10 June 2016.
Participant access to ACC

The Central Health and Disability Ethics Committee is satisfied that your study is not a clinical trial that is to be conducted principally for the benefit of the manufacturer or distributor of the medicine or item being trialed. Participants injured as a result of treatment received as part of your study may therefore be eligible for publicly-funded compensation through the Accident Compensation Corporation (ACC).

Please don’t hesitate to contact the HDEC secretariat for further information. We wish you all the best for your study.

Yours sincerely,

Mrs Helen Walker
Chairperson
Central Health and Disability Ethics Committee

End: appendix A: documents submitted
      appendix B: statement of compliance and list of members
Appendix 7 First Satiety Study Test Meal Preparation

All test meals were prepared prior to the study day. Ingredients include pasta sauce, onions, celery, black olives, herbs, beef mince, mixed vegetables (carrot, peas and corns), bacon, potato, rice and pasta. To prepare the Bolognese sauce, the bacon was fried. Onions were then added and cooked until softened and removed to sauce pan. The lean mince was browned in batches and added to the sauce pan followed by chopped celery, thyme, bay leaves and chopped black olives. The pasta sauce was added and the whole stirred, and simmered for about 90 min. The pasta, rice and potatoes were weighed separately, boiled according to package instructions, and reweighed after cooking. The mixed vegetables were boiled for 5 minutes.

The meals were constructed by placing 200 g mixed vegetables, including peas, carrots and corns (containing 20 g of carbohydrate), 200 g Bolognese sauce (containing 47 g of carbohydrate), and the amount of starch staple required to add 45 g of carbohydrate into aluminium containers which were sealed and frozen until required. Before consuming the meals were thawed overnight in a refrigerator and heated in a convection oven.
Appendix 8 First Satiety Study Participant Information Sheet

PARTICIPANT INFORMATION SHEET

Study title: Satiating effects of carbohydrate foods in a mixed meal

Locality: Plant and Food Research, Palmerston North
Ethics committee ref.: [Redacted]
Lead investigator: Dr John Monro
Contact phone number: 06 3556137

You are invited to consider taking part in a study on the effects that different types of carbohydrate foods have when consumed as part of a mixed meal. If you do want to take part now, but change your mind later, you can pull out of the study at any time.

This Participant Information Sheet will help you decide if you’d like to take part. It sets out why we are doing the study, what your participation would involve, what the benefits and risks to you might be, and what would happen after the study ends. We will go through this information with you and answer any questions you may have. You do not have to decide today whether or not you will participate in this study. Before you decide you may want to talk about the study with other people, such as family, whānau, friends, or healthcare providers. Feel free to do this.

If you agree to take part in this study, you will be asked to sign a Consent Form, which is a record that you joined the study voluntarily, but it is not binding. You will be given a copy of both the Participant Information Sheet and the Consent Form to keep.

This document is four pages long. Please make sure you have read and understood all the pages.
**What is the purpose of the study?**

The purpose of this study is to determine whether different types of carbohydrate foods have different effects on satiety (hunger/appetite) when they are consumed with other foods and food components. Although carbohydrate foods tested individually may differentially affect appetite, when they are consumed as part of a mixed meal the influence of other food components is likely to modify their effect. We would like to find out whether or not the difference in the satiating potential of different carbohydrate foods, when consumed as part of a mixed diet, is large enough to be useful as one of variables to help guide food choices for good health.

**What does the study involve?**

The study is a pilot study involving three carbohydrate foods, consumed at lunch time on different days, with each carbohydrate food accompanied by the same meat and vegetable complement (minced beef in flavoursome tomato and vegetable “Bolognese” sauce). It is a randomized repeated measures trial which means you will be asked to consume the three test foods, one per testing session, in random order. The foods will be: (1) white rice (250 g), (2) pasta 250 g (3) mashed potato (250 g) each served with 300 g of the meat and vegetable sauce. Therefore, you will need to be available for three testing sessions, on different days.

Individuals will be chosen to participate in the study if they are within the age bracket (18-70) and considered to be generally healthy. Health status will be determined initially by the use of a health questionnaire, which asks about your current and past health issues.

On the days of the study you will be asked to have your normal breakfast but refrain from eating between 8 am and 12.00 pm (lunch time). We ask that you consume a similar breakfast on each of the 3 test days. At lunch time, you will be provided with the test meal and asked to consume it within 15 min. You will then be allowed to return to your normal activities.

You will be provided with a set of satiety rating sheets with four questions on each, and two extreme answers for each question connected by a line. You simply place a mark on the line in a position that corresponds with how you are feeling at the time. The questions and the extremes (in brackets) are:
How hungry do you feel? (I am not hungry at all ------ I have never been more hungry)
How satisfied do you feel? (I am completely empty ------ I cannot eat another bite)
How full do you feel? (Not at all full ------ Totally full)
How much do you think you can eat? (Nothing at all ------ A lot)

You will be asked to fill out an satiety rating sheet:

- Immediately before the meal,
- Immediately after consuming the meal,
- 30 minutes after starting the meal,
- 1 hour, 2 hours and 3 hours after starting the meal.

without referring to the scores of earlier times.

That is all you need to do.

If you agree to take part in the study, we would like you to be available on three days. The trial will start on 1 July, and we would like to get as many subjects as possible through the trial on the 1-3 July (Wed-Fri). We realise that it may not suit everyone to be available on three consecutive days so are prepared to extend the trial into the following week. A follow up meeting will also be included to feed back the results of the study and answer any questions.

**Participants:** Men and women will be suitable for the study.

All participants will need to:

- Have no known allergy to, or intolerance of beef, tomato, wheat, rice or potato.
- Be healthy, as confirmed by a short medical questionnaire
- Be willing to go without food from 8.00 am to lunch time on the trial days
- Be willing to go without food for three hours after lunch while scoring the satiety.
The research in this project will be undertaken in a culturally sensitive manner with all aspects of the trial explained in full to you in a manner most suitable to you. We will be available to answer questions throughout the study and will seek advice from appropriate advisory groups should it be necessary. You will be given access to interpreters at any time in the study should you require them. The opportunity for whanau support is available at all times.

**WHAT WE EXPECT FROM YOU?**

**Screening:** If you agree to take part in this study, we will make an initial appointment for you to come into Plant & Food Research in Palmerston North. This is so we can assess if you are eligible to participate in the study.

**POSSIBLE BENEFITS AND RISKS FROM THIS STUDY**

This study focuses on the effects of natural commonly consumed foods on hunger/appetite levels and does not use any pharmaceutical products, and does not involve collection of any body samples. Due to the initial exclusion of subjects with a history of intolerance of the meal components it is unlikely that there will be any adverse reaction to the foods.

All meals will be prepared under hygienic conditions by trained food technologists in our Food Concepts Unit kitchen.

A benefit from the study is that participants will receive feedback and gain some understanding of their own individual responsiveness to different types of carbohydrate foods.

Published results from the study may be very useful for people with diabetes who wish to control their food intakes as part of managing obesity and blood glucose responses.

**YOUR PARTICIPATION**

Your participation in this study is completely voluntary. We are happy for you to bring along a support person to each of the clinic appointments if you would like. There will be no remuneration for taking part in the study, but the test lunches will be made to be enjoyable as well as serving the scientific purpose of the study.
COMensation

If you were injured as a result of treatment given as part of this study, which is unlikely, you won’t be eligible for compensation from ACC. However, compensation would be available from Plant & Food Research in line with industry guidelines. We can give you a copy of these guidelines if you wish. You would be able to take action through the courts if you disagreed with the amount of compensation provided.

If you have private health or life insurance, you may wish to check with your insurer that taking part in this study won’t affect your cover.

Confidentiality

No material that could personally identify you will be used in any reports on this study. A code that identifies you to the research team will be used on all study documentation. During the study your file will be held in a locked cupboard or filing cabinet when not in use. At the end of the study, your files will be kept for 10 years in secure document storage, and then destroyed by shredding.

Rights

Participation in this study is completely voluntary, and you have the right to decline to participate, or to withdraw from the research at any stage, without the need to give reason and also without experiencing any disadvantage.

As some personal information is obtained from you during this study, you have the right to access the information that we have collected about you at any stage. Information obtained from the questionnaire and blood samples, will be kept completely confidential at all times. Only the investigators of the study will have access to these records.

If you have any queries or concerns about your rights as a participant in this research study you can contact an independent health and disability advocate. This is a free service provided under the Health and Disability Commissioner Act.

Telephone (NZ wide): 0800 555 050

Free Fax (NZ wide): 0800 2787 7678 (0800 2 SUPPORT)

Email (NZ wide): advocacy@hdc.org.nz
If you have any questions about the study at any time please do not hesitate to call (John Monro)(06 3556137)

This study has been given approval by the New Zealand Health and Disabilities Ethics Committee (HDEC).

**CONTACT DETAILS**

Dr John Monro (Principal investigator) Contact number (06) 355 6137
Appendix 9 Second Satiety Study Ethical Approval

14/204

16 February 2015

Dr B Venn
Department of Human Nutrition
Division of Sciences

Dear Dr Venn,

I am again writing to you concerning your proposal entitled “HUNT311 clinical nutritional laboratory: a repeated teaching activity”, Ethics Committee reference number 14/204.

Thank you for your request for amendment to add blood pressure as a measurement into this year’s HUNT 311 laboratory. In addition, you have added Natasha Rodrigues, an MSc student, to the project due to her skills with carbohydrate and fructose metabolism.

Your proposal continues to be fully approved by the Human Ethics Committee. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing. I hope all goes well for you with your upcoming research.

Yours sincerely,

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

c.c. Professor S Samman   Department of Human Nutrition
Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

**What is the Aim of the Project?**

The aim of this study is to test the glycaemic and satiating properties of three meals. This requires attending the laboratory on three occasions. You and other HUNT311 students will use the information in the writing of a HUNT311 assignment. If you choose not to participate, you will still be required to attend the laboratory to observe and data will be provided to you; the assessment of your assignment will in no way be affected.

**What Type of Participants are Being Sought?**

HUNT311 students who are willing to participate. If you have special dietary needs please let us know. The meal will be gluten-free, dairy-free, and nut-free. A vegetarian option is available.

**What will Participants be Asked to Do?**

You will be asked to attend the Department of Human Nutrition Undergraduate Laboratory on three occasions, separated by one or two weeks apart. If eligibility criteria are met, you will be asked to read and sign a consent form, we will collect some personal information from you comprising demographics, height and weight. Following this, the first test will be conducted. Testing is conducted at
lunchtime, you will be streamed to arrive at the laboratory either at 11:50am, or at 1:15pm. You will be asked not to eat or drink for two and a half hours before the start time (ie; for those people attending the 11:50 lab, please do not eat or drink after 9:15am: for those attending the 1:15pm lab, please do not eat or drink after 10:30 am). **If you have eaten within this period of time you will be turned away and asked to reschedule your lab.** Note: no sugar-sweetened chewing gum, you may drink water up until 30 minutes before the start time but please do not drink too much water as you are required to eat a full-sized meal.

If you walk or cycle to the laboratory please do so slowly so as not to elevate your heart rate and blood glucose. On arrival, a finger-prick blood sample will be taken in the fasting state using a single-use disposable lancet designed to minimize discomfort. You will then be given a meal. After this, additional finger-prick blood samples will be taken at 15, 30, 45, 60 and 90 min. The fingerpricks may cause some discomfort. In the event of an abnormal result, a repeat finger-prick may be required. The total volume of blood collected will amount to less than half a teaspoon. During this time we would like you to remain seated in the room with the exception of toilet visits if necessary. You are free to read or talk.

**What Data or Information will be Collected and What Use will be Made of it?**

For the main laboratory exercise we will collect data on your age, ethnicity, smoking habits and gender and we will be measuring your height and weight. The purpose of collecting this information is to describe the overall characteristics of the study population. From your blood samples we will be testing glucose concentration. Personal information will remain confidential to the study investigators. Paper copies will be kept in a lockable office and electronic data stored on a departmental computer. The results of the project will be pooled and may be published and available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve your anonymity. The data and samples collected will be securely stored in such a way that only those mentioned below will be able to gain access to it. Data and samples obtained as a
result of the research will be retained for at least 5 years in secure storage. Any personal information held on the participants such as contact details may be destroyed at the completion of the research even though the data and samples derived from the research will, in most cases, be kept for much longer or possibly indefinitely. If you choose not to supply information this may exclude you from taking part in the study. You have rights of access to the personal information that you have given to us and you may correct or change this information.

Testing blood glucose has the potential to reveal whether a person has diabetes or is at risk of pre-diabetes. If elevated blood glucose concentrations are found, you will be advised to make an appointment with student health or with your general practitioner.

**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 or to your HUNT311 assessment of any kind.

**What if Participants have any Questions?**

If you have any questions about our project, either now or in the future, please contact -

Liz Williams; email e.williams@otago.ac.nz

Dr Bernard Venn; email bernard.venn@otago.ac.nz

Telephone: 03 479 5068

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Appendix 11 Second Satiety Study Ngāi Tahu Research Consultation

Committee consultation

Ngāi Tahu Research Consultation Committee
Te Komiti Rakahau ki Kāi Tahu

Tuesday, 18 November 2014.
Dr Bernard Venn,
Department of Human Nutrition,
DUNEDIN.

Te mātātara o Dr Bernard Venn,

HUNT311 clinical nutritional laboratory; a repeated teaching activity

The Ngāi Tahu Research Consultation Committee (the committee) met on Tuesday, 18 November 2014 to discuss your research proposition.

By way of introduction, this response from the Committee is provided as part of the Memorandum of Understanding between Te Rūnanga o Ngāi Tahu and the University. In the statement of principles of the memorandum it states “Ngāi Tahu acknowledges that the consultation process outlined in this policy provides no power of veto by Ngāi Tahu to research undertaken at the University of Otago”. As such, this response is not “approval” or “mandate” for the research, rather it is a mandated response from a Ngāi Tahu appointed committee. This process is part of a number of requirements for researchers to undertake and does not cover other issues relating to ethics, including methodology they are separate requirements with other committees, for example the Human Ethics Committee, etc.

Within the context of the Policy for Research Consultation with Māori, the Committee bases consultation on that defined by Justice McGechan:

"Consultation does not mean negotiation or agreement. It means: setting out a proposal not fully decided upon, adequately informing a party about relevant information upon which the proposal is based; listening to what the others have to say with an open mind (in that there is room to be persuaded against the proposal); undertaking that task in a genuine and not cosmetic manner. Reaching a decision that may or may not alter the original proposal."

The Committee considers the research to be of importance to Māori health.

The Committee notes this is a class laboratory exercise but also notes it is dealing with some important aspects for Māori health. The Committee suggests that Māori health issues are outlined as part of this class to discuss important health disparities.

We wish you every success in your research and the committee also requests a copy of the research findings.

This letter of suggestion, recommendation and advice is current for an 18 month period from Tuesday, 18 November 2014 to 18 May 2016.

The Ngāi Tahu Research Consultation Committee has membership from:
Te Rūnanga o Ōtākou Incorporated
Kītō Hītoripa Rāneka ki Pakekahaiki
Te Rūnanga o Moeraki
Ngāi Tahu Research Consultation Committee

Nāhaku noo, nā

Mark Brunton
Kaiwhakahaere Rangahau Māori
Research Manager Māori
Research Division
Te Whare Wānanga o Otago
Ph: 64 3 479 8738
Email: mark.brunton@otago.ac.nz
Web: www.otago.ac.nz

The Ngāi Tahu Research Consultation Committee has membership from:

Te Rūnanga o Ōtāhau Incorporated
Kāti Huirapa Rūnanga ki Puketerahi
Te Rūnanga o Moeraki

205
Dear Dr Venn,

I am writing to confirm for you the status of your proposal entitled “A survey to assess dietary knowledge enhancement after watching an online nutrition tool developed by a New Zealand registered dietitian specialising in diabetes management”, which was originally received on November 11, 2016. The Human Ethics Committee’s reference number for this proposal is D16/374.

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 8255
Email: gary.witte@otago.ac.nz
Winner 2017
Peoples’ Choice Poster

Exploring emotions, knowledge and nutritional support in different ethnic groups living in New Zealand with pre-diabetes & type 2 diabetes

Submitted by
Zhuoshi Zhang, John Monro & Bernard Venn
On behalf of University of Otago and Plant & Food Research NZ

“best care for everyone”

Dr Dale Bramley
Chief Executive Officer

Waitemata Health Excellence Awards

207
Waitemata Health Excellence Awards

Winner 2017
Emerging Researcher

Zhuoshi Zhang

In recognition of the contribution made to a research project and presentation of a poster submitted on behalf of University of Otago and Plant & Food Research NZ

"best care for everyone"

Dr Dale Bramley
Chief Executive Officer

Waitemata District Health Board
Best Care for Everyone
Appendix 14 Posters Presentations

Poster 1: Exploring Emotions, Knowledge and Nutritional Support in Different Ethnic Groups Living in New Zealand (NZ) with Pre-Diabetes and Type 2 Diabetes Mellitus (T2DM)

Presented at the 17th International Congress of Dietetics, Granada, Spain, September 2016 and 2017 Waitemata District Health Excellence Awards, Auckland, New Zealand, June 2017.

Poster 2: Difference in appetite ratings among three lunch meals containing different starchy foods

Presented at the 17th International Congress of Dietetics, Granada, Spain, September 2016.
**Introduction**

Structured multidisciplinary team input is essential for the best diabetes care and prevention of diabetes complications (1-2). However, the reality for many countries is a general lack of resources to cater to the growing numbers of people with diabetes (3), and to take care of health inequalities for diabetes prevalence and outcome in ethnic minority groups (4).

**Objective**

Explore patients’ experience and emotions involved in living with type 2 diabetes and pre-diabetes. Collect ethnic-specific feedback on current support and expectations of nutritional advice.

**Methods**

Twenty-nine participants of European (E) (n = 6), Maori (M) (n = 5), Pacific Island (PI) (n = 4), East Asian (EA) (n = 8) and Indian (I) (n = 6) ethnicity in the Waitemata, Auckland, Counties Manukau and MidCentral District Health Board areas attended ethnic-specific focus groups. The discussions were audio recorded and transcribed. Data were coded and summarised into themes using inductive and deductive qualitative analysis.

**Results**

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<th>Characteristics</th>
<th>E (n=6)</th>
<th>M (n=5)</th>
<th>EA (n=8)</th>
<th>PI (n=4)</th>
<th>I (n=6)</th>
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</tr>
</tbody>
</table>

**Theme 1: Motivation**

"You go on to the Internet and you can find that this is good, and you can also go to other sites and it says this is all wrong."

"Keep to plain English. Don’t confuse things. Have you heard of the KISS principle? Keep it simple. That is very important."

"I don’t really have any diet advice that anyone gave to me."

"All the time I come to see my GP. She tells me the same thing, keep doing some exercise, eat this and don’t eat that. But I said, the food that you just told me not to eat is not fair."

"In old days, everything is fresh. For Samoan, fish is fresh from sea, and chicken straight no freezer. With these foods, we never get disease, no diabetes."

**Theme 2: Diabetes care behaviours**

"Where to from here? What do I need to do to avoid complications?"

"These three fruits are deadly for diabetes, they are very high in sugar."

"The pile of meds I am on now. I don’t know what I am taking. Sometimes I just suffer it. How do you know what else is going wrong inside? You’re always drugged out."

"We want more pictures and videos, throughout the written things."

"I want to know what is the symptom of diabetes. If I am pre-diabetic, I should know the symptom."

"Eat less potatoes, we are not allowed to eat potatoes, only once a week."

**Theme 3: Desired diabetes support**

"You need to have a reason to want to live."

"What kind of foods are recommended and what kinds are bad?"

"You need to have a reason to want to live."

"I want to know what is the symptom of diabetes. If I am pre-diabetic, I should know the symptom."

"You don’t really have a lot time, you go in there, and you just don’t have time to ask some questions."

**Theme 4: Positive attitude**

"Feelings of frustration."

"I like to know more about the food. What kind of foods are recommended and what kinds are bad?"

"I don’t really have any diet advice that anyone gave to me."

"Keep to plain English. Don’t confuse things. Have you heard of the KISS principle? Keep it simple. That is very important."

"You need to have a reason to want to live."

**Theme 5: Negative attitude**

"I don’t really have any diet advice that anyone gave to me."

"All the time I come to see my GP. She tells me the same thing, keep doing some exercise, eat this and don’t eat that. But I said, the food that you just told me not to eat is not fair."

"In old days, everything is fresh. For Samoan, fish is fresh from sea, and chicken straight no freezer. With these foods, we never get disease, no diabetes."

**Theme 6: Desired diabetes advice**

"You don’t really have a lot time, you go in there, and you just don’t have time to ask some questions."

"I don’t really have any diet advice that anyone gave to me."

"All the time I come to see my GP. She tells me the same thing, keep doing some exercise, eat this and don’t eat that. But I said, the food that you just told me not to eat is not fair."

"In old days, everything is fresh. For Samoan, fish is fresh from sea, and chicken straight no freezer. With these foods, we never get disease, no diabetes."

**Theme 7: Desired diabetes support**

"We want more pictures and videos, throughout the written things."

"I want to know what is the symptom of diabetes. If I am pre-diabetic, I should know the symptom."

"Eat less potatoes, we are not allowed to eat potatoes, only once a week."

**Theme 8: Diabetes care with Internet**

"Feelings of frustration."

"I like to know more about the food. What kind of foods are recommended and what kinds are bad?"

"You need to have a reason to want to live."

**Conclusion**

Emotions associated with diabetic experience varied among ethnicities. There was a high demand for simple, reliable and culturally sensitive diabetes self-management education. Credible online diabetes nutritional education is needed for additional diabetes support in the community and to cater for different ethnic needs.

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Difference in appetite ratings among three lunch meals containing different starchy foods

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Introduction

Dietitians use carbohydrate counting as a means of recommending appropriate portion sizes of starchy foods. We hypothesized that different starchy foods incorporated into equi-carbohydrate, equi-energetic lunch meals would induce different appetite ratings.

Methods

Beef mince, non-starchy vegetables and tomato-based sauce were combined with 45g available carbohydrate from potato, rice or pasta. Fourteen volunteers ate freshly-heated meals in random order whilst rating appetite on 10cm Visual Analog Scales (VAS).

Table: Meal composition

<table>
<thead>
<tr>
<th>Meal</th>
<th>Mince + sauce (g)</th>
<th>Vegetables (g)</th>
<th>Starchy staple food (g)</th>
<th>Total carbohydrate (g)</th>
<th>Total energy (kJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato</td>
<td>200</td>
<td>200</td>
<td>337</td>
<td>112</td>
<td>3010</td>
</tr>
<tr>
<td>Rice</td>
<td>200</td>
<td>200</td>
<td>142</td>
<td>112</td>
<td>3010</td>
</tr>
<tr>
<td>Pasta</td>
<td>200</td>
<td>200</td>
<td>138</td>
<td>112</td>
<td>3010</td>
</tr>
</tbody>
</table>

Results

- In AUC pairwise comparison, people felt less hungry [mean (SD)] following potato 263 (230) than rice 374 (237) or pasta 444 (254) mm.min.
- People felt more full, more satisfied, and wanted to eat less following the potato meal compared with the rice and pasta meals (P all <0.01).
- The initial decline in appetite immediately after eating was not different among meals (P>0.05).
- Over time, scores of hunger, fullness and how much people wanted to eat were different between potato and rice meals.

Figure: Incremental changes to hunger ratings following meals

Conclusions

The potato meal repressed appetite more than the rice and pasta meals. Using potato as the source of carbohydrate in meals could be beneficial either by reducing appetite if equi-energetic meals are consumed, or by maintaining appetite with smaller quantity.