Validation of a short Food Frequency Questionnaire which ranks individuals by sugar intakes in Pacific Islanders living in South Auckland, New Zealand

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Abstract

Background: Chronic diseases such as type 2 diabetes, obesity, gout and cardiovascular disease have higher prevalence among Pacific Islanders than any other ethnicity in New Zealand. Increasing evidence has shown a link between increased fructose consumption and these diseases. However measuring dietary sugar intakes in these populations is difficult.

Objective: To test the relative validity and repeatability of a short Food Frequency Questionnaire developed to measure sugar intakes in Pacific Islanders living in South Auckland, New Zealand.

Design: A sample size of 68 participants were recruited from the Pukapuka Community Centre in Mangere, Auckland and through a Pacific Dietitian based in South Auckland. Participants completed two administrations of the FFQ approximately four weeks apart. Three interviewer administered 24h recalls were taken over the four weeks between questionnaires. Statistical analyses including Spearman’s correlation coefficients, cross classification agreement and Bland Altman tests of agreement were calculated to compare sugar intakes from the second administration of the FFQ with the mean 24h recall to assess the validity of the FFQ. Reproducibility was assessed by comparing repeated administrations of the FFQ using intraclass correlations.

Results: Spearman’s correlation coefficients ranged from 0.67 for fructose to 0.76 for total sugars derived from all sources. Correlations increased slightly for sugars derived from non-alcoholic beverages but decreased for sugars derived from fruits. On average, around 50% of participants were correctly classified into the same quartile for both sugars from all sources and non-alcoholic beverages, an only around 35% of participants for sugars from fruits, however less than 4% were grossly misclassified for all sugars from all sources. Bland-Altman statistics demonstrated that
the FFQ had a strong level of agreement with the 24h recall for fructose, glucose and total sugars with values close to 100% and 95% confidence intervals including 100; however agreement was relatively poor for sucrose. The FFQ exhibited good reproducibility between administrations with intraclass correlations all greater than 0.7. Paired t-test analysis between the first and second administrations of the FFQ show there may have been an intervention effect with sugar intakes from the second FFQ administration significantly lower than from the first.

**Conclusion:** The FFQ showed good relative validity particularly for measuring total sugars and sugars from all sources and non-alcoholic beverages. High reproducibility was also seen between the first and second administrations of the FFQs. The results compare favourably with previous FFQs assessing sugar intakes. This is to our knowledge the first short FFQ measuring sugar intakes in Pacific Islanders living in New Zealand.
Preface

This validation study was conducted in South Auckland through the Department of Human Nutrition, University of Otago, Dunedin, New Zealand. The food frequency questionnaire (FFQ) was designed and pretested previously by another student, Petra Teufl in March 2013. Petra initiated the validation study collecting data from 33 participants. I completed the validation study collecting data from a further 35 participants between July 2013 and September 2013 and present the findings of the complete study in this thesis.

My supervisor, Dr Lisa Te Morenga, and Dr Louise Mainvil were responsible for the concept and overall study design. Associate Professor Tony Merriman made this project possible by introducing the research team to Nuku Rapana, leader of the Pukapuka Cook Island community in Auckland and endorsing the research project.

The candidate was responsible for the following under supervision:

- Procurement of study equipment
- Organising printing of FFQs, 24h recall templates, all other documentation
- Organising vouchers for participants
- All advertising, recruitment, home-visits and data collection in South Auckland
- Entry of 35 triple repeat 24h recalls, coordinating diet analysis for additional 33 participants from previous study
- Data entry of the first and second FFQs, processing data from 68 participants
- Interpretation of statistical analysis presented in this thesis
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1. Introduction

It is becoming increasingly important to be able to accurately measure dietary intake in populations with higher rates of chronic diseases such as type 2 diabetes and CVD. While rates of obesity and related chronic diseases have been rising steadily over the past 50 years, so have intakes of dietary sugars. In particular the increased intake of sugar-sweetened beverages has increased population level consumption of fructose, a monomer of sucrose which is otherwise known as the standard table sugar and found in many processed foods. The parallel increase in both of these factors over the last half century has led to the hypothesis that fructose consumption may have an important role in the development of non-communicable chronic diseases (Johnson et al, 2009). Many studies have found such associations between sugars and disease risk, but the evidence is not consistent (Lustig, Schmidt & Brindis, 2012). Better evidence is required to justify public health measures looking to reduce population sugar intakes.

In New Zealand Pacific Islanders have disproportionately high rates of type 2 diabetes, gout and CVD, all of which have been linked to increased fructose intake. The Pacific population also has the lowest rates of literacy nationwide. This factor makes accurate dietary assessment in this population challenging. Food groups such as sugars and sweets, which tend to be discretionary foods and easily forgotten, may be particularly prone to misreporting (Vucic et al, 2009). Among the many dietary methods available to measure nutrient intakes food frequency questionnaires (FFQ) can be administered in a large population studies relatively easily and cost-effectively. Moreover they have been found to measure intakes more successfully in low income low literacy populations (Vucic et al, 2009). However FFQs have their limitations and need to be designed for specific population groups with similar age, health state and psychological background (Cade et
al, 2004). Devising a tool to more accurately measure sugar intakes in Pacific populations is an important step towards understanding whether sugars intakes are a determinant of their increased health risk. This study aims to validate a FFQ developed specifically for Pacific people, which could be used in large population studies in a Pacific community living in South Auckland.
2. Literature Review

2.1 Introduction

It has been widely debated whether sugar intake is directly responsible for the increased risk of multiple preventable diseases. There is some evidence for associations between sugar intake and increased risk of gout, metabolic syndrome, type 2 diabetes as well as cardiovascular disease (Johnson et al, 2009) but it is not consistent, and the sugar industry continues to claim that evidence that sugar has a harmful effect on health does not justify recommendations public policies to limit sugars intakes (Waxman, 2004).

Obesity is a common factor in all the above mentioned diseases, the rate of which is continually increasing worldwide. Fat consumption, originally thought to be the primary contributor to excessive weight gain is however no longer on the increase, while worldwide intakes of sugar have been increasing since the 1970’s due to the introduction of soft drinks to the market as well as the relatively cheap production of sugar sweetened processed foods all of which can be highly energy dense, with low satiety (Lustig, Schmidt & Brindis, 2012). A study comparing total sugar intakes in the Australian population from the 1983 and 1995 national nutrition surveys showed an increase of 14g in men and 5g in women (Cook, 2001). While international data suggests that sugar intakes have been rising, the New Zealand data does not support this view. In New Zealand mean total sugar intakes appear to have decreased by 11g for males and 2g for females between the 1997 National Nutrition Survey and the ANS 2008/09 (University of Otago, 2011). However the ANS data set also shows an inverse relationship with energy intake and BMI category which is unlikely and suggests differential under-reporting amongst overweight and obese adults; sugar is likely to be under-reported.
In New Zealand several ethnic groups have a disproportionately high prevalence of obesity and related gout, cardiovascular disease and type II diabetes (Sundborn et al, 2008; Winnard et al, 2012). Intakes of sugars are highest in Pacific populations and could be a contributing factor in the high rates of chronic disease seen in Pacific populations (University of Otago, 2011).

Relevant literature was found by searching the following databases: Medline via OvidSP from 1948 to November 2013, Google scholar up to November 2013 and by searching reference lists and citing articles for relevant studies. Search terms used were: validation study, validity, food frequency questionnaire, questionnaire, dietary assessment, sugar, fructose, type 2 diabetes, cardio-vascular disease, CVD, gout.

2.1.2 Health Problems in Pacific Island people

The Pacific Island ethnic group has the highest rates of morbidity in obesity, metabolic syndrome, type 2 diabetes and heart disease. Results from the 2008/2009 Adult Nutrition Survey show that Pacific Islanders have the highest prevalence of obesity at 58.4% followed by Maori (45.4%) and New Zealand European and others (24%) (University of Otago, 2011). The prevalence of overweight or obese individuals according to data from the ANS 2008/09 was estimates as 86% (University of Otago, 2011). In the ANS body mass index (BMI) was classified using the WHO international classification for obesity of ≥30 kg/m² for all ethnicities in participants over the age of 18. Overweight was defined as a BMI between 25 kg/m² and 29.99kg/m² (University of Otago, 2011). Obesity is associated with poorer health outcomes including increased risk of diabetes, some cancers, heart disease, and with reduced life-span (Wang et al, 2011).
A less recent but more population specific survey, the Diabetes Heart and Health Study (DHAHS) conducted in 2002/3 in Auckland reported that 53% of Pacific males and 74% of Pacific females, aged 35-74 years, were obese (Sundborn et al, 2010). The cross-sectional study involved 1011 Pacific Islanders primarily Samoan and Tongan living in South Auckland and used a self-administered questionnaire to examine how the individuals saw their own participation in physical activity as well as perceptions of their own weight. Actual weight and heights were also measured and BMI calculated using Pacific Islander-specific cut offs, i.e. BMI 26.0 – 32.0 kg/m\(^2\) for overweight and BMI > 32.0 kg/m\(^2\) for obese. In contrast to the ANS which used lower cut offs for overweight and obesity Sundborn et al (2010) reported that for all Pacific ethnicities 95% of males were overweight or obese and 100% females. The differences in definitions of overweight and obesity and inclusion ages between the DHAS and the ANS 2008/09 data may account for the lower total rates of overweight and obesity in the ANS 2008/09 compared with DHAHS. However both surveys highlight the much higher prevalence of overweight and obesity in Pacific Island populations when compared with other ethnicities including Maori and NZ European.

Both the ANS and DHAHS reported higher rates of morbidity from type 2 diabetes in Pacific Island populations compared with other ethnicities. A study of the results from the DHAHS conducted by Sundborn et al (2007) showed that Pacific Islanders living in Auckland not only had a 4 times greater prevalence of diabetes than NZ Europeans but also had an increased relative risk for having diabetes within younger age groups, RR 11.61 for newly diagnosed diabetes in the <45 year age group and RR 4.16 for newly diagnosed diabetes in the 45-64 years age group (Sundborn et al, 2007). The ANS 2008/09 measured prevalence of diabetes through asking participants if they had been told by a doctor that they have diabetes (not including during
pregnancy) and adding participants who had unknown diabetes but an HbA1c over ≥ 6.5% (University of Otago, 2011). In a recent analysis of ANS 2008/09 data it was found that 15.4% (95% CI 11.5, 19.4) of Pacific people had either diagnosed or undiagnosed diabetes compared to 9.8% (95% CI 7.4, 12.2) of Maori and 7.0% (95% CI 6.0, 8.0) of New Zealand Europeans (Coppell et al, 2013). Coppell et al (2013) go on to explain that because of the nature of diagnosis through the ANS 2008/09 using HbA1c levels alone, the estimates are likely an underestimation.

2.1.2 Sugar intakes in Pacific Island people in New Zealand

The term sugar is important to describe accurately since it is used in many different ways throughout literature. Typically when referring to sugar it means table sugar which consists of sucrose, which is a disaccharide of fructose and glucose.

Expert consultations on the scientific updates of the health effects of dietary sugars by the World Health Organisation (WHO) and the Food and Agricultural Organisation of the United Nations use the following classification of carbohydrates and groups of sugars including the category “free sugars” (Te Morenga, Mallard & Mann, 2013). Based on the classification in Te Morenga’s paper the sugars of interest in this study consist of monosaccharides glucose and fructose, as well as disaccharide sucrose which is made up of glucose and fructose, and the term “free sugars” which stands for “all monosaccarrides and dissacharides added to foods by the manufacturer, cook or consumer, sugars naturally present in hone, syrups, and fruit juices” (Te Morenga, Mallard & Mann, 2013).

According the most recent ANS data mean total sugar intakes in Pacific Islanders is estimated to be 128g /day in males and 106g/ day in females (University of Otago, 2011). In the ANS
2008/09 total sugars included sucrose, fructose, glucose, maltose and lactose (University of Otago, 2011). This is comparable with estimated sugar intakes of the total population (115g/day).

When looking at the spread of sucrose intakes across age groups the ANS data shows that for Pacific ethnicities younger age groups have a higher intake; for example Pacific Island males in the age group 19-30 had estimated mean daily total sugar intakes of 145g/day versus 108g/day in 31-50 years (University of Otago, 2011).

Sucrose and fructose are better markers of free sugars intakes. The top sucrose containing foods are sugar and sweets followed by non-alcoholic beverages and fruits, and the top fructose containing foods are fruit and non-alcoholic beverages (University of Otago, 2011). Estimated daily intakes of sucrose were highest amongst Pacific people than NZ Europeans; 64.4g/day for males and 54.3g/day for females compared with 59.7g/day for males and 46.3g/day for females in the NZ European group. When looking at the spread of sucrose intakes across age groups the ANS data shows that for Pacific ethnicities younger age groups have higher intakes, for example males ages 19-30 years have a mean estimated sucrose intake of 74.5g/day while for males aged 31-50 years it is 53.1g/day (University of Otago, 2011). The same pattern can be seen for total sugars.

Across all ethnicities the primary source for sugar intake differs between males and females. In males ANS data shows sources of total sugar come primarily from non-alcoholic beverages 17.6%, followed by sugar and sweets 15.9% and then fruit 15.2% (University of Otago, 2011). For females the top three sources of total sugar in the diet appear to be fruit, 20.2%, then non-alcoholic beverages 15.9% then sugar and sweets 13.4% (University of Otago, 2011). This is again across all ethnicities and all age groups.
The dietary assessment method employed the ANS 2008/09 included a single 3-4 step 24h recall. Researchers have found the 5 step multiple pass method of 24h dietary recall to reduce the bias associated with collecting energy intake (Moshfegh et al, 2008). In this method a forgotten food list is used to prompt participants to remember intakes of particular items such as snacks. While these lists can contribute to skewed data if participants are prone to say yes to interviewers they also allow for the recollection of items often missed due to the nature of when and how they are consumed. This could mean that the ANS reported sugar intakes may be underreported in particular by participants who are obese (Moshfegh et al, 2008).

2.2 Associations between sugars and disease

2.2.1 Brief History

The association between increased sugar intakes and increased rates of obesity has been debated for some time. Johnson et al (2009) write that historically as humans began eating larger quantities of sugar in the early twentieth century, the number of cases of diabetes was rapidly increasing in prevalence. It was also noted, that the type of diabetes was “slower, more progressive” and typically found in overweight, wealthy individuals (Johnson et al, 2009). This description matches that of the onset of type 2 diabetes. It is interesting then, to see the correlation between the rate of increase in type 2 diabetes in the early part of the twentieth century and the onset of the availability of sugar to the population. Johnson goes on to mention how later in the twentieth century, type 2 diabetes has become more prevalent among lower socioeconomic groups (Johnson et al, 2009). These observations are however all based on ecological data, including immigration studies and cross sectional studies which have a very weak evidence base.
In the past 50 years, it has been noted that sugar consumption has increased threefold in the United States (Lustig, Schmidt & Brindis, 2012). Sugar has become a cost effective ingredient that increases the palatability of foods, particularly when fat is removed, and in some diets sugar makes up 2000 kilojoules per day of energy intake (Lustig, Schmidt & Brindis, 2012).

2.2.2 Sugar intake and gout

Gout is a common inflammatory arthritis, which debilitates thousands of New Zealanders. Gout is most prevalent among Maori and Pacific Islander people with the percentage prevalence for Maori at 6.06%, for Pacific 7.43%, and for NZEO 3.24% (Winnard et al, 2012). An aetiology of gout is high serum uric acid levels for prolonged periods of time (Dalbreth et al, 2012). However evidence, described below, has also shown associations between the intake of sugar sweetened beverages and gout.

The relationship between sugar intake and hyperuricaemia has been studied for some time (Johnson et al, 2007). It is in fact the metabolism of fructose which can cause increased levels of uric acid in the blood (Johnson et al, 2007). Fructose is metabolized primarily in the liver, via the enzyme fructokinase into fructose-1-phosphate with the addition of adenosine tri-phosphate (ATP). This particular step in fructose metabolism uses up large amounts of ATP, causing a build-up of adenosine mono-phosphate (AMP) and it is through the deamination process of AMP that causes serum uric acid levels to rise.

Much of the mechanism of fructose metabolism induced serum uric acid increase was studied in the 1970’s and 1980’s, all of which showed an increase in serum uric acid concentration when participants were administered fructose in their diets. Contradicting this view was a prominent
cross-sectional study by Sun et al (2010) which found no association between fructose intake and serum uric acid concentrations using data taken from the US National Health and Nutrition Examination Study (NHANES) 1999 – 2004. They did however find a significant increase in risk of hyperuricaemia in the highest quartile of alcohol intake [odds ratio 1.568 (95% CI :1.078 – 2.549)] and a reduced risk with increasing intakes of fibre [odds ratio 0.448 (CI 0.291-0.69)]. Sun et al (2010) developed their own method for estimating individual fructose intake, which was not validated and may have underestimated the fructose content of foods. For example their estimation of the fructose content of orange juice was calculated using the ratio of fructose to total carbohydrates of one orange although orange juice in most cases has added sugars and one glass will be made up of multiple oranges (Hamilton, 2009). The fact that the study writers are full time employees of a food manufacturing company which make fructose containing products among others raises some questions regarding the reliability of these findings (Sun et al, 2010). Recent prospective cohort studies do support the earlier research linking high fructose intakes with raised serum uric acid concentrations. Choi & Curhan (2008) examined the associations between sugar-sweetened beverage intake and incident gout in the Health Professionals Follow Up Cohort Study which included 46,393 men followed for 12 years. Intakes of sugar sweetened beverages as well as other fructose sources were estimated with a self-administered food frequency questionnaire (Choi & Curhan, 2008). They found a significant 29% increase in relative risk (RR) of incidence of gout with consumption of 5-6 servings of sugar sweetened beverages (SSB) each week compared with less than one serving per month (Choi & Curhan, 2008). The RR was even higher for intakes of sugar sweetened beverages of 1/day and 2/day, RR 1.45 (95% CI: 1.02 – 2.08) and 1.85 (95% CI: 1.08 – 3.16) respectively. Similarly when examining free fructose intake, there was an increased risk of incidence of gout, with the fifth
quintile doubling the risk of gout compared to the reference group, RR 2.02 (1.49 – 2.75) (Choi & Curhan, 2008).

Choi et al (2010) also examined the association between SSB intakes and incident gout in women participating in the Nurses Health Study. 78,906 participants were followed up for 22 years. Comparison of multivariate RR for intakes of 1 SSB/day and ≥2 SSB/day to the reference group were 1.74 (95% CI 1.19 – 2.55) and 2.39 (95% CI 1.34 – 4.26) (Choi et al, 2010). When examining the associations between free fructose intake and incident gout, a similar pattern as for the men’s study was observed. In the top two quintiles of intake the RR was significantly higher, 1.34 (CI 1.01 – 1.76) and 1.62 (CI 1.20 – 2.19) when compared to the reference group. Both the above studies show associations between excessive intakes of fructose and higher incidences of gout in males and females. However what constitutes a moderate or excessive of fructose can vary considerably between studies (Livesey, 2009). According to Livesey (2009), moderate intakes of fructose less than 100g/ day could have beneficial health effects including lowing HbA1c ,while intakes above 100g/day - 150g/day could be considered excessive.

There appears to be reasonable evidence of an association between higher fructose intakes and incidence of gout. There is a valid argument that there should be a better idea of what excessive vs moderate intakes are and more research should look into how to measure intakes of sugar and fructose in particular. The ability to accurately estimate sugars intakes in needed before any conclusions about the health effects of sugars can be made.
2.2.3 Sugar intake and diabetes

Increased intakes of sugars as seen across the world over the twentieth century have coincided with increased rates of diabetes (Johnson et al., 2009). It has been reported that the initial rise in diabetes rates predominantly occurred in the so-called wealthy population in the early 20th century, however, sugar also became one of the key staple ingredients in the diet of indigenous populations (Johnson et al., 2009). Early investigations into the diets of Pukapukans living on an atoll and Maori in New Zealand found that sugar was introduced through the “western diet” (Prior, Rose & Davidson, 1964; Prior & Davidson, 1966, Wright-St Clair, 1969). As a result of this changed diet evidence shows that the Maori and Pacific Island populations have developed excessive rates of diabetes (Wright-St Clair, 1969).

Current consensus involves placing much of the cause of diabetes on being obese, however, diabetes also exists amongst people, who are not classified as obese (Pan et al., 2004). This has led to the hypothesis that there have to be other factors involved in the development of diabetes, which Johnson et al hypothesize to be due to the metabolism of fructose. As well as the ATP depleting and consequent uric acid inducing effects of fructose metabolism described in the previous section, fructose has been shown to have a lipogenic effect (Stanhope & Havel, 2008). Johnson et al review the research where uric acid has been seen to inhibit nitric oxide, which in turn reduces the effect of insulin on skeletal muscle cell glucose uptake, thereby having an effect on insulin resistance (Johnson et al, 2009).

Studies have explored the effect of substituting fructose beverages out of the diet for non-fructose beverages to look for protective/preventative measures. One study which provided evidence towards the diabetic effect of SSBs in the above mentioned meta-analysis also found a risk
reduction of 6% (HR 0.94, 95% CI 0.91-0.96, p < 0.01) with the intake of one coffee per day (de Koning et al, 2011). They also reported a 17% risk reduction for type 2 diabetes with the substitution of one sugar sweetened beverage for 1 cup of coffee. However they also found water to increase the risk of type 2 diabetes albeit by a small margin (HR 1.03; 95% CI 1.01-1.06) which is likely to be a chance significant finding rather than a true effect. Another more recent study found no significant effect of water intake on type 2 diabetes risk, but did see a 7% risk reduction for type 2 diabetes when substituting 1 glass of SSB for 1 glass of water (Pan et al, 2012).

A well designed recent meta-analysis found evidence for the role of SSBs in the development of metabolic syndrome and type 2 diabetes where 11 prospective cohort studies met the inclusion criteria (Malik et al, 2010). They found that individuals with the highest intakes of SSBs had a 26% increased risk of developing type 2 diabetes (RR 1.26, 95% CI 1.12-1.41) and a 20% increased risk of developing metabolic syndrome (RR1.20, 95% CI 1.02-1.42). All but one of the studies included in the meta-analysis measured sugar intakes by FFQ and the comparison for risk was made between quartiles of SSB intake with the lowest quartile being either none or less than 1 serving (250ml) of SSB per day and the highest quartile more than one 250 ml serving per day (Malik et al, 2010). There was significant heterogeneity among the study results, however larger and longer duration studies were found to have the strongest and more significant positive associations.
2.2.3 Sugar intake and the metabolic syndrome

Observational studies have reported associations between fructose intake and the metabolic syndrome. Dhingra et al (2007) examined the risk of developing the metabolic syndrome with increased soft drink consumption, as well as the effects on the individual components of the metabolic syndrome. They found a significantly 44% (95% CI 1.20- 1.74) increased incidence risk over 4 years follow up, using data from the Framingham Heart Study, for developing the metabolic syndrome in people who drank more than 1 soft drink per day vs less than one drink per day. They also found significant associations between increased soft drink intake and odds for increased waist circumference, fasting glucose, hypertriglyceridemia, low HDL-C which are all but one of the metabolic syndrome criteria. There was a positive but non-significant association when looking at hypertension, and other studies have had similar difficulties showing an association between fructose intake and hypertension. However this study used data about intakes of both diet and regular soft drinks and found significant increased risk associated with both (Dhingra et al, 2007), which makes it difficult to determine if fructose intake is in fact the cause.

The proposed link between fructose intake and metabolic syndrome is the effect of fructose metabolism on hepatic lipid synthesis (Stanhope & Havel, 2008). A study by Stanhope et al. (2009) looking at glucose vs. fructose sweetened beverage consumption in controlled environment over ten weeks found significant lipid altering effects in the fructose group which did not occur in the glucose group. In this double-blinded parallel arm study subjects went through two 8 week intervention periods consuming fructose or glucose sweetened beverages providing 25% energy intake, which is very high compared to guidelines for upper limits of sugar intake at around 6-10% daily energy intake (Mann, 2003; Stanhope et al, 2009). While both
groups of subjects gained significant weight over the course of the study, which is to be expected when the sweetened beverage consumption was set at 25% of energy requirements (most population studies report around 15% total energy as the maximum from sugar sweetened beverages) there were differences in lipid profiles between the groups. The differences in lipid profiles exhibited between the groups include plasma lipid and lipoprotein concentrations increasing in the fructose consumption group, but not for glucose consumption. Other lipid altering effects seen in the fructose consuming group include increases in fasting and postprandial intake apoB-apoA ratio and total and LDL cholesterol. Stanhope et al. (2009) note that increases in plasma triglyceride concentrations in their fructose consuming group could be due to increased de novo lipogenisis (DNL). The profile of lipids which seemed to be altered by high intakes of fructose can be associated with an increased risk of cardiovascular disease.

In another acute experimental study looking at the difference between glucose sweetened and fructose sweetened beverage intakes (at 30% of total energy intake) found circulating TGs to be significantly increased after fructose consumption compared with glucose consumption (Teff et al, 2009). In this study area under the curve (AUC) was measured and compared for endocrine and metabolic responses to consuming the fructose beverages or glucose beverages with meals. It was found that after fructose ingestion significantly higher AUC was seen for circulating TGs (704.3mg/dL ± 124.4 p 0.0001), while the AUC was significantly lower insulin and leptin (549.1uU/ml ± 79.7 p 0.0001 and 107.0ng/ml ± 15.0 p 0.03 respectively). These findings are consistent with the hypothesis that the relatively unregulated nature of downstream metabolism fructose metabolism results in increased triglyceride synthesis primarily due to increasing fatty acid coenzyme A and diacylglycerol (Stanhope et al, 2009).
2.3 Dietary Assessment of Sugars Intakes

2.3.1 Introduction

Selection of methodology is dependent on the objective of the study. The gold standard dietary assessment method for determining usual intake is a weighed food record over three 24 hour periods (Gibson, 2005). The determination of usual intake is particularly important when looking at relationships between diet and chronic disease. However, for population surveys, the resources generally allow for less time consuming measures of intake and food recalls or food frequency questionnaires are used. Other issues to consider include the literacy level of target populations and cultural suitability.

Under reporting of intake is common for sugary foods which has the effect of underestimation of the health effects of sugar in studies examining the relationship between sugars and health outcomes.

2.3.2 Bias associated with dietary assessment

Diet records require high levels of literacy, numeracy and motivation and are often not completed to a useful level in low income populations (Vucic et al, 2009). Vuvic et al (2009) found that not only were semi-weighed methods of dietary assessment the least preferred method for both respondents and interviewers; they also yielded the lowest energy and nutrient intake estimates among participants. Pryer et al (1997) examined data collected for the Dietary and Nutritional Survey of British Adults to identify characteristics of the population group who under-reported energy intakes. Low energy reporters were defined as those whose mean self-reported intakes
(measured using 7-day weighed dietary records) were less than 1.2 times of their estimated basal metabolic rate (Pryer et al, 1997). This group included a high proportion of people of the “manual social classes”, who were smokers and were heavier. Vuvic et al (2009) argues that four repeat multiple pass 24-hour recall data is the most appropriate for assessing dietary intakes in low income households because they yield the most accurate estimates of energy intake. Basiotis et al (1987) suggest that four 24-hour recalls are required to assess intakes of females but five 24hr recalls are necessary to assess dietary intakes of males, in order to more precisely estimate carbohydrate intake at the group level.

2.3.4 Conclusion

High sugar intakes may be associated with increased non-communicable disease risk. However strong evidence for this association is limited and conflicting evidence exists. Any effects that have been noted have mainly been seen with very high intakes of sugars. The sugars intakes amongst Pacific people estimated from the ANS 2008/09 are typically lower than the level thought to increase risk however Pacific populations continue to be overrepresented in health statistics for gout, type 2 diabetes and cardiovascular disease. Accurately assessing sugars intakes is difficult and under-reporting is common. Better dietary assessment instruments are needed to verify this relationship in Pacific people.
3. Objective Statement

The aim of the Pukapuka Kai study was to validate a short FFQ for reproducibility and reliability in ranking subjects by intakes of fructose, glucose, sucrose and total sugars from total diet, non-alcoholic beverages and fruit to measure sugar intakes in Pukapuka Pacific Islanders living in South Auckland, NZ, using repeated 24hr recalls as the gold standard comparison method.
4. Subjects and Methods

4.1 Food frequency questionnaire

The food frequency questionnaire was called the Pukapuka Kai Study and contained 33 questions that asked about the intake of sugar containing foods over the past month (Appendix A). The foods asked about in the questionnaire included beverages such as juice, fruit drinks, soft drinks and flavoured milk; one section asked about alcoholic beverages; there was a section asking about the amount of sugar added to tea or coffee as well as questions on baked goods, cereals, sugar added to cereals and other sweet foods intake. Questions were split into two parts: the first part required participant to specify how often they ate the specified food over the past month and the second quantified the amount eaten each time in ‘natural’ units such as ‘one piece’ of fruit. The items included in the FFQ were selected from various sources including previous FFQs, the ANS and an environmental audit of Mangare, South Auckland which highlighted the need to include certain items such as ‘donuts’ due to their contribution of sugar to the diet of the local population (Teufl, 2013). The FFQ included photographs of beverage size, thickness of spread on bread, muffin size and the size of heaped teaspoons to aid quantifying by participants.

The development of the FFQ including pretesting options of closed and open ended question styles and refinement of the language to use whole foods as units was carried out in a previous study by a Master of Dietetics’ student.

The study was conducted by a Master of Dietetics student of the University of Otago. The Human Ethics Committee of the University of Otago, Dunedin granted ethical approval for the study.
(Appendix B) and written informed consent was obtained from all participants at the first appointment (Appendix C).

4.2 Recruitment and Study Population

To assess validity of the short FFQ a sample of 68 participants were recruited. Participants were initially recruited from the Pukapuka Cook Island community, by word-of-mouth and face-to-face approaches, with the support of leaders and influential members of the Pukapuka centre in Mangere, Auckland. When the pool of willing volunteers from the Pukapuka community was exhausted further participants (n=10) were recruited via the networks of a Pacific Dietitian based in Auckland with extensive connections among the Pacific Island community. Participant recruitment occurred between 25th February and 4th September 2013.

Participants were eligible for the study if they met the following criteria:

- Pacific Island ethnicity living in South Auckland, New Zealand
- Aged between 18 – 70 years
- Intending to stay in Auckland for the next 4 weeks
- Physically and mentally capable to provide written informed consent to participate

Using evidence based guidelines to calculate an appropriate sample size it was agreed that a total sample population of 70 would suffice for validation of the FFQ (Gibson RD 2008) (Cade, Thompson et al. 2002).
4.3 Reference method

Due to the nature of participants potentially having low literacy levels and the potential for under reporting repeat 24-hr dietary recalls were deemed the most appropriate reference method (Cade et al, 2004; Vucic et al, 2009).

As part of the 24 hour recall collection method three dimensional food models and colour photographs of food were available to assist participants to accurately estimate intake.

The New Zealand national nutrition surveys use a four stage interviewer administered recall method; in this study and extra step was added to probe participants for frequently forgotten foods (Moshfegh et al, 2008). The USDA 5-step multiple-pass method of dietary recall was used at each of the 24h recall interviews as per the following description (Conway et al, 2003): Step one involves the participant reporting an uninterrupted list of all foods and beverages consumed. In the next step a series of questions with forgotten foods is read out. Step three involves the participant specifying the time and occasion of each food consumed. Then the participants are asked to provide descriptions and amounts of each food consumed; a booklet of common food photographs and model sizes is used as an aid. Finally, step five involves a final probe for anything else consumed.

4.4 Data Collection

Participants were asked to participate in four interviews over the course of four weeks. At the first session the participants were given an information sheet along with a verbal description about the study to read (Appendix C). Participants who consented to participate then signed a
consent form and completed a contact details form (Appendix D) and general demographic questionnaire (Appendix E). The type of information collected on the demographic questionnaire included age, education, household size and previously diagnosed chronic health conditions.

For each of the following two weeks the participants met with the researcher for a 24 hour dietary recall interview. Interviews were planned to take place on different days of the week, including at least one weekend day to maximize representativeness of dietary patterns. At each interview participants were asked whether the dietary recall represented their usual intake and if not, a reason why. Interviews were held either at the Pukupuka Community Center in Mangere South Auckland, or at participants’ own homes. During the first sessions both the food frequency questionnaires (FFQ1) was administered and a 24 hour dietary recall was collected. At visits two and three only a dietary recall was collected.

The FFQ was administered twice, once at the start and once after four weeks in order to measure the test retest reliability of the tool. The first administration of the FFQ (FFQ1) occurred in the first two weeks of the study, while the second FFQ2 was administered in week 4 to capture the dietary intakes measured by the repeated 24 hour recalls. The aim of FFQ administration was to be self-administered, however while the participant was completing the FFQ the researcher was available to answer any queries.

Participants were reimbursed for time and travel costs with a $10 supermarket voucher for each interview completed.
4.4 Data analysis

4.4.1 Food Frequency Questionnaires

A Microsoft Excel (Microsoft Office 2010) spreadsheet was developed to estimate participant’s usual intake of fructose, sucrose, and total available sugars. Each participant’s FFQ results were manually entered into the spreadsheet to derive sugars estimates. Total fructose intakes were estimated as the total free fructose content in each food or drink item plus 50% of the sucrose content. In New Zealand most of the fructose content in food comes from free fructose and/or sucrose, while in the USA the primary sweetener instead of sucrose is high fructose corn syrup, a product formed from enzymatically increasing the fructose content. In the spreadsheet the reported frequency of consumption of each food item was multiplied by the corresponding nutrient profile to calculate the daily sugars intake per item. Values for each item were summed to give an estimate for each individual’s daily sugar intake for the previous month.

The nutrient profile of food items in the above mentioned spreadsheet was determined using data from the Pacific Island population of the ANS 2008/09 (University of Otago, 2011). For the items with multiple foods listed for example “Milo, powder drinking chocolate or other milk mix”, the foods included in the group were weighted by the percentage of the reported frequency i.e. 77% “Milo”, 20% “Chocolate, drinking, powder” and 3% “Nesquik, powder”. Additional items such as doughnuts were added to the FFQ spreadsheet that were not represented by the ANS based on observations of these being an important food source at the Pukapuka Community Centre. Doughnuts were given a weighting of 80% of the “sweet buns, iced buns, doughnuts or pastries” item. The percentage weighting of each food was multiplied by the fructose, glucose, sucrose and total available sugar contents for that food. This was obtained from the latest version of the NZ food composition tables (NZ FOODfiles 2010v2) (Department of Human Nutrition,
The sugars content for each food was then summed to calculate the nutrient profile of each item in the FFQ.

4.2.2 Twenty-four hour recall

The 24 hour recalls were analysed with dietary assessment software Kai-culator (version 0.85), developed by the Department of Human Nutrition, University of Otago (Department of Human Nutrition, 2013). The food composition database includes current and previous versions of FOODfiles; for this study FOODfiles 2010v2 from Plant and Food Research Ltd and selected recipes calculated for the 2008/09 New Zealand Adult Nutrition Survey. For each participant the average values of the three 24 hour dietary recalls were calculated to give daily estimates for fructose, glucose, sucrose and total sugar intakes from sugar from all sources, non-alcoholic beverage intake and fruit intake.

4.3 Statistical Analyses

As the estimates for sugars intakes were not normally distributed the data was log transformed and the geometric means for sugars from all sources and median with minimum and maximum intakes for sugars from non-alcoholic beverages and fruits are reported. Geometric mean usual sugar intakes derived from the 24hr recalls were compared with findings from the ANS 2008/09 data for Pacific Islanders. Statistical analysis using cross-classification, Bland-Altman and paired t-tests were calculated for male and female data separately in order to test the validity and reliability of the tool between genders.
2.3.1 Individual ranking

To test whether the FFQ can be used to rank individuals according to their intake, cross-classification of nutrient intakes from the FFQ2 and the mean 24hr recalls was undertaken. The percentage of participants correctly classified into the same quartile, adjacent quartile and grossly misclassified into extreme quartiles was calculated. The Cohen’s weighted kappa was calculated for each sugar from the observed and expected proportions on a 4 x 4 table of frequency. Kappa values fall between zero (indicating complete disagreement) and one (indicating complete agreement) for each category. Values of 0.80 are considered to show very good agreement, 0.61 to 0.8 good agreement, 0.41-0.6 moderate agreement, 0.21 to 0.4 fair agreement and 0.2 or less, poor agreement (Masson et al, 2003).

4.3.2 Strength of the association

Since the sugars intakes were not normally distributed Spearman correlations were calculated to assess the strength of the association between FFQ2 and the mean 24h recall estimates (Willett, 1998; Cade et al, 2002). As total diet was not assessed by the FFQ, analyses could not be adjusted for total energy intake.

4.3.3 Group mean intake estimates

To test whether the FFQ can be used to estimate a group’s mean intake, a two-sided paired t-test was used to examine the geometric mean differences in sugar intake between the FF2 and the mean 24h recall (Gibson, 2005, Gibson & Ferguson, 2008).
4.3.4 Precise individual level-agreement

The Bland-Altman method was used to measure the agreement between FFQ2 and the mean 24h recall intake for log-transformed sugars estimates (Bland & Altman, 1986). The mean difference, or bias, for between sugars estimates derived from the FFQ2 and the repeated 24h dietary recall and the 95% limits of agreement (LoA) were calculated. Effect estimates were back transformed to give results in a FFQ:24h recall ratio. To enable easier interpretation the ratios were multiplied by 100 to be expressed as percentages (i.e. mean percentage agreement). A mean percentage of agreement of 100% represents perfect agreement between the 24h recalls and the FFQ. However a mean percentage of agreement with a lower 95% CI higher than 100 indicated that the FFQ significantly over-estimates the nutrient intake and by the same principle, if the upper 95% CI is lower than 100. The width of the LoA indicates the degree of agreement between the two methods (Bland & Altman, 1986; Cade et al, 2002).

4.3.5 Test-re-test reliability

Test re-test reliability of the FFQ was assessed by examining the differences in geometric mean sugar intakes derived from FFQ1 and FFQ2 by paired t-test and intraclass correlations (ICCs). Because ICCs take into account both within and between-subject variation this method is considered the gold standard for assessing reliability (Kottner et al, 2011). An ICC of 0.5 or above is considered acceptable (Cade et al, 2004).
5. Results

5.1 Recruitment and participants

A total of 68 participants were recruited for this study. The first 58 were recruited through the Pukapuka community centre in Mangere, Auckland. A further 10 participants were recruited through a Pacific health Dietitian based in South Auckland. Characteristics of the participants are described in table 5.1. There were slightly more females than males and a large proportion (36%) of the study participants were under 30 year of age. The majority of the participants identified as being of Pukapukan ethnicity, Cook Islanders, or both. The 10 additional participants were Tongan (n=9) or Samoan (n=1). Approximately one third of the participants reported that they did not have any high school qualifications, and 70% of participants reported having at least school certificate. Of the 61 participants who provided information regarding their employment status, just over one half reported being in full time employment, a large proportion reported being a “homemaker” or being unemployed at the time of the study and 8% if study participants were students. The majority of the participants reported having a household size of 4 to 6 people or more than 7 people. 40 participants reported having a pre-existing medical condition; 25% reported having been told by their doctor that they have high blood pressure, and 24% reported having diabetes (all reports were of T2DM).
Table 5.1: Characteristics of participants in the wider Pukapuka Kai Study (n=68, South Auckland New Zealand 2013)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>30</td>
<td>44</td>
</tr>
<tr>
<td>Female</td>
<td>38</td>
<td>56</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-29</td>
<td>24</td>
<td>36</td>
</tr>
<tr>
<td>30-39</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>40-49</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td>50-59</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>60+</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
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<td></td>
</tr>
<tr>
<td>Pukapuka Islander</td>
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<td>84</td>
</tr>
<tr>
<td>Cook Islander</td>
<td>17</td>
<td>25</td>
</tr>
<tr>
<td>Tongan</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Samoan</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Highest education qualification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No secondary school qualification</td>
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<td>30</td>
</tr>
<tr>
<td>Secondary school qualification</td>
<td>38</td>
<td>50</td>
</tr>
<tr>
<td>Tertiary qualification – university</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Tertiary qualification - technical/trade school or</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>polytechnic</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
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<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>35</td>
<td>57</td>
</tr>
<tr>
<td>Part-time</td>
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<td>2</td>
</tr>
<tr>
<td>Retired</td>
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<td>5</td>
</tr>
<tr>
<td>Student</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Homemaker</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Unemployed</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Otherc</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Household size (n)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 3</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>4 to 6</td>
<td>30</td>
<td>44</td>
</tr>
<tr>
<td>7+</td>
<td>27</td>
<td>40</td>
</tr>
</tbody>
</table>
Co-morbidities

<table>
<thead>
<tr>
<th>Condition</th>
<th>n</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>High blood pressure</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>High cholesterol</td>
<td>13</td>
<td>19</td>
</tr>
<tr>
<td>Heart disease or angina</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Diabetes</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>Cancer</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gout</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Asthma</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Sleep Apnoea</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>28</td>
<td>41</td>
</tr>
</tbody>
</table>

n = number of people

a Participants were able to identify with more than one ethnicity

b Data available for 61 participants

c Other included those who self-identified as an invalid

Household size: the number of people in the participants household inclusive of the participant

e Participants were able to select multiple co-morbidities, given former diagnosis from a medical professional

5.2 Relative Validity

5.2.1 Spearman’s Correlation Coefficients

Relative validity of the FFQ was good to excellent for all sugars from all food sources and from non-alcoholic beverages with spearman correlation coefficients ranging from 0.67 to 0.76 and 0.64 to 0.79 for sugars from all sources and sugars from non-alcoholic beverages respectively.

Table 5.2 Spearman correlation coefficients between FFQ2 and 24h recall, compared with results from previous FFQ validation studies of sugar intakes

<table>
<thead>
<tr>
<th>Sugar</th>
<th>All sources</th>
<th>NABa</th>
<th>Fruit</th>
<th>Barrett (2012)</th>
<th>Barclay (2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>0.67*</td>
<td>0.79*</td>
<td>0.54*</td>
<td>0.66</td>
<td>-</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.70*</td>
<td>0.69*</td>
<td>0.51*</td>
<td>0.65</td>
<td>-</td>
</tr>
<tr>
<td>Sucrose</td>
<td>0.71*</td>
<td>0.64*</td>
<td>0.59*</td>
<td>0.47</td>
<td>-</td>
</tr>
<tr>
<td>Total sugars</td>
<td>0.76*</td>
<td>0.75*</td>
<td>0.57*</td>
<td>0.55</td>
<td>0.49</td>
</tr>
</tbody>
</table>

a Non-alcoholic beverages

* p-value < 0.001
5.2.2 Cross-classification of participants estimated sugar intakes

Tables 5.3 – 5.5 shows the agreement in cross-classification between FFQ2 and the 24h recall for sugars from all sources, non-alcoholic beverages and from fruits.

The percentage of participants correctly classified into the same quartile ranged from 49% (fructose) to 63% (total sugars) from all sugar sources (table 5.3). Table 5.3 also shows that 99% of participants were correctly classified to within one quartile each category of sugars. Findings were similar for sugars from non-alcoholic beverages with 46- 50% of participants correctly classified, and 96% or more classified to within one quartile (table 5.4). Cohen’s weighted kappa scores ranged from 0.46 to 0.60 for sugars from all sources and similar for sugars from non-alcoholic beverages, 0.41 to 0.53 indicating good agreement.

For sugar intakes derived from fruit a lower proportion of participants were correctly classified into the same quartile, reducing the Cohen’s weighted Kappa to 0.27 for glucose and 0.29 for fructose (table 5.5). However no participants were grossly misclassified except for glucose (n= 2).

Table 5.3 Cross classification of participants into quartiles of mean sugar intakes from all sugar sources

<table>
<thead>
<tr>
<th></th>
<th>Same quartile</th>
<th>Adjacent quartile</th>
<th>Extreme Quartile</th>
<th>Weighted Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>49</td>
<td>50</td>
<td>1</td>
<td>0.46</td>
</tr>
<tr>
<td>Glucose</td>
<td>57</td>
<td>51</td>
<td>1</td>
<td>0.48</td>
</tr>
<tr>
<td>Sucrose</td>
<td>54</td>
<td>44</td>
<td>1</td>
<td>0.55</td>
</tr>
<tr>
<td>Total Sugars</td>
<td>63</td>
<td>35</td>
<td>1</td>
<td>0.60</td>
</tr>
</tbody>
</table>
Table 5.4 Cross classification of participants into quartiles of mean sugar intakes derived from non-alcoholic beverages

<table>
<thead>
<tr>
<th></th>
<th>Same quartile</th>
<th>Adjacent quartile</th>
<th>Extreme Quartile</th>
<th>Weighted Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>50</td>
<td>49</td>
<td>1</td>
<td>0.53</td>
</tr>
<tr>
<td>Glucose</td>
<td>51</td>
<td>44</td>
<td>4</td>
<td>0.51</td>
</tr>
<tr>
<td>Sucrose</td>
<td>47</td>
<td>50</td>
<td>3</td>
<td>0.41</td>
</tr>
<tr>
<td>Total Sugars</td>
<td>46</td>
<td>53</td>
<td>1</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Table 5.5 Cross classification of participants into quartiles of mean sugar intakes derived from fruits

<table>
<thead>
<tr>
<th></th>
<th>Same quartile</th>
<th>Adjacent quartile</th>
<th>Extreme Quartile</th>
<th>Weighted Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>35</td>
<td>65</td>
<td>0</td>
<td>0.29</td>
</tr>
<tr>
<td>Glucose</td>
<td>34</td>
<td>63</td>
<td>3</td>
<td>0.27</td>
</tr>
<tr>
<td>Sucrose</td>
<td>44</td>
<td>56</td>
<td>0</td>
<td>0.41</td>
</tr>
<tr>
<td>Total Sugars</td>
<td>31</td>
<td>59</td>
<td>0</td>
<td>0.36</td>
</tr>
</tbody>
</table>

5.2.3 Bland-Altman analysis

The strength of agreement between the FFQ and the 24hr recalls is shown in table 5.6. The mean percentage agreement for fructose, glucose and total sugars was strong with values close to 100% and the 95% confidence interval including 100. Agreement was relatively poor for sucrose. The limits of agreement were wide for each of the sugar intakes estimated, particularly for fructose (26%–421%) and glucose (25%–453%).
Table 5.6 Bland-Altman statistics measuring strength of agreement for sugar intakes from all sources between FFQ2 and 24h recall\textsuperscript{a}

<table>
<thead>
<tr>
<th>Sugar</th>
<th>Mean % agreement (CI)\textsuperscript{b}</th>
<th>Limits of Agreement %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>105 (88,124)</td>
<td>26-421</td>
</tr>
<tr>
<td>Glucose</td>
<td>106 (89,126)</td>
<td>25-453</td>
</tr>
<tr>
<td>Sucrose</td>
<td>118 (103,137)</td>
<td>36-386</td>
</tr>
<tr>
<td>Total sugars</td>
<td>97 (86,110)</td>
<td>36-265</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Data from the 24h recall and the FFQ were natural log-transformed, back-transformed and then multiplied by 100.

\textsuperscript{b} Mean % agreement = FFQ2/24h recall, CI = 95% confidence interval of the mean % agreement

5.2.4 Sugar Intakes from all sources

Table 5.2 presents the geometric mean intakes of sugars from all sources measured by FFQ2 and the 24h recall. Mean daily intakes of sugars for the participants were similar for fructose and glucose, higher for sucrose and higher still total sugars. Two-sided paired t-tests for measuring the difference in mean sugar intakes between FFQ2 and the 24h recalls show that there was no significant difference fructose, glucose or total sugars intakes (table 5.7). However, FFQ2 gave a significantly higher estimate of sucrose intake compared to the 24h diet recall (table 5.7).

The mean intakes of sugars in this study population were lower than the mean reported by ANS 2008/09. The ANS reported mean intakes of total sugars as 106g/day, where results from our study show total sugars intakes at around 90g/day (table 5.7). Sucrose intakes from all sources were similar between our study and the ANS 2008/09, with a range of 43.8g/day to 65.1g/day measured by the two FFQs and 24h recall comparable to the ANS 2008/09 data of 53g/day.

Fructose intakes were also lower in our study, 15.7 – 21g/day from the different methods vs 19.3 – 21.7 g/day from the ANS 2008/09.
Table 5.7 Mean and median daily intakes of sugars from FFQ1, FFQ2 and 24h recall and from the 2008/09 Adult Nutrition Survey (ANS)\textsuperscript{a}

<table>
<thead>
<tr>
<th>Sugar</th>
<th>FFQ1 (Mean (95% CI))</th>
<th>FFQ2 (Mean (95% CI))</th>
<th>24h recall (Mean (95% CI))</th>
<th>ANS 2008/09 (Median (95th% CI))</th>
<th>p value FFQ1 vs FFQ2\textsuperscript{d}</th>
<th>p value FFQ2 vs 24h recall\textsuperscript{d}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>21.0 (16.8, 26.2)</td>
<td>16.4 (13.2, 20.4)</td>
<td>15.7 (12.5, 19.6)</td>
<td>19 (16, 22)</td>
<td>0.009</td>
<td>0.592</td>
</tr>
<tr>
<td>Glucose</td>
<td>20.7 (16.2, 26.3)</td>
<td>15.5 (12.2-19.6)</td>
<td>14.6 (11.8, 18.1)</td>
<td>-</td>
<td>0.002</td>
<td>0.5146</td>
</tr>
<tr>
<td>Sucrose</td>
<td>65.1 (51.5, 82.4)</td>
<td>51.9 (42.4, 63.4)</td>
<td>43.8 (36.6, 52.4)</td>
<td>53 (44, 62)</td>
<td>0.036</td>
<td>0.0212</td>
</tr>
<tr>
<td>Total sugars</td>
<td>115.3 (92.9, 143.2)</td>
<td>87.8 (72.5, 106.3)</td>
<td>90.3 (76.2, 107.1)</td>
<td>106 (95, 116)</td>
<td>0.000</td>
<td>0.6361</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Median dietary intakes among Pacific participants as reported in the 2008/09 New Zealand Adult Nutrition Survey

\textsuperscript{b}Geometric mean and 95% confidence interval (CI)

\textsuperscript{c}Male and female combined estimates

\textsuperscript{d}p values calculated by paired t-test
5.2.5 Sugar intakes from non-alcoholic beverages and fruits

The data for individual sugar intakes from non-alcoholic beverages and fruit could not be log transformed to derive geometric mean intakes as there were a number of zero values. Therefore, intakes of fructose, glucose, sucrose and total sugars are given as medium, minimum and maximum statistics for the group, as presented in table 5.8. The values are relatively similar between the measurement methods however the median sucrose estimate was significantly lower when measured by the 24h recall compared to both the FFQs. The range of total sugars intake from non-alcoholic beverages was zero to 499.2g (table 5.8). The range of sugar intake estimates from fruits is much lower, with a minimum of zero and maximum of 168.9g as recorded by one of the first FFQs (table 5.8).
<table>
<thead>
<tr>
<th>Sugar</th>
<th>NAB median (min - max)</th>
<th>FFQ1</th>
<th>FFQ2</th>
<th>24h recall</th>
<th>p value&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Fruit median (min - max)</th>
<th>FFQ1</th>
<th>FFQ2</th>
<th>24h recall</th>
<th>p value&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>fructose (g)</td>
<td>2.35 (0 - 88.4)</td>
<td>2.55 (0 - 87.5)</td>
<td>2.03 (0 - 101.3)</td>
<td>0.24</td>
<td>11.4 (0 - 58.9)</td>
<td>6.35 (0 - 56)</td>
<td>5.81 (0 - 55.1)</td>
<td>0.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>glucose (g)</td>
<td>3.55 (0 - 81.5)</td>
<td>2.3 (0 - 91.2)</td>
<td>2.18 (0 - 86.7)</td>
<td>0.05</td>
<td>9.8 (0 - 66.8)</td>
<td>5.2 (0 - 75.9)</td>
<td>4.9 (0 - 39.6)</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sucrose (g)</td>
<td>29.35 (0 - 229.2)</td>
<td>25.2 (0 - 258.0)</td>
<td>6.45 (225.83)</td>
<td>0.00</td>
<td>10.8 (0 - 68)</td>
<td>6.5 (0 - 60)</td>
<td>6.4 (0 - 45.4)</td>
<td>0.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total sugars (g)</td>
<td>50.1 (0 - 411.4)</td>
<td>37.7 (0 - 499.2)</td>
<td>13.3 (0 - 490.9)</td>
<td>0.00</td>
<td>27.9 (0 - 168.9)</td>
<td>17.9 (0 - 158.6)</td>
<td>17.7 (0 - 125.6)</td>
<td>0.38</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>non-parametric Wilcoxon Signed Rank Test derived p value of the difference between FFQ2 and 24h recall
5.2.6 Validity and reliability in Males and females

More males were correctly classified into the same or adjacent quartile than females 84 – 92% vs 72.7% - 77.8%, with stronger Weighted Kappa scores ranging from 0.62 to 0.81 (table 5.9). For females weighted kappa scores were lower ranging 0.24 – 0.40 and percentage correct classification was higher for sucrose and total sugars compared to fructose and glucose.

<table>
<thead>
<tr>
<th>Sugar</th>
<th>Male Correct classification (%)</th>
<th>Male Weighted Kappa</th>
<th>Female Correct classification (%)</th>
<th>Female Weighted Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>83.9</td>
<td>0.62</td>
<td>72.7</td>
<td>0.24</td>
</tr>
<tr>
<td>Glucose</td>
<td>83.9</td>
<td>0.62</td>
<td>74.4</td>
<td>0.33</td>
</tr>
<tr>
<td>Sucrose</td>
<td>86.2</td>
<td>0.67</td>
<td>77.8</td>
<td>0.40</td>
</tr>
<tr>
<td>Total sugars</td>
<td>92.0</td>
<td>0.81</td>
<td>76.9</td>
<td>0.38</td>
</tr>
</tbody>
</table>

High Spearman’s correlation coefficients ranging 0.76 to 0.88 shows a strong correlation between the FFQ and 24h recalls for males, while for females the correlation coefficients were lower from 0.39 for fructose and 0.58 for sucrose (table 5.10). Table 5.10 also shows that the intraclass coefficients (ICC) were higher for males than females, with ICCs of 0.78 – 0.91. For both males and females reliability coefficients were similar across individual sugars measured. However for females the ICCs were lower ranging from 0.63 to 0.70 (table 5.10).
Table 5.10 Intraclass correlation coefficients (ICC) and Spearman correlation coefficients (SCC) between FFQ2 and 24h recall for sugar intakes from males and females

<table>
<thead>
<tr>
<th>Sugar</th>
<th>Validity</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>SCC</td>
<td>SCC</td>
</tr>
<tr>
<td>Fructose</td>
<td>0.86</td>
<td>0.39</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.84</td>
<td>0.44</td>
</tr>
<tr>
<td>Sucrose</td>
<td>0.76</td>
<td>0.58</td>
</tr>
<tr>
<td>Total sugars</td>
<td>0.88</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Table 5.11 shows mean sugar intakes for male and female participants.

P-values calculated by paired t-test found no significant difference between measurement tools of individual sugar intakes in males and females. Table 5.11 shows that mean sugar intakes are higher in males than females for all individual sugar intakes measured.

Table 5.11 Mean daily intakes of sugars from FFQ2 and 24h recall for males and females

<table>
<thead>
<tr>
<th>Sugar</th>
<th>FFQ2 (Mean (95% CI)a</th>
<th>24h recall (Mean (95% CI)a</th>
<th>p valueb</th>
<th>FFQ2 (Mean (95% CI)a</th>
<th>24h recall (Mean (95% CI)a</th>
<th>p valueb</th>
</tr>
</thead>
<tbody>
<tr>
<td>fructose</td>
<td>22.9 (15.9, 32.9)</td>
<td>21.2 (13.7, 32.7)</td>
<td>0.4605</td>
<td>12.8 (10.0, 16.4)</td>
<td>12.5 (10.1, 15.5)</td>
<td>0.8717</td>
</tr>
<tr>
<td>glucose</td>
<td>21.4 (14.4, 31.8)</td>
<td>20.1 (13.5, 29.9)</td>
<td>0.5398</td>
<td>12.1 (9.2, 16.0)</td>
<td>11.5 (9.2, 14.4)</td>
<td>0.696</td>
</tr>
<tr>
<td>sucrose</td>
<td>67.7 (48.5, 94.4)</td>
<td>56.6 (40.3, 79.5)</td>
<td>0.1205</td>
<td>42.5 (33.3, 54.3)</td>
<td>36.2 (30.3, 43.1)</td>
<td>0.0954</td>
</tr>
<tr>
<td>total sugars</td>
<td>116.9 (83.0, 164.6)</td>
<td>117.7 (85.6, 161.9)</td>
<td>0.9312</td>
<td>70.9 (57.8, 87.0)</td>
<td>74.2 (62.9, 87.5)</td>
<td>0.6087</td>
</tr>
</tbody>
</table>

aGeometric mean and 95% confidence interval (CI)
bp values calculated by paired t-test
5.3 Repeatability

5.3.1 Reliability Intraclass Correlation Coefficients (ICC’s)

Table 5.12 shows the ICC’s used to assess the reproducibility between repeat administrations of the FFQ. For all sugars types ICCs were greater than 0.7 indicating strong agreement between the first and second administrations of the FFQ.

Table 5.12 Intraclass correlation coefficients for the repeat administrations of the FFQ

<table>
<thead>
<tr>
<th></th>
<th>ICC</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>0.77</td>
<td>0.61 - 0.86</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.78</td>
<td>0.61 - 0.82</td>
</tr>
<tr>
<td>Sucrose</td>
<td>0.74</td>
<td>0.59 - 0.84</td>
</tr>
<tr>
<td>Total sugars</td>
<td>0.79</td>
<td>0.59 - 0.87</td>
</tr>
</tbody>
</table>
6. Discussion

The Pacific Island Kai FFQ was designed to rank participants’ sugar intakes and provide a measure of sugar intakes in Pacific Island people living in South Auckland, New Zealand based on their intake of foods containing sugars over the past month. The FFQ showed good validity particularly at being able to correctly classify individuals into quartiles, with at least 97% participants classified to within one quartile for all sugars measured, and weighted kappa scores ranging from 0.46 to 0.60 indicating fair to good agreement. Spearman correlation coefficients were also strong especially for sugars from all sources and non-alcoholic beverages comparing highly to previous research. The ability of the FFQ to give an indication of individual intakes was good for fructose and glucose using paired t-tests and Bland-Altman analysis however intakes for sucrose were generally overestimated.

6.1 Validity

To assess the validity of the questionnaire to accurately measure sugar intakes various statistical methods were used to compare the FFQ with the three diet 24h diet recalls collected over three weeks. Since the FFQ asked questions about the previous months’ intake, it seemed appropriate to use repeat 24h recalls to measure usual intake over the same time period which the FFQ was measuring. While weighed diet records are considered the gold standard for validation of an FFQ (Gibson, 2005), a consideration in this study was the appropriateness of the measurement method for our population. Previous research has shown that subjects have fewer difficulties with the 24h dietary recall approach than with collecting weighed diet records (Vucic et al, 2009). Vucic et al
(2009) also note that higher estimates of nutrients are recalled in low literacy and low income populations when FFQs and 24h recalls are used. Since sugar intakes in particular can be under reported, using 24h recalls was deemed the best method for validating the FFQ.

Spearman’s correlation coefficients were similar to those reported in previous studies (Barrett & Gibson, 2010; Sam et al, 2012) for fructose and glucose and superior to coefficients reported for sucrose and total sugars by Barrett & Gibson (2010) and Barclay et al (2008). For sugars from non-alcoholic beverages the correlation coefficients were similar however we found that the Spearman’s correlation coefficients were lower among all sugars from fruit. Fruit intakes among participants was highly variable while intake of non-alcoholic beverages was very stable amongst those participants who reported drinking non-alcoholic beverages. This pattern of high variability of fruit intakes has been found in previous studies (Salvini et al, 1989).

The FFQ was able to reliable rank participants into quartiles of sugars intakes. While useful to see how well the FFQ ranks individuals within a group, the potential to group participants with very different intakes into the same quartile and vice versa exists (Masson et al, 2003). When measured for cross classification the FFQ was able to correctly rank individuals, with a low proportion grossly-misclassified across all sugars from all sources, non-alcoholic beverages and fruit. The cross-classification agreement was lower for sugar intakes from fruit, probably because the values were lower and fruit intakes among this population could be highly variable day to day making it difficult to
conclusively measure using the FFQ. However even for sugar from fruit the proportion of participants grossly misclassified was very low ranging from 0 to 3%, and overall percentage correctly classified was comparable to previous findings ranking sugar intakes (Sam et al, 2012; Barclay et al, 2008; Barrett & Gibson, 2010).

A potential reason why this study had slightly higher correlation coefficients and better correct classification than in previous research is that the Pacific Island Kai FFQ had fewer questions than the one’s used in Barrett & Gibson (2010) and Barclay et al (2008) which also assessed other nutrients. The FFQ used in Barrett & Gibson (2010) study consisted of 297 questions and they even report the potential for boredom and fatigue in completing such a long questionnaire. In Barclay et al (2008) study a 147 item FFQ was used. Concentrating on one food group with fewer overall questions may have resulted in the comparably higher percentage correct classification seen in this study as well as higher weighted kappa scores.

Mean sugars intakes estimates from the FFQ and the 24h dietary recalls were not significantly different for fructose, glucose and total sugars from all food and beverage sources. However there was a significant difference between the assessment methods for estimates of sucrose intake. Sugars intakes derived from the FFQ for non-alcoholic beverage sources showed good validity for fructose, glucose and total sugars but not sucrose. As for the FFQ measuring intakes from non-alcoholic beverages and fruit the validity was reduced slightly, only measuring fructose and glucose from non-alcoholic beverages with statistical significance similarly to the 24h recall. Bland-Altman analyses
provided a measure of the absolute agreement between the two measurements methods. Due to measurement error it is unlikely that the FFQ and mean 24h recall would show precise agreement at an individual level for clinical use, but this type of test can reveal valuable information about the instrument’s performance. There was strong agreement between the FFQ and the 24h recall again for fructose, glucose and total sugars while for sucrose the FFQ overestimated intakes. The strength of agreement was better than that found in previous studies all of which found FFQs to over-estimate sugar intakes, however none of these studies measured sugar intakes specifically, but as part of a larger questionnaire (Sam et al, 2012; Barrett & Gibson, 2010; Barclay et al, 2008).

Analysis on validity and reproducibility of the FFQ for males and females was also completed. The FFQ had much higher correct classification into same or adjacent quartile for males than females, with stronger kappa scores. Spearman correlation coefficients were higher in males than females; with correlations almost double that of females for all sugar intakes measured. Spearman correlation coefficients can be considered excellent (>0.70) for males and adequate (0.3-0.5) to good (0.5-0.7) for females (Willett, 1998). Mean daily sugar intakes appear to be higher for men than women which can also be seen from results of the ANS (University of Otago, 2011). Previous research has found that women tend to under-report total energy intakes more than men. Although this research was looking at total energy intakes, this could explain the differences in the validity and reliably of the tool between genders (Livingstone & Black 2003).
This FFQ was not designed to measure individual intakes absolutely. The difference in the mean intakes between the FFQ and 24h recall measured by paired t-test were not significant for fructose, glucose and total sugars however it was for sucrose. Bland-Altman analysis found a good level of agreement between fructose, glucose and total sugars but overestimated sucrose intake. The level of agreement was good overall but in light of the inability to accurately estimate sucrose intakes for the group the FFQ would not be entirely suitable to measure individual intakes of sugars. Another small study which employed Bland Altman analysis to validate their short FFQ looking at sugar intakes found a high degree of under and overestimation of sugar intakes, however as in this study their aim was not to measure absolute sugar intakes in individuals but to correctly rank participants as part of large scale epidemiological studies where the ability to rank intakes useful (Shanita & Hanifah, 2012). Moreover, since this study aims to contribute to further research looking at associations of sugar intake and risk of disease, measures of precision such as the cross classification and Spearman correlation hold more weight than measures of bias (Berdanier, Dwyer & Feldman, 2008).

Intakes of sugars were generally lower in this study compared to reports by the ANS 2008/09. Both studies used 24h recall to quantitatively measure intakes; however our study reported intakes measured by the FFQ while the ANS 2008/09 did not include a quantitative FFQ. This is probably why the higher values from this study are almost as high as those from the ANS 2008/09 as the FFQ was found to generally overestimate sugar intakes. However another reason why the sugar intakes in this particular population were lower could be due to previous interventions at the Pukapuka Centre. The Centre
Leader was strongly involved with getting the Pukapuka people healthy and involved many initiatives to reduce unhealthy eating, which included a ban on soft drinks being sold at the Pukapuka Centre tuck shop. Through talking to people at the centre it appeared that messages about limiting sugar intakes had already been given to the community, and many of the people in the study with diagnosed diabetes reported knowing they needed to limit intakes of sugars and carbohydrate foods. Therefore it is likely that our study population has lower intakes of high sugar foods compared with other Pacific Island populations across New Zealand.

6.2 Reliability

Intra-class correlation coefficients indicate very good reliability between the first and second administrations of the FFQs with values exceeding 0.7 which surpass those previously published as strong correlations (Sam et al, 2012; Cade et al, 2004). The relatively short time between administrations of the FFQs (4 weeks) may explain the high correlation, with participants potentially exhibiting a “learning effect” whereby they remembered previous responses (Cade et al, 2004). However data for sugar intakes from all sources compared from FFQ1 and FFQ2 showed intakes were significantly decreased at the second administration. This will likely mean that although the method of collection was just as valid the second time, the involvement of the participants in the study may have had an intervention effect, raising awareness about sugar intakes resulting in participants reducing their sugar intakes over the period measured by FFQ2.
6.3 Strengths and Limitations

Dietary assessment, particularly in low income, low literacy populations is a difficult task with many complications to consider (Vucic et al, 2009). Potential issues with generalisability of the study results, accuracy of the reference method and design of the study are discussed in the following sections.

The size of the FFQ developed is small enough to keep participants attention while asking about all the necessary sugar sources in order to measure fructose, glucose, sucrose and total sugars. It also asked about culturally relevant foods due to the environmental audits carried out throughout the development process. The FFQ was designed to include pictures to help participants accurately record portion size and measures were taken to decrease format complexity by asking questions in an open ended (non-tabular) format.

Sugars from other sources such as milk were not measured, in part to keep with the WHO definition of free sugars and also to keep the food list down as milk sugars are found in many foods.

The sample limitations include a small sample size of only 68, the limited capture of Pacific Island ethnicities being primarily (84% of participants) of Pukapuka Cook Island descent. Further research would need to test the FFQ’s ability to capture sugar intakes in the wider Pacific population living in New Zealand including those not as closely associated with a community centre. Another limitation concerning the characteristics of
this study population is uneven spread of age groups, with a high disproportionately high percentage (36%) of participants under the age of 30. The potential differences in food intakes between different age groups may have influenced the group’s mean sugar intakes reported in this thesis. Further study would need to ensure a more population representative age distribution.

Our study had a completion rate of almost 100% meaning that participants were not only motivated but there was substantial support and initiative from the Pukapuka Community Centre for participants to get involved. This may be difficult to replicate on a larger scale, however shows the importance of working closely with community groups when involving them in research.

We used repeated 24h dietary recalls as the reference method against which we compared the FFQ. Three to seven day weighed records are generally considered the gold standard reference method as they have a different set of errors associated with them, unrelated to those in an FFQ (Margetts & Nelson, 2010). For example 24h recalls and FFQs both rely on participants’ memory, while weighed records are kept as and when participants eat. However as we aimed for relatively low participant and researcher burden, using methods best suited to our population the 24h dietary recall method was selected. Issues with the 24h recall method include participants forgetting foods as they were relying on memory, or under-reporting due to the fear of being judged by the interviewer (Gibson, 2005). A strength in this instance was the level of training of each of the administrators of the 24h recalls, both of which were 5th year dietetic students with formal training on how to
complete a five-stage 24h recall with adequate prompting and a forgotten foods list. Using evidence that validating FFQs against 24h recalls has been successful in the past, as well as evidence that no more than three 24h recalls over the course of one month would be suitable to gain results about usual intake it can be concluded that this study employed the most appropriate reference method (Ma et al, 2009; Shanita & Hanifah, 2012).

Due to the limitations of dietary assessment methods, validation studies can use biomarkers as an additional indicator of habitual intake to supplement the dietary assessment method (Cade et al, 2002; Gibson, 2005). Bingham et al have documented that urinary fructose and sucrose can be used as biomarkers for intake can attenuate the effects of under-and over-reporting as they are independent of the issues plagued by all dietary assessment methods (Bingham et al, 2007). A series of studies have successfully used urinary fructose and sucrose as biomarkers for intake (Tasevska et al, 2005; Tasevska et al, 2009; Tasevska et al, 2011). Using urinary fructose to validate the intakes measure by the FFQ may have given a better idea of whether the FFQ did in fact over-estimating for sucrose or whether the FFQ had good validity for fructose, glucose and total sugars. However, errors associated with biomarkers include difficulty ascertaining the true relationship between the biochemical marker and usual dietary intake (Cade et al, 2002). In future research attempting to measure sugar intakes the utilization of urinary sucrose biomarkers could offer a more objective measure of validity to complement the alternative dietary method used.
The overarching aim of the research into measuring sugar intakes is to give clear evidence of associations between increased sugar intakes and chronic disease in New Zealand. The link between excess sugar consumption and the pandemics of non-communicable metabolic diseases is very plausible and yet the evidence for this is surprisingly weak and limited. Further research needs to generate robust evidence, if there is any, for an association between sugars intake and health risk in Pacific communities.
7. Application to Practice

As part of wider research this study will generate evidence-based knowledge about the effect of sugars on health risks. In particular the potentially harmful upper limits of sugar intake, and which food groups contribute the largest proportion of sugars to the diets of Pacific Islanders. As a result, resources and messages can be developed to help dietitians educate patients on appropriate sugar intakes from appropriate sources. Sugar has its place as part of a healthy balanced diet. Dietitians should be encouraged to advice people to keep sugar sweetened foods as treats and opt for healthy day to day foods such as plenty of fruit and vegetables, wholegrain breads, and substituting sugar sweetened beverages for water or milk.
7. References


The Australian Food and Nutrition Monitoring Unit. Queensland, Australia, Commonwealth of Australia.


8. Appendices

A  Pukapuka Kai FFQ
B  Ethics Approval
C  Informed Consent Sheet
D  Contact Form
E  Demographic Questionnaire
Appendix A: Pukapuka Kai FFQ
The Pukapukan Kai Study

We would like to learn more about Pukapukan eating patterns in New Zealand.

How can you help?

• Please tell us about YOU (not someone else in your household)
• Please be honest
• Answer each question as best as you can
• Tick or fill in ONE answer for EACH question
  (Erase or scribble out mistakes)

Atawai wolo (thank you very much) for helping us with this important project!

Subject ID: __________
Date completed QFFQ-2: __________
INSTRUCTIONS: This is how you answer the questions

Ke Ola, Ko Pewea Koe, I am Tere and over the past month I usually drank water 4 times a day. I have about a cup each time!

Tere writes:
Over the past month, on average, how often do you drink water?

☐ never (go to next question)
☐ 4 times a day
☐ times a week
☐ times a month

How much do you usually have each time?

☐ 1 cup OR
☐ ml OR
☐ litre

PLEASE NOTE: Each item has 2 questions:
• “how often”
• “how much”
These photos may help you estimate **how much** you usually drink:

1 cup = 250ml
Think about your usual drinking pattern over the past month…

1. On average, how often do you drink fruit DRINK (NOT 100% fruit juice) (eg. Golden Circle, Thextons, Ribena)?
   - ☐ never (go to next question)
   - ☐ times a day
   - ☐ times a week
   - ☐ times a month

   How much do you usually drink each time?  
   ____ cup (photo on page 3) OR  
   ____ ml (photos on page 3) OR  
   ____ litre

2. On average, how often do you drink 100% fruit JUICE (no added sugar) (eg. Just Juice, Fresh-Up)?
   - ☐ never (go to next question)
   - ☐ times a day
   - ☐ times a week
   - ☐ times a month

   How much do you usually drink each time?  
   ____ cup (photo on page 3) OR  
   ____ ml (photos on page 3) OR  
   ____ litre

3. On average, how often do you drink low-calorie cordial (eg. Thriftee, Vitafresh Low Calorie)?
   - ☐ never (go to next question)
   - ☐ times a day
   - ☐ times a week
   - ☐ times a month

   How much do you usually drink each time?  
   ____ cup OR  
   ____ ml OR  
   ____ litre
4. On average, **how often** do you drink regular cordial (eg. Raro, Refresh, Vitafresh)?

- ☐ never (go to next question)
- ☐ times a day
- ☐ times a week
- ☐ times a month

How do you **prepare** the cordial?

- ○ strong (less water added)
- ○ following packet instructions (1 packet = 1 litre)
- ○ weak (more water added)

**How much** do you usually drink each time?  

- ____ cup (photo on page 3) OR  
- ____ ml OR  
- ____ litre

5. On average, **how often** do you drink diet soft drink (eg. Coke Zero, Diet lemonade)?

- ☐ never (go to next question)
- ☐ times a day
- ☐ times a week
- ☐ times a month

1.25 litre  355 ml

**How much** do you usually drink each time?  

- ____ cup OR  
- ____ ml (more photos on page 3) OR  
- ____ litre

6. On average, **how often** do you drink regular soft drink (eg. Coke, Lemonade)?

- ☐ never (go to next question)
- ☐ times a day
- ☐ times a week
- ☐ times a month

1.25 litre  355 ml

**How much** do you usually drink each time?  

- ____ cup OR  
- ____ ml (more photos on page 3) OR  
- ____ litre
Think about your usual drinking pattern over the past month…

7. On average, how often do you drink sports drink (eg. Gatorade, Powerade)?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually drink each time?  _____ cup OR _____ ml OR _____ litre

8. On average, how often do you drink energy drink (eg. V, Red Bull, Mother)?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually drink each time?  _____ small can (250 ml) OR _____ medium can or bottle (350 ml) OR _____ large can (500 ml)

9. On average, how often do you drink flavoured milk (eg. Primo, Calci Yum, bought milkshake)?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually drink each time?

_____ cup OR _____ ml OR _____ litre
Think about your *usual* drinking pattern *over the past month*…

For the following questions, this photo may help you estimate **how much** you usually drink:

![Photo of drinks with measurements]

10. On average, **how often** do you drink beer, lager or cider?

- ☐ never (go to next question)
- ☐ times a day
- ☐ times a week
- ☐ times a month

**How much** do you usually drink **each time**?

- ____ bottle (330ml) OR
- ____ can (355 ml) OR
- ____ large bottle (745 ml) OR
- ____ pint or handle (400 ml) OR
- ____ jug (1000 ml) = 1 litre OR
- ____ ml (photos above)

11. On average, **how often** do you drink wine (red, white or sparkling)?

- ☐ never (go to next question)
- ☐ times a day
- ☐ times a week
- ☐ times a month

**How much** do you usually drink **each time**?

- ____ wine glass (photo above) (150ml) OR
- ____ wine bottle (750ml) OR
- ____ ml
Think about your usual drinking pattern over the past month…

12. On average, how often do you drink port, sherry, vermouth or liqueurs?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually drink each time?  
_____ small sherry glass (60ml) OR
_____ wine glass (150ml) (photo on page 7) OR
_____ ml

13. On average, how often do you drink straight spirits (no mixer) (eg. gin, whisky, vodka, rum)?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually drink each time?  
_____ nip (30ml) OR
_____ double nip (60ml) OR
_____ ml

14. On average, how often do you drink spirits with mixer (eg. RTDs, gin and tonic, rum and Coke)?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually drink each time?  
_____ spirit glass (150ml) with 1 nip
_____ spirit glass (150ml) with 2 nips OR
_____ tall glass (200ml) with 1 nip OR
_____ tall glass (200ml) with 2 nips OR
_____ small bottle (330ml) (photo on page 7)
Think about your *usual* eating pattern *over the past month*…

15. On average, **how often** do you *add sugar* or *honey* to your tea or coffee?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

**How much** do you usually add *each time*?

___ teaspoon  OR  ___ big spoon

**How much** is on *each spoon*?  (please circle ONE)

level  rounded  heaped

16. On average, **how often** do you *add sugar* or *honey* to your Milo, hot water or other drinks?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

**How much** do you usually add *each time*?

___ teaspoon  OR  ___ big spoon

**How much** is on *each spoon*?  (please circle ONE)

level  rounded  heaped
Think about your *usual* eating pattern *over the past month*…

17. On average, **how often** do you add Milo, powder drinking chocolate or other milk mix to your drinks?

- [ ] never (go to next question)
- [ ] times a day
- [ ] times a week
- [ ] times a month

**How much** do you usually add **each time?**  ___ teaspoon OR ___ big spoon

**How much** is on **each spoon?** (please circle ONE)

- [ ] level
- [ ] rounded
- [ ] heaped

18. On average, **how often** do you eat jam, honey, syrup, chutney or Nutella on your bread?

- [ ] never (go to next question)
- [ ] times a day
- [ ] times a week
- [ ] times a month

**How many** slices of bread do you usually eat **each time?**  ___ slices

**How much** do you usually eat on **each slice?** (please circle ONE)

- [ ] Photo A
- [ ] Photo B
- [ ] Photo C
19. On average, how often do you eat tomato sauce on your food?
☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually add each time?  ____ teaspoon OR
                                                ____ big spoon OR
                                                ____ ml

20. On average, how often do you eat dried fruit (eg. raisins, sultanas, prunes)?
☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually eat each time?  ____ cup OR
                                                ____ level handful (1/2 cup)

21. On average, how often do you eat canned fruit, stewed fruit or baked fruit?
☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually eat each time?  ____ cup

22. On average, how often do you eat fresh raw fruit (eg. apple, banana, orange, pear, grapes)?
☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually eat each time?  ____ whole piece of fruit OR
                                                ____ cup
Think about your *usual* eating pattern over the past month...

23. On average, **how often** do you eat yoghurt, dairy food, milk pudding, mousse or custard?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

**How much** do you usually eat each time?

____ pottle (1/2 cup) OR
____ cup

---

24. On average, **how often** do you eat ice cream, ice blocks, jelly or frozen yoghurt?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

**How much** do you usually eat each time?

____ Photo A OR
____ Photo B OR
____ Photo C OR
____ ice block

---

25. On average, **how often** do you put sugar, jam, honey, syrup or sweet sauce on other foods (like cereal, pancakes or ice cream)?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

**How much** do you usually add each time?

____ teaspoon OR
____ dessert spoon OR
____ ml
26. On average, **how often** do you eat **breakfast cereals**?

- [ ] never (go to next question)
- [ ] times a day
- [ ] times a week
- [ ] times a month

Which **type** of cereal do you eat **most often**?

- [ ] Weetbix
- [ ] Cornflakes
- [ ] Coco pops
- [ ] Nutra-grain
- [ ] Ricies
- [ ] Porridge
- [ ] Other: __________________________

**How much** do you usually eat each time?

- [ ] Photo A OR
- [ ] Photo B OR
- [ ] Photo C OR
- [ ] weetbix

27. On average, **how often** do you eat **muesli bars**, **cereal bars** or **nut bars**?

- [ ] never (go to next question)
- [ ] times a day
- [ ] times a week
- [ ] times a month

**How much** do you usually eat each time?

- [ ] bar OR
- [ ] grams

28. On average, **how often** do you eat **chocolate biscuits** (eg. Tim Tam, Toffee Pop) or **cream-filled sweet biscuits** (eg. Cameo cream)?

- [ ] never (go to next question)
- [ ] times a day
- [ ] times a week
- [ ] times a month

**How much** do you usually eat each time?

- [ ] biscuit OR
- [ ] packet (~200 gm)
Think about your *usual* eating pattern *over the past month*...

29. On average, how often do you eat other sweet biscuits (eg. wine biscuits, gingernuts)?
   - ☐ never (go to next question)
   - ☐ times a day
   - ☐ times a week
   - ☐ times a month
   
   **How much** do you usually eat each time?  
   - ____ small biscuit (eg. wine) OR
   - ____ large biscuit (eg. Cookie Time) OR
   - ____ packet (~200 gm)

30. On average, how often do you eat sweet buns, iced buns, doughnuts or pastries?
   - ☐ never (go to next question)
   - ☐ times a day
   - ☐ times a week
   - ☐ times a month
   
   **How much** do you usually eat each time?  
   - ____ doughnut / bun / pastry

31. On average, how often do you eat cake, sponge, muffins or baked pudding?
   - ☐ never (go to next question)
   - ☐ times a day
   - ☐ times a week
   - ☐ times a month
   
   **How much** do you usually eat each time?  
   - ____ grams
32. On average, how often do you eat lollies (eg. jet planes, mints, toffees, liquorice)?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually eat each time? ___ lollies OR ___ family pack (150-200 gm)

33. On average, how often do you eat chocolate or chocolate bars (eg. Moro, Crunchie)?

☐ never (go to next question)
☐ times a day
☐ times a week
☐ times a month

How much do you usually eat each time? ___ square ___ grams (gm)

45 gm 50 gm

100 gm 200 gm 350 gm
34. Have you **changed your diet** in the past 30 days?

☐ No  (go to next question)

☐ Yes

**How** has it changed?  (tick all that apply)

- ☐ I eat less food.   ☐ I eat more food.
- ☐ I eat less sugar.   ☐ I eat more sugar.
- ☐ I eat less fat.   ☐ I eat more fat.
- ☐ I eat less fruit.   ☐ I eat more fruit.
- ☐ I drink less fruit juice.   ☐ I drink more fruit juice.
- ☐ I drink fewer sugary drinks.   ☐ I drink more diet drinks.
- ☐ I drink less alcohol.   ☐ I drink more alcohol.
- ☐ Other: ______________________________________________________

35. Have you **lost weight** in the past 30 days?

☐ No

☐ Yes

-----------------------------------------------

**THE END**

Please check every page to see if you have answered every question

**Atawai wolo (thank you very much) for helping us with this important project!**
Appendix B: Ethics Approval
HUMAN ETHICS APPLICATION: CATEGORY B

(Departmental Approval)

1. University of Otago staff member responsible for project:
   Te Morenga Lisa, Dr

2. Department: Human Nutrition

3. Contact details of staff member responsible:
   office: 479-3978
   lisa.temorenga@otago.ac.nz

4. Title of project: Development and validation of a sugar screener for Pacific adults living in Auckland

5. Indicate type of project and names of other investigators and students:

<table>
<thead>
<tr>
<th>Staff Research</th>
<th>Names</th>
</tr>
</thead>
</table>
   | X              | Lisa Te Morenga  
                | Louise Mainvil |
                | Tony Merriman (Biochem) |

<table>
<thead>
<tr>
<th>Student Research</th>
<th>Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Olivia Boniface</td>
</tr>
</tbody>
</table>

   Level of Study (e.g. PhD, Masters, Hons) M.Diet

6. When will recruitment and data collection commence?
1 February 2013

When will data collection be completed?

31 October 2013

7. **Brief description in lay terms of the aim of the project, and outline of research questions** (approx. 200 words):

Western diets contain increasing amounts of added sugars from sweetened foods and sugary drinks. Excessive fructose (a sugar that is found in sweetened foods, drinks and fruits) consumption may be linked to the increasing prevalence of diseases such as diabetes, obesity, gout and cardiovascular disease. However intakes of dietary sugars (like fructose) are difficult to measure reliably and are typically under-reported, particularly in low-income populations. Thus it is difficult to determine with any certainty whether excessive sugars intakes are responsible for these diseases, and to justify public health recommendations to limit sugars intakes. This research aims to develop, pre-test and validate dietary a brief assessment instrument for assessing sugars intakes in a Pacific population living in Auckland (primarily Pukapuka Cook Islanders) We will validate the instrument by comparing the estimates of sugars intakes derived from it with usual sugars intakes measured by collection of three 24hr dietary recall interviews conducted approximately weekly over a one month period. We consider the 24hr recall method to be the best method for assessing usual dietary intakes in (potentially) low literacy populations but is time consuming and requires trained nutritionists/dietitians to administer. The intention for the instrument is that it will used to measure sugars intakes in large population studies, thus facilitating future research to examine the effect of sugars on health risks and interactions between sugar consumption and genes. This will contribute to our understanding of the role of sugar in the development of gout, diabetes and cardiovascular disease in Pacific people.

8. **Brief description of the method.** Please include a description of who the participants are, how the participants will be recruited, and what they will be asked to do:-

Volunteers for this study will be recruited from the Pukapukan community based in Mangere, Auckland via contacts with Nuku Rapana, President of the Pukapuka Island Community Inc.

Initial qualitative interviews will be conducted with 5-10 Pukapukan adults examining responses and interpretation to an existing sugar intake questionnaire designed to assess sugars intakes over the previous month (developed as a sugar intake screener for the DRINKS study). During the interview volunteers will be asked to complete the sugars FFQ while verbalising their understanding of the questionnaire. The student will take written notes reflecting these verbal responses and, if the volunteer agrees, will make an audio recording. The questionnaire will be adapted and refined on the basis of these interviews.

To validate the accuracy and reproducibility of the sugar intake questionnaire we will recruit up to 30 adults volunteers (aged 18 – 65) to participate in 4 x 1.5 hour interviews conducted approximately one week apart over a 4 week period.

At the first interview the student will establish relationships and rapport with the volunteer. Once the volunteer is comfortable and has been informed of the intention and requirements of the study and has agreed to participate they will be asked to complete the sugars FFQ. Following completion of the FFQ the student dietitian will collect a 24hr dietary recall capturing everything eaten and drunk during the previous 24 hours following a standard 3-
pass recall method. At the 2nd and 3rd interviews the student will collect a 24hr recall only. At the final interview the student will administer the sugar intake questionnaire only.

Interviews will be held in the participants home where possible which provides the opportunity for the interviewer to verify typical serving sizes, preparation methods and foods consumed, or at the Pukapuka Community Centre (23 Canning Cres, Mangere). The student has read the University of Otago guidelines on conducting research with Pacific peoples and will endeavour to adhere to culturally appropriate practices during all interviews. A community research assistant, Terito Ine, will act assist the student at early visits to establish relationships with volunteers in a culturally appropriate way.

Volunteers will receive a $10 supermarket voucher at the completion of each interview.

Reproducibility of the sugar questionnaire will be assessed by examining the correlation between sugars estimates derived from the questionnaires completed in weeks one and week. Validity will be assessed by examining the correlation between sugars estimates derived from the sugar questionnaire completed in week 4 and the mean usual sugars intakes estimated from the 24hr recalls.

9. Please disclose and discuss any potential problems: (For example: medical/legal problems, issues with disclosure, conflict of interest, etc)

If participants are interviewed in their own home measures to ensure the student’s safety during visits to volunteers homes will include pre and post interview contact with the supervising investigators (LTM and LM) and the maintenance of a detailed online visit diary (Google calendar). The student will not be expected to conduct any interview where they do not feel safe.

Applicant’s Signature: .................................................................

(Principal Applicant: as specified in Question 1, Must not be in the name of a student)

Signature of *Head of Department: .................................................................

Name of Signatory (please print): .................................................................

Date: .................................................................

Departmental approval: I have read this application and believe it to be scientifically and ethically sound. I approve the research design. The Research proposed in this application is compatible with the University of Otago policies and I give my consent for the application to be forwarded to the University of Otago Human Ethics Committee.

IMPORTANT: The completed form, together with copies of any Information Sheet, Consent Form and any recruitment advertisement for participants, should be forwarded to the Manager Academic Committees or the Academic Committees Assistant, Registry, as soon as the proposal has been considered and signed at departmental level. Forms can be sent hardcopy to Academic Committees, Room G23 or G24, Ground Floor, Clocktower Building, or scanned and emailed to gary.witte@otago.ac.nz.
Validation of a sugar screener for Pacific populations

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?

Excessive consumption of sugars such as Fructose has been shown to increase the onset of obesity and hypertension, factors which contribute to the metabolic syndrome. However, assessment of consumption is under-reported due to memory recall and personal bias. This can lead to inaccurate provision of recommendations for sugars intake. This research aims to develop a simple, paper-based dietary questionnaire for assessing the intakes of different types and sources of sugars by Māori people. The dietary questionnaire will help to determine whether high sugar intakes are related to increased health risks.

What Type of Participants are being sought?

We are looking for approximately 60 Pacific volunteers who are willing to talk to about the foods and drinks they usually eat with a University of Otago student dietitian. At the end of the study volunteers will have the opportunity to talk to the student and ask questions about healthy eating.

What will Participants be Asked to Do?

Should you agree to take part in this project, you will be asked to participate in 4 interviews with the student dietitian over a one month period. These interviews will take place in your own home or, if you prefer, we will arrange the interviews to take place at the Pukapuka Community Centre in Canning Cres. At the first interview you will be asked to answer a questionnaire asking about how often you eat different sorts of foods and drinks. Following this the student will collect information about everything you ate and drank the day before. You will be asked questions about what foods you ate and at what time, what was the size of your food servings, what brands of products you used, and how you cooked your food. The total amount of time you spend with the student at each interview session could be up to 1.5 hours. If it is okay with you the student may ask to record the interview. You will receive a $10 supermarket voucher at the completion of each interview.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind. At the second and third interviews the student dietitian will again record
information about everything you ate and drank the day before. At the last interview the student will just ask you to fill in the simple questionnaire again.

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

We will only collect data about your diet and your responses to the food questionnaire and some general information about you age, occupation and living arrangements. We will not collect any personal information that could be used to identify you unless you would like us to send you further information or an analysis of your diet.

The data collected will be securely stored in such a way that only those mentioned below will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

The student will prepare a written report on the findings of the interviews. You will not identifiable in this report. The report will be used to help us to develop a questionnaire that can reliably measure sugar intakes in Pacific populations so that we can find out if eating too much sugar increases the chance of developing diseases like gout, diabetes and heart disease.

This project involves an open-questioning technique. The general line of questioning includes your opinions on the sugar questionnaire, and questions relating to what you ate and drank during the previous day including the types, amounts and brands of foods, portion sizes, sauces and condiments added to foods, and how you cooked your food. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops. In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable you are reminded of your right to decline to answer any particular question(s) and also that you may withdraw from the project at any stage without any disadvantage to yourself of any kind.

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

You may withdraw from participating in the project at any time and without any disadvantage to yourself in any way.

**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:-

*Petra Teufl*  
Department of Human Nutrition  
Add contact phone number 021 0427 283  
student@student.otago.ac.nz

*Dr. Lisa Te Morenga*  
Department of Human Nutrition  
Add contact phone number 021 0427 283  
lisa.temorenga@otago.ac.nz

This study has been approved by the Department stated above. 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.
Development and validation of a sugar screener for Pacific populations

CONSENT FORM FOR PARTICIPANTS

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

I know that:-

1. My participation in the project is entirely voluntary;

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

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

4. This project involves an open-questioning technique. The general line of questioning includes your opinions on the sugar questionnaire, and questions relating to what you ate and drank during the previous day including the types, amounts and brands of foods, portion sizes, sauces and condiments added to foods, and how you cooked your food. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops.

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

I agree to take part in this project.

................................................................. ..............................................
(Signature of participant) (Date)
Notes concerning Category B Reporting Sheets

1. This form should **only be used** for proposals which are **Category B** as defined in the policy document "Policy on ethical practices in research and teaching involving human participants", and which may therefore be properly considered and approved at departmental level;

2. A proposal can only be classified as Category B if **NONE** of the following is involved:
   - Personal information - any information about an individual who may be identifiable from the data once it has been recorded in some lasting and usable format, or from any completed research; *(Note: this does not include information such as names, addresses, telephone numbers, or other contact details needed for a limited time for practical purposes but which is unlinked to research data and destroyed once the details are no longer needed)*
   - The taking or handling of any form of tissue or fluid sample from humans or cadavers;
   - Any form of physical or psychological stress;
   - Situations which might place the safety of participants or researchers at any risk;
   - The administration or restriction of food, fluid or a drug to a participant;
   - A potential conflict between the applicant’s activities as a researcher, clinician or teacher and their interests as a professional or private individual;
   - The participation of minors or other vulnerable individuals;
   - Any form of deception which might threaten an individual's emotional or psychological well-being.
   - The research is being undertaken overseas by students.

   [If any of the above is involved, then the proposal is Category A, and must be submitted in full to the University of Otago Human Ethics Committee using the standard Category A application form, and before the teaching or research commences];

3. Please ensure the Consent Form, Information Sheet and Advertisement have been carefully proofread; the institution as a whole is likely to be judged by them;

4. A Category B proposal may commence as soon as departmental approval has been obtained. No correspondence will be received back from the University of Otago Human Ethics Committee concerning this Reporting Sheet **unless the Committee has concerns**;

5. Please submit a Category B Reporting Sheet immediately after it has been signed by the Head of Department to the Human Ethics Committee:

   Manager,
   Academic Committees
   Academic Services
   Room G23, Clocktower Building
   University of Otago
   gary.witte@otago.ac.nz
Appendix C: Informed Consent Sheet
Validation of a sugar screener for Pacific populations

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?

Excessive consumption of sugars such as Fructose has been shown to increase the onset of obesity and hypertension, factors which contribute to the metabolic syndrome. However, assessment of consumption is under-reported due to memory recall and personal bias. This can lead to inaccurate provision of recommendations for sugars intake. This research aims to develop a simple, paper-based dietary questionnaire for assessing the intakes of different types and sources of sugars by Pacific people. The dietary questionnaire will help to determine whether high sugar intakes are related to increased health risks.

What Type of Participants are being sought?

We are looking for approximately 35 Pacific Island volunteers who are currently living in the South Auckland area who are willing to talk to about the foods and drinks they usually eat with a University of Otago student dietitian. At the end of the study volunteers will have the opportunity to talk to the student and ask questions about healthy eating.

What will Participants be Asked to Do?

Should you agree to take part in this project, you will be asked to participate in 4 interviews with the student dietitian over a one month period. These interviews will take place at your local community centre or if you prefer, in your own home. At the first interview, after an introduction, you will be asked to answer a questionnaire asking about how often you eat different sorts of foods and drinks. Following this the student will collect information about everything you ate and drank the day before. You will be asked questions about what foods you ate and at what time, what was the size of your food servings, what brands of products you used, and how you cooked your food. The total amount of time you spend with the student at each interview session could be up to 1.5 hours. If it is okay with you the student may ask to record the interview. You will receive a $10 supermarket voucher at the completion of each interview.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind. At the second and third interviews the student dietitian will again record
information about everything you ate and drank the day before. At the last interview the student will just ask you to fill in the simple questionnaire again.

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

We will only collect data about your diet and your responses to the food questionnaire and some general information about you age, occupation and living arrangements. We will not collect any personal information that could be used to identify you unless you would like us to send you further information or an analysis of your diet.

The data collected will be securely stored in such a way that only those mentioned below will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

The student will prepare a written report on the findings of the interviews. You will not identifiable in this report. The report will be used to help us to develop a questionnaire that can reliably measure sugar intakes in Pacific populations so that we can find out if eating too much sugar increases the chance of developing diseases like gout, diabetes and heart disease.

This project involves an open-questioning technique. The general line of questioning includes your opinions on the sugar questionnaire, and questions relating to what you ate and drank during the previous day including the types, amounts and brands of foods, portion sizes, sauces and condiments added to foods, and how you cooked your food. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops. In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable you are reminded of your right to decline to answer any particular question(s) and also that you may withdraw from the project at any stage without any disadvantage to yourself of any kind.

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

You may withdraw from participating in the project at any time and without any disadvantage to yourself in any way.

**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:-

Olivia Boniface and/or Dr. Lisa Te Morenga
Department of Human Nutrition  Department of Human Nutrition
021 234 3157  021 0427 283
bonol113@student.otago.ac.nz  lisa.temorenga@otago.ac.nz

This study has been approved by the Department stated above. 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.
Development and validation of a sugar screener for Pukapukan populations

CONSENT FORM FOR PARTICIPANTS

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

I know that:-

1. My participation in the project is entirely voluntary;
2. I am free to withdraw from the project at any time without any disadvantage;
3. Personal identifying information including audio recordings will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for at least five years;
4. This project involves an open-questioning technique. The general line of questioning includes your opinions on the sugar questionnaire, and questions relating to what you ate and drank during the previous day including the types, amounts and brands of foods, portion sizes, sauces and condiments added to foods, and how you cooked your food. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops.
5. The results of the project may be published and available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve my anonymity.

I agree to take part in this project.

..................................................................................  ......................................
(Signature of participant)  (Date)
Appendix D: Contact Form
Contact Details Form

Name:____________________________________________________________

Gender (please circle):  male    /     female

Date of Birth: ______________________________________

Address:__________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

Contact Number: ____________________________(home)

______________________________(mobile)

______________________________(work)

Email address: ____________________________________________________

Where would you prefer to have your interviews (this can change each time if you like):

How would you prefer to be contacted (please circle):

Email   /   Text   /  Phone call

(For study staff use only)

Appointment 1 (1st FFQ and 24hr recall):
Date: ___________________________ (weekday/weekend)  Time:
Voucher given: yes / no
Notes:

Appointment 2 (2nd 24hr recall):
Date: ___________________________ (weekday/weekend)  Time:
Voucher given: yes / no
Notes:

Appointment 3 (3rd 24hr recall):
Date: ___________________________ (weekday/weekend)  Time:
Voucher given: yes / no
Notes:

Appointment 4 (2nd FFQ):
Date: ___________________________ (weekday/weekend)  Time:
Voucher given: yes / no
Notes:
Appendix E: Demographic Questionnaire
A few questions about yourself

1. Are you?
   □ Male □ Female

2. Your present age: ______ years

3. Which ethnic group(s) do you belong to? (Mark the circles that apply to you)
   □ New Zealand European
   □ Māori (specify Iwi: ____________________________)
   □ Pukapuka Islander
   □ Cook Island Māori
   □ Samoan
   □ Tongan
   □ Niuean
   □ Chinese
   □ Indian
   □ Other (such as Dutch, Japanese, Tokelauan). Please State: _______________

4. What is your highest educational qualification? (mark ONE only)
   □ No high school (secondary school) qualification
   □ School Certificate or Sixth Form Certificate (National Certificate Level 1 or 2)
   □ University Entrance/Bursary or Higher School Certificate (completed 7th form)
   □ Technical/trade school or polytechnic diploma (at least 3 months of full-time study)
   □ University degree/diploma

5. What is your usual occupation? (If retired, state occupation before retirement.)
   ____________________________________________________________________

6. What is your current employment situation? (mark ONE only)
   □ Employed, full time □ Student
   □ Employed, part time □ Homemaker
   □ Self-employed □ Unemployed
   □ Retired □ Other: (please specify)______________________________


   Age of children:
   □ 0-5 years □ 6-10 years □ 11-15 years □ 16+ years

9. Have you ever been told by a doctor that you have (mark all that apply)
   □ High blood pressure
   □ High cholesterol
   □ Heart disease or angina
   □ Diabetes (other than during pregnancy): Type 1 or Type 2 (Please circle)
   □ Cancer
   □ Gout
   □ Asthma
   □ Sleep apnea
None of the above

Thank you!