Validation of a Food Frequency Questionnaire assessing the sugar intakes of Pacific Islanders in Auckland, New Zealand

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1 Abstract

Background: Evidence linking fructose intakes to gout, type 2 diabetes and obesity is growing. This is of particular interest in Pacific people who have higher rates of these diseases compared to other ethnic groups in New Zealand. Research to examine the links between sugar and non-communicable diseases in the Pacific population is limited, however, by lack of a validated, culturally appropriate instrument to assess sugar intakes in this group.

Objective: To test the relative validity and reliability of a Food Frequency Questionnaire (FFQ) designed to measure usual sugar intakes in Pacific Islanders living in Auckland, New Zealand.

Methods: 90 Pacific Island participants were recruited over three phases during 2013 and 2014 from the Auckland region. Participants took part in four dietary assessment interviews over four weeks: the sugars FFQ was administered in weeks one and four. Three 24-hour recalls were administered in weeks one, two and three. Validity of the sugars FFQ for assessing sugar intakes from various food categories was assessed by cross classification agreement, Kappa scores, Spearman’s and intraclass correlation coefficients and Bland-Altman tests of agreement with mean 24-hour recall intakes. Reliability was assessed by intraclass correlation coefficients comparing sugar intakes estimated from the two sugars FFQ administrations.
**Results:** Relative validity of the sugars FFQ was moderate-good. Correct classification into the same or adjacent quartiles for sugars intakes from all sources and from sugar sweetened beverages (SSB) were 86% and 91%, respectively, and Kappa scores for both categories were 0.54, indicating moderate agreement. Intraclass correlation coefficients were 0.81 and 0.86 and Spearman’s correlation coefficients were between 0.65 and 0.74, respectively. Sugar intakes from fresh and canned fruit showed less reliability with 76-80% correctly classified into the same or adjacent quartiles and Kappa scores of 0.25-0.33 indicating fair agreement. Bland-Altman analysis indicated good agreement at the group level for total sugars; fructose and glucose intakes from all sources however the wide limits of agreement from all sugar intakes indicating poor agreement at the individual level. For servings of fruit 88% of participants were correctly classified into the same or adjacent quartiles and Spearman’s and intraclass correlation coefficients were 0.5 and 0.68, respectively. Reproducibility of the sugars FFQ was good with intraclass correlation coefficients over 0.7 for sugar intakes from all categories.

**Conclusion:** The relative validity and repeatability of the sugars FFQ in Pacific populations was good and comparable with (or better than) other validated FFQs assessing sugars intakes. The sugars FFQ could be used to identify high, moderate and low sugar consumers in large population studies conducted amongst Pacific populations.
Preface

This study was carried out in Auckland through the Department of Human Nutrition, University of Otago, Dunedin, New Zealand. It is part of a project that has been running for two years involving three Master of Dietetics students. In 2013 Petra Teufl and Olivia Boniface designed and pretested the sugars FFQ for Pacific people, developed the FFQ intake calculation spreadsheet and carried out validation of the sugars FFQ in 68 participants predominately from the Pukapukan community in South Auckland. In 2014 I continued this validation in 22 participants from the wider Pacific community in Auckland and I adapted the sugars FFQ spreadsheet to capture additional information on sugar intakes in food group categories and fruit intakes and re-analysed the dietary records and sugars FFQs collected in 2013.

In this thesis the final findings of this validation study, including a total of 90 subjects, are presented.

My supervisor Dr Lisa Te Morenga was responsible for the concept and overall study design.

The candidate was responsible for:

- Printing sugar FFQs, 24-hour recall templates and all other documentation
- Purchasing supermarket vouchers for participants
- Advertising, recruitment and co-ordinating interviews for data collection with participants in Auckland

- Entering three sets of diet recalls for 22 participants into Kaiculator

- Data entry for 22 participants’ first and second sugars FFQs

- Reanalysis of previous participants’ dietary data
Acknowledgements

I dedicate this thesis to my Nana and Poppa who continue to be an inspiration to me each and every day, I miss you both dearly.

Dr Lisa Te Morenga who has been an outstanding supervisor, providing helpful and constructive advice, wonderful insights and great inspiration. I have learnt so much about research, scientific writing and nutrition from you and am thankful for this. I have thoroughly enjoyed our conversations and could not have completed this project without your knowledge, experience and support. Thank you to the University of Otago for your financial help in completing this project.

A big thank you to Liz Flemming for the skype calls and answering all my Kaiculator related questions. I appreciate the time and effort you put into helping me and going the extra mile to solve issues I had with Kaiculator.

Thank you to Jill Hazard for completing the statistical analysis for this project. I am grateful for your expertise in this area and the time you spend carrying out the analysis and explaining it to me.

Petra and Olivia thank you for the data you collected last year and for the sugars FFQ and other sheets you developed and pre-tested. I could not have completed this thesis without the work you both did last year.

A special thanks to my family and friends from New Zealand and around the world who have been a great source of support and encouragement
throughout this thesis project. Thanks for your prayers, the laughs you have provided me with and for your continual love.

To my Dietetic classmates, thank you for being on this journey with me it is always encouraging to know that other people are going through the same things. A special mention to Group 5 for all the great times and support last year.

One group of people who this project would be nothing without is all the amazing participants. Thank you for giving up your time and welcoming me into your homes. I have learnt so much through you, Fa’afetai.

Last but not least thanks goes to my creator, my ultimate source of encouragement and strength. Thank you God for giving me the passion and gifts to peruse Dietetics may this thesis and all that I do in life bring glory to your name.
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1 Introduction

Pacific Islanders face a higher burden of disease compared to other ethnicities (1). This is evident by the prevalence of diabetes being 3 times higher, gout 5 times higher, high blood pressure 1.4 times higher and obesity 2.5 times higher in the Pacific population (1, 2). The cause of these higher prevalences is likely to be multi-factorial, although there is some evidence that free sugar intakes (defined as all monosaccharides and disaccharides added to foods by the manufacturer, cook, or consumer; sugars naturally present in honey, syrups, and fruit juices) (3), particularly fructose, have been associated with an increased risk of non-communicable diseases including type 2 diabetes, metabolic syndrome and gout (4). Gout itself has also been associated with the development of diabetes and this association is especially common in Pacific people. Elevated uric acid levels which can result in gout in some individuals, have also been reported to predict the development of metabolic syndrome (4, 5). Pacific populations now have one of the highest rates of both obesity and type 2 diabetes, however before the introduction of the high sugar, high fat western diets, obesity and type 2 diabetes were relatively unknown (6, 7), thus it is of interest to examine the role of sugar intakes from various food sources in the etiology of non-communicable diseases in Pacific people.

Fructose is a monosaccharide found in high fructose corn syrup and is part of the disaccharide sucrose. The major sources of fructose in the New
Zealand diet are fruit, and sugar (sucrose) sweetened foods and drinks (8). In the 2008/2009 Adult Nutrition Survey (ANS) non-alcoholic beverages accounted for the greatest intake of total sugars for Pacific Islanders, 24% and 20% for males and females, respectively. The other major contributors to total sugar intake were sugar and sweets (18% and 17%), fruit (13% and 19%) and milk (7% and 8%) for Pacific Island males and females, respectively (8). ANS findings report that Pacific Islanders have lower total sugar intakes than the total population (8); however a higher percentage of their total sugar intake comes from non-alcoholic beverages and sugar and sweets and a lower percentage from nutrient-dense fruit and milk products compared to the total population (8).

There has been limited research specifically examining the effect of sugar intakes on the risk of developing diabetes, gout, high blood pressure and obesity in Pacific populations. It is difficult to accurately estimate sugar intakes in order to show relationships with disease thus a validated culturally appropriate FFQ for estimating sugar intakes in the Pacific Island population would enable such research in future.
2 Literature Review

2.1 Introduction
In this Literature Review I examine the evidence linking high sugar, specifically fructose intakes and serum uric acid (SUA) concentrations to determine whether high free sugar intakes in Pacific populations is a plausible explanation for the increased risk of non-communicable diseases that have been linked with raised serum uric acid. The difficulty of accurate dietary assessment of free sugar intakes in this population and Pacific Islanders current sugar intakes are also discussed in this Literature Review.

2.2 Fructose and Serum Uric Acid (SUA)
A number of studies have investigated the relationship between dietary fructose intake and SUA; key studies are summarised in Table 2.1. The proposed mechanism of how fructose could increase SUA is that high fructose intakes induce uric acid synthesis by increasing ATP degradation to AMP (a uric acid precursor) during hepatic metabolism (4). This has lead to the hypothesis that high fructose intakes could result in raised SUA levels.

Cross-sectional studies examining the link between fructose and SUA have been inconsistent in their findings (9, 10). Choi et al. conducted a cross-sectional study in the USA with 14,761 people from the NHANES III study (Table 2.1) (9). An FFQ was administered assessing sugar sweetened soft drinks (SSSD) as they contain large amounts of fructose. The FFQ also
assessed diet soft drink intake and orange juice consumption. Choi et al. found that SUA increased with increasing SSSD intake but no association was seen between diet soft drink intake and SUA (9). Choi et al. also analysed an additional survey that estimated total fructose intake through a 24-hour dietary recalls completed by a sub group of the NHANES III study population to estimate usual dietary intake in a sample of older subjects (>50 years). There were 2,570 participants in this sub population. SUA levels were significantly higher in participants consuming 10-49.9 g/d, 50-74.9g/d or >75g/d of total fructose than those consuming under 10 g/d of fructose. Multivariate odds ratios for hyperuricemia were 1.03, 2.05 and 4.11, respectively with a significant p for trend (9). In contrast a cross-sectional study by Zgaga et al. involving 2037 people in the United Kingdom (UK) did not find an association between total fructose intake and SUA levels after adjusting the analyses for energy intake (Table 2.1) (10). A 150 item semi-quantitative FFQ was administered to assess the intake of dairy products, meat and sugar sweetened beverages, calcium and fructose over the past year. This is similar to how Choi et al. measured SSSD intakes however Choi et al. measured total fructose intake through a 24-hour dietary recall and did not correct for energy intake. In Zgaga et al. the average total fructose intake was 56 g/day. Choi et al. reported significant increases in SUA with fructose intakes of more than 10 g/day. The reason for this discrepancy in findings by the two groups (9, 10) is not clear but it could be due to factors including the different dietary assessment methods used in the studies to estimate fructose intakes and different adjustments.
made or differences in food compositions in the US and the UK. For example high fructose corn syrup is used more widely in the US. In addition there may have been insufficient contrast between high and low fructose consumers to see an effect in the Zgaga et al. study. Nevertheless Zgaga et al. did find a significant association between SSSD consumption and SUA (as did Choi et al.) but made the observation that it is difficult to determine if it is compound(s) present in SSSD that cause increases in SUA or whether SSSD are a marker of an “unhealthy” diet and lifestyle (10). As these studies are both cross-sectional no causal link can be made from their results as confounders and other factors could affect the results.

A number of controlled feeding studies using fructose have been carried out in animals and humans, to directly examine the mechanisms through which fructose may influence metabolism. It is clear from these studies that high fructose feeding raises SUA relatively quickly, however the fructose levels tested are typically well beyond levels normally consumed. A crossover study with three males subjects who consumed 250-290 g of fructose throughout the day for 12 days saw greater and significant increases in SUA than after consumption of the same amount of glucose (11). Another study administered 1g of fructose per kilogram of body weight orally with water to 6 subjects with gout, 6 without gout and 5 with gouty parents. After fructose ingestion, changes in the extent and duration of raised SUA levels were significantly different in gouty patients and children of gouty parents compared to non gouty subjects (12). Similar results were observed in a study by Fox et al. Four gouty patients received
infusions of 0.5 g of fructose per kilogram in a solution over 10 minutes, resulting in a 33% increase in SUA thirty minutes after the infusion (13). The amounts of fructose used e.g. 250 g/day and mode of delivery (i.e intravenous infusions) used in these studies are not representative of how the general population consumes fructose. Therefore results from these studies provide information about the mechanisms through which fructose may influence health but on their own do not provide sufficient evidence to justify public health measures regarding fructose reduction.

Stronger evidence of association is provided in randomised control trials (RCT) where potentially confounding factors can be controlled. A RCT by Perez-Pozo et al. aimed to test the hypothesis that in 40-65 year old men excessive fructose intake can induce features of metabolic syndrome. Seventy four participants were fed 200 g of fructose in two litres of sweetened drink each day for two weeks with half the group also receiving allopurinol, a urate lowering drug (Table 2.1). There was a significant 21% increase in SUA in the fructose only group, but in the group also receiving allopurinol there was a 31% decrease in SUA from baseline (14). The difference between treatments was statistically significant. However as this study was carried out over a short period of time and large amounts of fructose was given to participants we cannot be certain if these effects would be observed in the long term and at the population level if given typical fructose intakes. Wang et al. conducted a systematic review and meta-analysis of all the RCTs investigating the effect of fructose feeding on SUA under different dietary conditions (Table 2.1). In isocaloric trials when
Fructose was exchanged for other carbohydrates, in some cases sucrose, no increase in SUA was seen (15). As sucrose is composed of fructose and glucose the findings of this meta-analysis should be interpreted with caution. However two short term RCTs in men involving hypercaloric supplementation of fructose with amounts in excess of 35% of energy intake (213-219 g/d) were shown to significantly increase SUA levels compared to isocaloric control diets (15). Wang et al. propose that excess energy intake along with fructose consumption could increase SUA. As associations were only shown when excess energy as fructose was consumed these studies may not be relevant to free-living people consuming typical diets, but they could be of relevance to population groups with high energy and fructose intakes e.g. adolescents.

A systematic review by Livesey found that fructose’s effect of increasing SUA was only shown in studies with fructose intakes greater than 200 g/day, which is much higher than the average person’s intake of fructose (16). Livesey estimates that over 95% of Americans above the age of 19 consume less than 100 g fructose a day from all sources, based on data from nationally representative surveys (16) although the extent to which these intake estimates are influenced by underreporting which often occurs in population surveys is unknown (17). Therefore studies testing such high fructose intakes may have only minor relevance to adult public health.
In summary there is clearly some effect of fructose on SUA but the evidence has limitations. One limitation is the differing amounts of fructose administered in RCTs e.g. 200 g/d and amounts associations with SSSD are reported in cross-sectional studies e.g. 0.5 serves/d. This makes it difficult to compare studies and extrapolate the data to the general population; therefore it is challenging to determine the intakes of fructose over which clinically meaningful increases in SUA are observed and if it has relevance to the general population. The literature suggests fructose when consumed in high doses raises SUA.
<table>
<thead>
<tr>
<th>Author</th>
<th>Study Design</th>
<th>Participants</th>
<th>Length of study</th>
<th>Findings</th>
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<tr>
<td>Choi et al. (9)</td>
<td>Cross-sectional study in USA</td>
<td>SSSD: n= 14,761 53% female Mean age: 45 Fructose intakes: n=2,570 all 50 years and over</td>
<td>n/a</td>
<td>SSSD intake is associated with SUA levels. SUA levels were significantly higher in those who consumed over 10 g/day of fructose.</td>
</tr>
<tr>
<td>Zgaga et al. (10)</td>
<td>Cross-sectional study in Scotland, UK</td>
<td>n=2037 44% female Average age: 62 99% White Caucasians</td>
<td>n/a</td>
<td>An association was seen between SUA and SSSD consumption. No association between fructose intake and SUA was seen.</td>
</tr>
<tr>
<td>Perez-Pozo et al. (14)</td>
<td>Randomised Control Trial in Spain</td>
<td>n=74 All men 40-65 years old</td>
<td>2 weeks</td>
<td>A significant increase of 21% in SUA in the fructose only group (200g/d for 2 weeks) was seen, and a 31% decrease in SUA was seen in the group receiving the urate lowering drug.</td>
</tr>
<tr>
<td>Wang et al. (15)</td>
<td>Systematic Review</td>
<td>21 trials, n=425 Hypercaloric trials: n= 35 All males Mean age:24</td>
<td>Only 5 trials went for &gt;5 weeks</td>
<td>Isocaloric exchange of fructose for other carbohydrate had no effect on SUA. Hypercaloric supplementation with fructose as excess energy significantly increased SUA</td>
</tr>
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2.3 Gout and SUA

Hyperuricemia is the key predictor for gout (2), even though gout occurs only in a fraction (under 5%) of people with hyperuricaemia, Maori and Pacific Island people have a 5 times increased risk of gout (2). Merriman et al. report that renal excretion of uric acid is heritable and postulate that if fructose does raise SUA this would be exacerbated in people who have genetic variants that reduce renal uric acid excretion such as Pacific Islanders thus increasing their risk of gout (2). Since fructose has been proposed as a risk factor for hyperuricemia, sugar intakes of Pacific Islanders could contribute to their high prevalence of gout. Associations have been seen between SUA and fructose intake (9, 18). In a cross sectional study SUA levels were observed to be 0.4mg/dl higher in extreme categories of SSSD intake (≥4 servings/d) compared to 0 servings/d; a clinically relevant difference (9). Choi et al. reported findings from a prospective cohort study that an increased intake of SSSD and fruit juice was associated with increased risk of gout (18). The multivariate relative risks for gout from SSSD intakes of 5-6 servings/week, 1 serving/day and ≥2 servings/day were 1.29, 1.45 and 1.85, respectively. This association was not observed however for diet soft drink consumption (18). Dessein et al. carried out an observational “before and after” weight loss and calorie restriction pilot study to examine if an intervention to reduce insulin resistance would also have SUA lowering effects in people with gout (19). For 16 weeks 13 men restricted their total dietary intake to 6690 kJ (1600 kcal) a day with 40% derived from carbohydrate, 30% from protein, and
30% from fat. Subjects replaced refined carbohydrates with complex ones (thereby lowering sugar intakes) and replaced saturated fats with mono- and polyunsaturated fats. A 67% decrease in frequency of gout attacks on average and weight loss was observed in all bar one participant, and on average a 18% decrease in SUA was observed after four months of intervention (19). As more than one macronutrient was altered in the diets and weight loss occurred, the effect on SUA and gout attacks cannot be attributed to any specific macronutrient or fructose.

In conclusion there is some suggestion of an association between fructose intake and gout. However longer duration studies and RCTs are needed before a causal link between fructose intake and gout can be confirmed. Studies carried out specifically in people of Pacific Island ethnicities are needed to identify the most appropriate approaches for preventing and treating gout amongst this high risk group.

2.4 Sugar, SUA and cardio-metabolic factors

Elevated SUA levels have been linked to increased cardio metabolic risk. A New Zealand epidemiological study by Stamp et al. had 751 participants (495 Maori, 256 non-Maori) between the ages of 20-64 who were randomly selected from the electoral roll. Stamp et al. found that SUA increased with the number of components of metabolic syndrome present in subjects (20). Stamp et al. also found hyperuricaemia was associated with increased cardiovascular mortality amongst those at risk of coronary heart disease (20). This association is indirectly supported by the findings
of a RCT by Perez-Pozo et al. that found ingestion of 200 g/day of fructose over two weeks significantly increased blood pressure. However consuming fructose in conjunction with taking allopurinol (a urate lowering drug) resulted in a significant decrease in 24-hour diastolic blood pressure and a decrease in daytime blood pressure (Table 2.2) (14). Te Morenga et al. conducted a meta-analysis and systematic review of RCTs examining the effects of dietary sugars on blood pressure and lipids (Table 2.2). They observed diets higher in sugar were associated with increased concentrations of triglycerides, total and LDL cholesterol, and diastolic blood pressure compared to lower sugar diets (21). Stronger associations were seen for blood pressure when higher sugar intakes resulted in higher body weights at the end of the studies (21). This corresponds with findings of a systematic review and meta-analysis by Wang et al. as when fructose was consumed in excess of energy requirements in two hypercaloric RCTs increases in SUA were observed (15). A systematic review and meta-analysis of RCTs and cohort studies examining the effect of dietary sugars on body weight reported intake of free sugars is a significant determinant of body weight, a cardio-metabolic risk factor (22). Contrary to these results a systematic review and meta-analysis by Ha et al. examined the effect of fructose on blood pressure in controlled feeding trials. Ha et al. reported that isocaloric exchange of fructose for other carbohydrates (some trials used glucose or sucrose) decreased diastolic blood pressure but had no effect on systolic blood pressure (Table 2.2) (23). Since the majority of the studies included in these meta-analyses were of relatively
short duration and had small sample sizes, longer and larger studies are required to confirm these results. The literature is suggestive of an effect of sugar and fructose on blood pressure and other cardio metabolic factors but the effects are stronger in hypercaloric studies which could be due to excessive calorie intake.

Table 2.2 Studies examining the effect of sugar and fructose on cardio-metabolic factors

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<tr>
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<th>Participants</th>
<th>Length</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perez-Pozo et al. (14)</td>
<td>Randomised Control Trial in Spain</td>
<td>n=74 All men 40-65 years old</td>
<td>2 weeks</td>
<td>Fructose significantly increased blood pressure and in the allopurinol group diastolic blood pressure significantly decreased as did daytime blood pressure.</td>
</tr>
<tr>
<td>Te Morenga et al. (21)</td>
<td>Meta-analysis and Systematic Review</td>
<td>40 trials 39-Lipids 12-Blood pressure n=1699</td>
<td>All trials over 2 weeks, most &gt; 8 weeks</td>
<td>Diets higher in sugar had significantly increased concentrations of triglycerides, total and LDL cholesterol and blood pressure compared to lower sugar diets.</td>
</tr>
<tr>
<td>Ha et al. (23)</td>
<td>Meta-analysis and Systematic Review</td>
<td>15 trials (2 of which were hypercaloric) n = 376</td>
<td>Median follow up: 4 weeks</td>
<td>Isocaloric exchange of fructose for other carbohydrates decreased diastolic blood pressure but had no effect on systolic blood pressure.</td>
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2.5 Accuracy of sugar intakes in Pacific Island populations

While there is some evidence that suggests high sugar intakes are implicated as a determinant of SUA, gout and cardio-metabolic factors, best evidence suggest sugar intakes are not particularly high at the population level in New Zealand. The most recent report of sugar intakes in the Pacific population in New Zealand is found in the ANS 08/09. There were no significant differences between total sugar intake in Pacific and non-Pacific adults, the mean daily intakes of fructose for Pacific Island males and females were 22 g and 19 g, respectively compared with the total population mean daily intake of 23 g and 20 g, respectively (8). These intakes are substantially lower than the intakes examined in the aforementioned RCTs involving fructose amounts of over 200 g/d which resulted in increased SUA.

A limitation of the epidemiology of the effects of sugars on health outcomes relates to uncertainties regarding estimates of sugars intakes, which are difficult to measure and typically underreported (24). Dietary assessment can also be problematic in low-income populations such as Pacific Islanders (25, 26). Bingham et al. conducted a cross-sectional comparison between 404 obese (BMI >30 kg/m²) and 471 normal weight (BMI <25 kg/m²) individuals in the UK examining the relationship between self-reported dietary sugar intakes and urinary sugar excretion as an independent biomarker of sugar consumption. They found no significant relationships between urinary sugar biomarkers and self-reported sugar intakes in obese individuals although significant associations were seen in normal weight
individuals (27). Bingham et al. concluded that dietary reports of obese individuals are less reliable than those of normal weight individuals. As Pacific people are 2.5 times more likely to be obese compared to non Pacific people they may underreport dietary intakes (1). Bingham et al. was carried out in UK adults therefore we cannot be certain similar results would be observed in Pacific people living in New Zealand. If however the same results were observed this could obscure potential relationships between sugar and disease markers in Pacific populations. This reiterates the importance of using a validated dietary assessment tool when assessing intakes in this population.

ANS dietary data were collected using a conventional multiple pass 24 hour dietary method (24). Although this is an appropriate method for the ANS to use, the NHANES survey has adapted this method to include questioning subjects about their consumption of foods from a list of frequently forgotten foods. Validation studies indicate that this adapted method correlates better for energy intakes with gold standard methods (28). The 24-hour recall methodology comes with limitations that decrease its accuracy. It relies on participants correctly remembering all the foods and drinks they consumed the previous day including sugar containing items such as cakes, biscuits and sugar sweetened beverages which are commonly forgotten or under reported (24). Due to the aforementioned factors intakes reported in the ANS may not be accurate and are more than likely to be underestimates of actual intakes. Due to this we are uncertain of the amounts of sugar Pacific Islanders are actually consuming so before
sugar consumption can be linked to health outcomes, more accurate data on Pacific Islanders sugar intakes are required.

Information about the frequency of consuming various food groups was also collected in the ANS using a dietary habits questionnaire (24). Pacific males (45%) and females (31.7%) were significantly more likely to report drinking soft drinks or energy drinks three or more times a week than non-Pacific people (29). Soft drinks and energy drinks provide a major source of sucrose, which is likely to have contributed to the higher intakes of sucrose seen in the Pacific population in the ANS (8). This is of significance as sucrose contains fructose and therefore Pacific adults may be consuming more fructose than non Pacific adults.

Consequently, to determine the relationship between sugar intakes; SUA, gout and cardio-metabolic factors, a validated dietary assessment instrument to measure sugar intake in the Pacific population would be valuable.

2.6 Conclusion:
The New Zealand Pacific population has a higher prevalence of gout therefore it is of interest to examine whether excessive fructose intakes are associated with this higher prevalence. Patients with gout are also more likely to have metabolic syndrome, diabetes, cardiac disease and hypertension all of which have a high prevalence in Pacific populations (1, 20). There is a need to gather sound epidemiological evidence to show
whether sugar, specifically fructose intakes are an important determinant of non-communicable diseases in Pacific Island people.

The majority of studies measuring sugar intakes cited in this Literature Review have been carried out in overseas populations. Their results cannot be extrapolated to Pacific Island populations, and therefore we cannot be certain that their results will be replicated in Pacific populations. This identifies a gap in the literature as there are currently no studies that assess sugar intakes in Pacific populations and the affect this has on metabolic syndrome risk factors. A validated FFQ assessing sugar intakes in the Pacific population is needed before studies can be undertaken looking at the effects of sugar on health outcomes to establish whether sugar is a reasonable target of public health strategies in the Pacific population. However a limitation will be that the bias of dietary reports being less reliable in those who are obese will unlikely be addressed in this FFQ.
3 Objective Statement:

Currently minimal research is available on the effect of sugar intakes on Pacific Islanders’ health. An accurate tool is needed to assess sugar intakes in this population for research to be undertaken and no tool is available to our knowledge.

The aim of this study is to validate a culturally appropriate food frequency questionnaire designed to assess usual sugars intakes in Pacific Island populations, and to assess whether it can reliably rank subjects by intakes of total sugar, fructose, glucose and sucrose from all sources, sugar sweetened beverages and fresh and canned fruits.

- To determine the validity of the sugars FFQ to assess sugar intakes it will be compared to mean sugar intakes from three 5-step 24 hour dietary recalls collected over a three week period.
- To determine repeatability of the sugars FFQ it will be administered twice, with three weeks between each administration.
4 Subjects and Methods

This 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.

4.1 Sugars FFQ development

A sugar consumption questionnaire was developed, based on the format of the FOOD-FFQ (Food Options of Dunedinites) (30) and tested for suitability in a Maori population during a summer studentship in 2012/2013. In 2013 the sugar consumption questionnaire was further developed and pre-tested in a study by a previous Master of Dietetics student to form the sugars FFQ (Appendix A). The questionnaire was subsequently adapted for use in the Auckland Pukapukan community. The FFQ was modified to include important sugar containing food and beverages in the Pukapuka South Auckland population. These were identified through investigating local food outlets and supermarkets in Mangere, South Auckland and observations of the target audience at the Pukapuka Community Centre. A conventional closed-questioning version and a simplified open-questioning version of the sugars FFQ was pre-tested on a sample of 10 members of the Auckland Pukapukan community using cognitive interviewing. Based on pre-testing feedback modifications were made to the sugars FFQ and the open-ended version of the sugars FFQ was selected to be validated.
The sugars FFQ was designed to assess usual sugar intake over the past month in Pacific Islanders living in Auckland. It contains questions pertaining to 33 items of sugar-containing foods and beverages. The sugars FFQ was altered minimally from the previous study to include a range of Pacific Island greetings and to replace Pukapukan language with Samoan language to account for the wider range of Pacific Island ethnicities targeted in this study compared with previous validation work. These changes did not affect the questions pertaining to dietary intakes.

4.2 Recruitment

A total of 90 Pacific participants were recruited by three Master of Dietetics students for the complete validation study. In 2013 fifty eight participants were recruited from the Pukapuka Cook Island community in Mangere, Auckland by word-of-mouth and face-to-face approaches with the support of leaders and influential members of the Pukapukan community.

In 2013 and 2014 thirty two participants were recruited from the wider Pacific population residing in Auckland via networks of a Pacific Dietitian, word of mouth, social media, flyers provided to community groups e.g. Pasifikia Beats Playgroup, Diabetes Support group, Church and flyers distributed to Pacific Island AUT students. Sixty eight participants were recruited between 25th February 2013 and 4th September 2013 and an additional 22 participants were recruited between 4th August 2014 and 30th August 2014.
Eligibility for the study required participants to be of Pacific Island ethnicity, over 16 years of age and residing in the Auckland area for the following four weeks. Participants were excluded if they did not have sufficient English speaking skills to complete the questionnaire and the interviews or if they were unable to physically and mentally provide written informed consent.

4.3 Participant Interviews

Interviewers received training in counselling Pacific people as part of their MDiet training. In addition the interviewers reviewed the University of Otago Pacific research protocol document and sought guidance from Auckland-based Pacific Dietitians and leaders of community groups involved in the study.

Participants were interviewed once a week for four consecutive weeks at participants homes or other convenient locations e.g. cafes, gyms, playgroup, exercise group. At the first interview participants were provided with written and verbal information about the study, and what was required of participants, and consent was obtained (Appendix B). General demographic information was collected including gender, age, ethnicity, usual occupation, current employment situation, highest educational qualification, number of adults and children in the household and health status (Appendix C). Participants then completed the sugars FFQ following brief instructions. Help was offered if participants had any difficulties
completing the sugars FFQ. Following completion of the sugars FFQ a 24-hour dietary recall interview was completed. Subsequent 24-hour recalls were carried out at the second and third interviews. Where possible the three 24-hour recall interviews were conducted on different days of the week including one weekend day. At the fourth interview participants completed the sugars FFQ for the second time to test the reproducibility of the sugars FFQ and to capture the dietary intake measured by the three 24-hour recalls. Participants were given a $10 supermarket voucher after each interview as a token of appreciation for helping out with the study.

4.4 Dietary recall reference method

24-hour recalls were selected as the reference method over weighed food record as they are considered more appropriate for collecting accurate data in populations with low literacy and income levels, such as Pacific groups in New Zealand (25, 26, 31, 32). Three 24-hour recalls were carried out in this study as Ma et al. found three to be the optimal number of recalls needed to assess intake (33).

The USDA 5 step multiple-pass 24-hour dietary recall method was used (34). This method has been shown to improve accuracy of reported intakes as it involves probing for intake of frequently forgotten foods by way of neutral questions (28, 34, 35). The 24-hour recall procedure involved the following steps; 1) participants were asked to list any food or drink they consumed the day before; 2) participants were asked about consumption of nine commonly forgotten foods (alcoholic drinks, non-alcoholic drinks,
fruit, vegetables, breads/rolls, cheese, sweet snacks, savoury snacks and any other foods or drinks they could remember); 3) timings and names of eating occasions was collected; 4) details of amounts, brands, types of food and drinks, cooking methods and sources of foods and drinks was collected and each eating occasion and intervals in between occasions were reviewed to elicit any additional recall; 5) reporting of small amounts of food or drink was encouraged and participants were asked if they could remember any additional food or drink consumed the day before. Coloured photographs of food models were used along with measuring cups and spoons to help participants gauge quantities of foods consumed.

4.5 Data analysis

4.5.1 Food Frequency Questionnaire
The sugars FFQ data was entered into a Microsoft Excel spreadsheet (developed by a previous Master of Dietetics student) to estimate usual intake of fructose, sucrose, glucose and total sugar. The spreadsheet allowed fructose, sucrose, glucose and total sugar intakes from dried fruit, fresh and canned fruit and fruit juice to be calculated. Total fructose intakes were estimated as the total of the free fructose content in each food or drink item. To obtain daily sugar intakes per item from the spreadsheet the reported frequency of consumption of food and drink items was multiplied by their nutrient profile. All the daily sugar intakes per item were added together to estimate participants daily sugar intake from the previous month. The spreadsheet also calculated sugar intakes from specific sources.
of food and drink e.g. sugar-sweetened beverages, dried fruit, fresh and canned fruit and fruit juice.

The nutrient profile of food items in the sugars FFQ spreadsheet was derived from FOODfiles 2010 (Plant and Food Research Ltd) food composition tables with merged food groups weighted based on the frequency of consumption amongst the Pacific sample of the ANS 2008/09 (available from Statistics New Zealand: http://www.stats.govt.nz/tools_and_services/microdata-access.aspx). For items in the sugars FFQ that had multiple foods listed for example "Milo, powder drinking chocolate or other milk mix", foods included in the group were weighted by the percentage of the reported frequency of consumption from the ANS dataset i.e. 77% "Milo", 20% “Chocolate, drinking, powder” and 3% "Nesquik, powder". Additional items such as doughnuts were added to the sugars FFQ spreadsheet as they were not represented by the ANS dataset and based on observations these were an important food item at the Pukapukan Community Centre. Therefore doughnuts were given a weighting of 80% in 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 NZ food composition tables (NZ FOODfiles 2010v2) (Department of Human Nutrition). The sugar contents for each food were then summed to calculate the nutrient profile of each item in the sugars FFQ.
4.5.2 Twenty-four hour recall

The 24 hour recall data was entered and analysed by Kaiculator (version 1.10) dietary assessment software developed by the Department of Human Nutrition, University of Otago. The food composition databases used for this study contained FOODfiles 2010 (Plant and Food Research Ltd), recipes developed for the ANS 2008/09. Where necessary recipes were collected from participants for Pacific specific dishes and entered into the database. From the three 24-hour recalls average amounts of fructose, sucrose, glucose and total sugars were calculated for each participant from all sources, sugar-sweetened beverage intake, fresh and canned fruit intake, dried fruit intake and fruit juice intake to give daily estimates.

4.5.3 Estimating fruit servings

To estimate daily consumption of fruit, quantities of fresh and canned fruit, dried fruit and 100% fruit juice (in gram units) were extracted from the sugars FFQ spreadsheet and Kaiculator data. The quantities of fruit in grams consumed by participants from each relevant food group item were divided by their respective serving sizes to acquire estimated number of daily fruit servings. The size of one serving used for each of the food groups are based on the Ministry of Health indicative serving sizes and are as follows; fresh and canned fruit = 130 g, dried fruit = 25 g and fruit juice = 250 g (36, 37). Servings consumed from each food group were summed together for each participant and then rounded to the nearest 0.25 to calculate an estimate of servings of fruit consumed daily. The Ministry of
Health state that only one serving of dried fruit or 100% fruit juice should contribute towards the recommended dietary intake of fruit (37). Therefore if participants had over one serving from dried fruit or 100% fruit juice only one serving was counted towards the total servings of fruit.

4.6 Statistical analysis

Correlation coefficients and Bland-Altman statistics were calculated to test the validity of the sugars FFQ, between high and low sugar intakes, and Pukapukan ethnicities and other ethnicities. Cross-classification, Bland-Altman statistics and correlation coefficients were used to assess the validity and repeatability of the sugars FFQ to estimate intake of fruit servings. Intake variables were log-transformed where appropriate to account for skewness. Sugars FFQ2 was used for the comparative test as it captured intakes over the same period of time as the mean 24-hour recall intakes.

4.6.1 Individual ranking

Cross-classification of sugar intakes from sugars FFQ2 and mean 24 hour recalls was carried out to assess whether the sugars FFQ can be used to rank individuals according to their sugar intake. The percentage of participants classified into the same quartiles, adjacent quartiles and extreme quartiles was calculated. Linearly weighted Cohen’s Kappa scores were calculated for sugar intakes from the observed and expected proportions on the 4x4 table of frequencies. Kappa values over 0.80
indicate very good agreement, between 0.61 and 0.80 indicate good agreement, between 0.41–0.60 indicate moderate agreement, between 0.21–0.40 indicate fair agreement and under 0.20 indicate poor agreement (38).

4.6.2 Strength of agreement
Spearman correlation coefficients were calculated to assess the strength of the association between sugars FFQ2 and 24-hour recall intakes as the data was not normally distributed (39). The closer to 1 correlation coefficients are the greater the strength of association between the two methods.

Intraclass correlation coefficients (ICC’s) were also calculated as they are seen as a better measure of strength of association than other methods (17). Values above for ICC’s 0.4 indicate good agreement between two methods (17).

4.6.3 Individual level agreement
The Bland-Altman statistics of mean difference and limits of agreement were calculated for sugar intakes from sugars FFQ2 and 24-hour recalls to measure the agreement across the range of intakes between the two methods (40). The width of the limits of agreement show the extent to which the two methods agree. The mean difference is used to see if one method tends to over or under estimate intakes (39).
4.6.4 Median Intakes
For all three categories median sugar intakes and range of sugar intakes were calculated for sugars FFQ1, sugars FFQ2 and 24-hour recalls. These were compared to median intakes of Pacific participants from the ANS 08/09. Median intakes were calculated over mean intakes due to skewness in the data.

4.6.5 Test re-test reliability
Intraclass correlation coefficients (ICC’s) were calculated to measure the reliability between sugars FFQ1 and sugars FFQ2. This is considered the gold standard method for reliability as it takes into account between and within subject variation (41). ICC's over 0.5 are considered acceptable between two administrations of an FFQ. When FFQ's are repeated in a time frame of 1 month or less higher correlation coefficients are reported compared to if repeat administration are further apart (32).
5 Results

5.1 Participants

A total of 90 participants completed all four interviews that were required for the study. Demographic characteristics of participants are presented in Table 5.1. Females accounted for 61% of the participants. Average age of participants was 37 years and 32% of participants were under 30 years of age. Just over half of participants identified as Pukapukan ethnicity, 20% identified as Cook Island ethnicity, 14% identified as Samoan, 12% identified as Tongan and a small percentage identified as Tuvaluan or Nuiean. The majority of participants reported having secondary school qualifications or higher but 19% reported having no secondary school qualifications. At the time of the study 42% of participants were in full-time employment while the majority of those not in full-time employment identified as being homemakers, unemployed or students. Eighty percent of participants lived in a household with 4 or more people; 35% of participants lived in households including 7 or more people. One third of participants reported having one or more chronic medical conditions, 16% of participants reported having been previously diagnosed with high blood pressure and 14% reported having been previously diagnosed with type 2 diabetes.
Table 5.1 Characteristics of participants in the Pacific sugar study from Auckland, New Zealand (n=90)

<table>
<thead>
<tr>
<th>Characteristics</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>35</td>
<td>39</td>
</tr>
<tr>
<td>Female</td>
<td>55</td>
<td>61</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-29</td>
<td>29</td>
<td>32</td>
</tr>
<tr>
<td>30-39</td>
<td>21</td>
<td>23</td>
</tr>
<tr>
<td>40-49</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>50-59</td>
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<td>13</td>
</tr>
<tr>
<td>60+</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
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<td></td>
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<td>53</td>
</tr>
<tr>
<td>Cook Islander</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Tongan</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Samoan</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Tuvaluan</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Niuean</td>
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<td>2</td>
</tr>
<tr>
<td><strong>Highest education qualification</strong></td>
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<td></td>
</tr>
<tr>
<td>No secondary school qualification</td>
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<td>19</td>
</tr>
<tr>
<td>Secondary school qualification</td>
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<td>56</td>
</tr>
<tr>
<td>Tertiary qualification - technical / trade school, polytechnic or university</td>
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<td>21</td>
</tr>
<tr>
<td>Non identified</td>
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<td>4</td>
</tr>
<tr>
<td><strong>Employment Status</strong></td>
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</tr>
<tr>
<td>Full-time</td>
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<td>42</td>
</tr>
<tr>
<td>Part-time</td>
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<td>6</td>
</tr>
<tr>
<td>Retired or Homemaker</td>
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<td>24</td>
</tr>
<tr>
<td>Student</td>
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<td>13</td>
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<tr>
<td>Unemployed</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Other (b) or non identified</td>
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<td>4</td>
</tr>
<tr>
<td><strong>Household size (n)(c)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 3</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>4 to 6</td>
<td>41</td>
<td>45</td>
</tr>
<tr>
<td>7+</td>
<td>32</td>
<td>35</td>
</tr>
<tr>
<td><strong>Co-morbidities</strong></td>
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<td></td>
</tr>
<tr>
<td>High blood pressure</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>High cholesterol</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Heart disease or angina</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Type 2 Diabetes</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Gout</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Asthma</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>None</td>
<td>61</td>
<td>68</td>
</tr>
</tbody>
</table>

\(n\) = number of participants
\(a\) Participants were able to identify with more than one ethnicity
\(b\) Others include those who self-identified as an invalid
\(c\) Household size: the number of people in the participants household including the participant
\(d\) Participants were able to select multiple co-morbidities, given former diagnosis from a medical professional.
5.1.1 Median sugar intakes

The highest median sugar intakes were reported in the first administration of the FFQ (sugars FFQ1) in all categories for all sugars; the second administration of the FFQ (sugars FFQ2) reported the next highest median intakes with 24-hour recalls reporting the lowest median intakes. Median sugar intakes were lower in 24-hour recalls collected in our study in comparison to those reported by Pacific people in the ANS 08/09.

Table 5.2 Estimated median and range of sugar intakes from all sources, sugar-sweetened beverages and fresh and canned fruit from sugars FFQ1 and sugars FFQ2 and 24 hour recalls compared to ANS 2008/09 median sugar intakes a, b

<table>
<thead>
<tr>
<th>24 hour recall</th>
<th>Total Sugar (g)</th>
<th>Fructose (g)</th>
<th>Glucose (g)</th>
<th>Sucrose (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sources</td>
<td>95.0 (20.4, 648.8)</td>
<td>14.3 (1.48, 129.4)</td>
<td>13.5 (1.79, 121.1)</td>
<td>47.6 (6.9, 377.31)</td>
</tr>
<tr>
<td>SSBs c</td>
<td>24 (0, 439.37)</td>
<td>1.3 (0, 101.32)</td>
<td>1.5 (0, 86.67)</td>
<td>15.7 (0, 349.73)</td>
</tr>
<tr>
<td>FCF d</td>
<td>18.3 (0, 125.58)</td>
<td>5.8 (0, 55.05)</td>
<td>4.7 (0, 39.59)</td>
<td>6.4 (0, 45.39)</td>
</tr>
</tbody>
</table>

Sugars FFQ1

<table>
<thead>
<tr>
<th></th>
<th>Total Sugar (g)</th>
<th>Fructose (g)</th>
<th>Glucose (g)</th>
<th>Sucrose (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sources</td>
<td>141.6 (5.5, 811.5)</td>
<td>23.8 (1.7, 14.2.1)</td>
<td>23.2 (1.5, 116.2)</td>
<td>85.4 (2.1, 564)</td>
</tr>
<tr>
<td>SSBs c</td>
<td>53.1 (0, 411.4)</td>
<td>2.5 (0, 84.4)</td>
<td>3.6 (0, 81.5)</td>
<td>38.3 (0, 229.2)</td>
</tr>
<tr>
<td>FCF d</td>
<td>28.4 (0, 188.5)</td>
<td>10.2 (0, 66.3)</td>
<td>8.5 (0, 50.3)</td>
<td>9.95 (0, 72.7)</td>
</tr>
</tbody>
</table>

Sugars FFQ2

<table>
<thead>
<tr>
<th></th>
<th>Total Sugar (g)</th>
<th>Fructose (g)</th>
<th>Glucose (g)</th>
<th>Sucrose (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sources</td>
<td>102.7 (10.2, 614)</td>
<td>16 (1.8, 173.3)</td>
<td>13.5 (1.7, 119.9)</td>
<td>54.5 (3.7, 371.4)</td>
</tr>
<tr>
<td>SSBs c</td>
<td>39.4 (0, 499.2)</td>
<td>2.2 (0, 87.5)</td>
<td>2.3 (0, 91.2)</td>
<td>28.8 (0, 280.1)</td>
</tr>
<tr>
<td>FCF d</td>
<td>16.6 (0, 158.6)</td>
<td>6 (0, 56)</td>
<td>4.9 (0, 43.4)</td>
<td>5.9 (0, 60)</td>
</tr>
</tbody>
</table>

ANS 08/09c

<table>
<thead>
<tr>
<th></th>
<th>Total Sugar (g)</th>
<th>Fructose (g)</th>
<th>Glucose (g)</th>
<th>Sucrose (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sources</td>
<td>106</td>
<td>19</td>
<td>-</td>
<td>53</td>
</tr>
</tbody>
</table>

a Median dietary intakes among Pacific participants as reported in the 2008/09 Adult New Zealand Nutrition Survey
b Reported as Median (minimum, maximum)
c SSBs = Sugar-sweetened beverages
d FCF = Fresh and canned fruit
e Male and female combined estimates
5.2 Relative validity

5.2.1 Cross classification of participants’ estimated sugar intakes

Tables 5.3 shows the agreement in cross-classification between sugars FFQ2 and 24-hour recalls in ranking individuals according to their sugar intakes from different sources.

For sugars from all sources the percentage of participants correctly classified into the same or adjacent quartiles ranged between 87% - 91% for the different types of sugars (i.e. glucose, sucrose, fructose and total sugars). Similar percentages were seen for sugars from sugar-sweetened beverages, 86% - 91% of participants were cross classified into the same or adjacent quartiles. For sugars from all sources and sugars from sugar-sweetened beverages the linearly weighted Cohen’s kappa scores indicated moderate agreement between sugars FFQ2 and 24-hour recalls (38). Kappa scores were between 0.47 - 0.54 and 0.44 - 0.54 for sugar from all sources and sugar-sweetened beverages, respectively.

Sugars from fresh and canned fruit had a lower percentage agreement; 76%-80% of participants were correctly cross classified into the same or adjacent quartiles. Cohen’s weighted kappa scores were between 0.25-0.33 for sugars from fresh and canned fruit indicating fair agreement between the methods.
Table 5.3 Cross classification of participants into quartiles for estimated mean sugar intakes from all sources, sugar-sweetened beverages and fresh and canned fruit

<table>
<thead>
<tr>
<th>All sources</th>
<th>Same quartile</th>
<th>Adjacent quartile</th>
<th>Extreme quartile</th>
<th>Kappa score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>43</td>
<td>35</td>
<td>1</td>
<td>0.47</td>
</tr>
<tr>
<td>Glucose</td>
<td>42</td>
<td>38</td>
<td>0</td>
<td>0.48</td>
</tr>
<tr>
<td>Sucrose</td>
<td>43</td>
<td>37</td>
<td>3</td>
<td>0.54</td>
</tr>
<tr>
<td>Total Sugar</td>
<td>47</td>
<td>35</td>
<td>1</td>
<td>0.54</td>
</tr>
</tbody>
</table>

SSBs a

| Fructose          | 41            | 38                | 0                | 0.50        |
| Glucose           | 38            | 41                | 1                | 0.44        |
| Sucrose           | 46            | 31                | 1                | 0.48        |
| Total Sugar       | 47            | 36                | 1                | 0.54        |

FCF b

| Fructose          | 29            | 39                | 2                | 0.25        |
| Glucose           | 29            | 41                | 3                | 0.26        |
| Sucrose           | 34            | 37                | 1                | 0.33        |
| Total Sugar       | 31            | 41                | 2                | 0.30        |

a SSBs = Sugar-sweetened beverages
b FCF = Fresh and canned fruit

5.2.2 Spearman’s Correlation Coefficients and Interclass Correlation Coefficients

Relative validity of the sugars FFQ appears to be particularly strong for sugars from all sources and from SSBs. Spearman correlation coefficients ranged between 0.67 and 0.72 and 0.65 and 0.74 for sugars from all sources and SSBs, respectively. Intraclass correlation coefficients were stronger with values for sugar from all sources and SSBs ranging between 0.81 and 0.85 and 0.82 and 0.86, respectively. For fresh and canned fruit the Spearman correlation coefficients ranged between 0.49 and 0.54 and intraclass correlation coefficients between 0.66 and 0.68. In comparison with previously published validation studies our instrument had higher Spearman’s correlation coefficients for total sugars estimated from an FFQ.
in comparison with a reference self-reported dietary assessment method indicating stronger relative validity (Table 5.4) (30, 42).

Table 5.4 Intraclass correlation coefficients (ICC) and Spearman Correlation coefficients (SCC) between sugars FFQ 2 and mean 24 hour recalls for sugar from all sources, sugar-sweetened beverages and fresh and canned fruit, compared with other FFQ validation studies

<table>
<thead>
<tr>
<th>All sources</th>
<th>ICC</th>
<th>SCC</th>
<th>Sam 2012 SCC a</th>
<th>Barrett 2012 SCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>0.85*</td>
<td>0.72*</td>
<td>-</td>
<td>0.55</td>
</tr>
<tr>
<td>Fructose</td>
<td>0.81*</td>
<td>0.67*</td>
<td>0.55</td>
<td>0.66</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.81*</td>
<td>0.68*</td>
<td>-</td>
<td>0.65</td>
</tr>
<tr>
<td>Sucrose</td>
<td>0.82*</td>
<td>0.70*</td>
<td>0.46</td>
<td>0.49</td>
</tr>
<tr>
<td>SSBs b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.85*</td>
<td>0.74*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fructose</td>
<td>0.86*</td>
<td>0.68*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.82*</td>
<td>0.65*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sucrose</td>
<td>0.82*</td>
<td>0.66*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FCF c</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.67*</td>
<td>0.53*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fructose</td>
<td>0.67*</td>
<td>0.49*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.66*</td>
<td>0.49*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sucrose</td>
<td>0.68*</td>
<td>0.54*</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*p-value <0.001

a SCCs for energy adjusted sugars used

b SSBs = Sugar-sweetened beverage
c FCF = Fresh and canned fruit

5.2.3 Bland-Altman

Table 5.5 reports the strength of agreement between sugars FFQ2 and the 24-hour recall. The mean differences for total sugars, fructose and glucose are not statistically different suggesting agreement at the group level; the wide limits of agreement below suggest poor agreement for sugar intakes at the individual level between the two methods.
Table 5.5 - Bland-Altman statistics measuring strength of agreement for sugar intakes from all sources between sugars FFQ2 and 24h recalls

<table>
<thead>
<tr>
<th>Source</th>
<th>Limits of agreement</th>
<th>Mean difference (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>-44.73, 49.17</td>
<td>2.22 (-2.7, 7.14)</td>
</tr>
<tr>
<td>Glucose</td>
<td>-33.57, 35.34</td>
<td>0.88 (-2.73, 4.49)</td>
</tr>
<tr>
<td>Sucrose</td>
<td>-82.47, 109.33</td>
<td>13.43 (3.38, 23.47)</td>
</tr>
<tr>
<td>Total Sugar</td>
<td>-144.97, 159.17</td>
<td>7.10 (-8.82, 23.03)</td>
</tr>
</tbody>
</table>

*a Data in grams  
*b CI = 95% confidence interval

5.2.4 High versus Low sugar intakes

Participants sugar intakes were split at the median and the top half were classified in the high sugar intake group and the bottom half in the low sugar intake group. Table 5.6 shows that the SCCs and ICCs are similar for low and high intakes of sugar suggesting equivalent performance for estimating sugars intakes amongst higher versus lower consumers.

Table 5.6 Spearman correlation coefficients (SCC’s) and intraclass correlation coefficients (ICC’s) for high versus low sugar intakes for sugar from all sources.

<table>
<thead>
<tr>
<th>Source</th>
<th>SCC</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low intake</td>
<td>0.43</td>
<td>0.56</td>
</tr>
<tr>
<td>High intake</td>
<td>0.50</td>
<td>0.68</td>
</tr>
</tbody>
</table>

5.2.5 Pukapukan versus other ethnicities

The SCCs and ICCs are greater for Pukapukan participants compared with those of other Pacific ethnicities (Table 5.7) although the correlations are strong for both groups. The Bland-Altman statistics indicate stronger
agreement between the sugars FFQ2 and 24-hour recalls for Pukapukan subjects compared to those of other Pacific other ethnicities (Table 5.8).

Table 5.7 Spearman correlation coefficients (SCCs) and intraclass correlation coefficients (ICCs) for Pukapukan versus other ethnicities for sugar from all sources.

<table>
<thead>
<tr>
<th>All sources</th>
<th>SCC</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pukapukan</td>
<td>0.74</td>
<td>0.87</td>
</tr>
<tr>
<td>Other ethnicities</td>
<td>0.66</td>
<td>0.79</td>
</tr>
</tbody>
</table>

Table 5.8 Bland-Altman statistics measuring strength of agreement for total sugar intake from all sources between sugars FFQ2 and 24 hour recalls for Pukapukan and other ethnicities.

<table>
<thead>
<tr>
<th>Total Sugar</th>
<th>Limits of Agreement a</th>
<th>Mean difference (CI)a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pukapukan</td>
<td>-118.4, 111.58</td>
<td>-3.409 (-20.1, 13.29)</td>
</tr>
<tr>
<td>Other ethnicities</td>
<td>-165.09, 203.32</td>
<td>19.12 (-9.59, 47.82)</td>
</tr>
</tbody>
</table>

a Data in grams

5.2.6 Estimation of fruit servings

Table 5.9 reports the proportion of agreement in cross-classification between sugars FFQ2 and 24-hour recalls in ranking individuals according to number of servings of fruit consumed. A Cohen’s weighted kappa score of 0.39 indicates fair to moderate agreement between the two methods. In comparison to the study by Mainvil et al. (43) our sugars FFQ has comparable Cohen’s weighted kappa score and percentages ranked in the same or adjacent quartiles as the FFQ used in their validation study.

Table 5.10 indicates good agreement between sugars FFQ 2 and 24-hour recalls in estimating servings of fruit consumed. This is shown by Spearman’s correlation coefficients and intraclass correlation coefficients
being 0.5 and 0.68, respectively. Pearson’s correlation coefficients (PCCs) from Mainvil et al. (43) are presented in Table 5.10. However as Pearson’s is a parametric test for continuous data results cannot be compared directly to Spearman’s correlation coefficients which is a non-parametric test based on ranks not actual values, suitable for non normal data. Limits of agreement of -3.27 to 3.31 indicate that the diet recalls and sugar FFQ2 lack individual level agreement when estimating precise servings of fruit consumed. The mean difference between methods was not statistically different at P=0.022 showing good agreement at the group level.

Repeatability for fruit servings between the two administrations of the sugars FFQ was 0.68. An intraclass correlation coefficient of 0.68 for repeatability is seen as acceptable.

Table 5.9 Proportion of participants cross classified into quartiles for estimated fruit servings consumed compared to Mainvil et al.

<table>
<thead>
<tr>
<th>Study</th>
<th>Same Quartile</th>
<th>Adjacent quartile</th>
<th>Kappa Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current study</td>
<td>56%</td>
<td>32%</td>
<td>0.39</td>
</tr>
<tr>
<td>Mainvil et al. 2011a</td>
<td>61%</td>
<td>13%</td>
<td>0.41</td>
</tr>
</tbody>
</table>

aData from 5 item fruit FFQ presented
Table 5.10 Spearman correlation coefficients (SCCs), Intraclass correlation coefficients (ICC’s) for fruit servings from sugars FFQ2 and 24 hour recalls, compared to Pearson correlation coefficients (PCC) from other FFQ validation studies

<table>
<thead>
<tr>
<th>Study</th>
<th>SCC</th>
<th>ICC</th>
<th>Mainvil 2011 PCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit servings</td>
<td>0.5</td>
<td>0.68</td>
<td>0.57</td>
</tr>
</tbody>
</table>

* PCCs from the 5 item fruit FFQ presented

### 5.3 Reliability intraclass correlation coefficients (ICCs)

Table 5.11 shows the reliability of repeat administrations of the sugars FFQ. The ICCs are above 0.7 for sugars from each of the categories which indicates strong agreement between both administrations of the sugars FFQ. For sugar from all sources and sugar-sweetened beverages the ICCs are particularly strong for reliability ranging from 0.85-0.88 and 0.89-0.95, respectively.

Table 5.11 Intraclass correlation coefficients for the repeat administrations of the sugar FFQ for sugar from all sources, sugar-sweetened beverages and fresh and canned fruit

<table>
<thead>
<tr>
<th>All sources</th>
<th>ICC</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>0.85</td>
<td>0.69, 0.92</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.85</td>
<td>0.63, 0.92</td>
</tr>
<tr>
<td>Sucrose</td>
<td>0.88</td>
<td>0.72, 0.93</td>
</tr>
<tr>
<td>Total Sugar</td>
<td>0.87</td>
<td>0.68, 0.93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SSBs</th>
<th>ICC</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>0.89</td>
<td>0.82, 0.92</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.91</td>
<td>0.86, 0.94</td>
</tr>
<tr>
<td>Sucrose</td>
<td>0.93</td>
<td>0.88, 0.96</td>
</tr>
<tr>
<td>Total Sugar</td>
<td>0.95</td>
<td>0.90, 0.96</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FCF</th>
<th>ICC</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose</td>
<td>0.72</td>
<td>0.48, 0.84</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.72</td>
<td>0.49, 0.83</td>
</tr>
<tr>
<td>Sucrose</td>
<td>0.71</td>
<td>0.47, 0.83</td>
</tr>
<tr>
<td>Total Sugar</td>
<td>0.74</td>
<td>0.53, 0.84</td>
</tr>
</tbody>
</table>

*95% Confidence interval
6 Discussion

In this study the relative validity and reliability of a sugars FFQ estimating sugar intakes was assessed in Pacific Island people residing in Auckland, New Zealand. The sugars FFQ was designed with the purpose of ranking participants’ sugar intakes based on foods and drinks containing sugar they had consumed in the past month validated against three 24-hour dietary recalls collected over the same time period. Relative validity of the sugars FFQ appears to be acceptable; weighted kappa scores were between 0.47 and 0.54 for all sugars indicating moderate agreement and between 87% and 91% of participants were correctly classified into the same or adjacent quartiles for sugar intakes. Spearman and intraclass correlation coefficients indicated agreement for sugars from all sources and SSBs and were higher in comparison to previous FFQ validation studies (30, 42).

6.1 Validity

The sugars FFQ was designed to rank subjects by sugar intakes. Weighted kappa scores for sugars from all sources were higher and percentages of participants correctly classified within one quartile were comparable with and in some cases higher than previous studies ranking sugar intakes (42, 44). For sugars from all sources Spearman correlation coefficients were stronger in our study compared to those reported by other research groups (30, 42, 44). Sam et al. validated a 154 item FFQ against 8 day weighed diet records. They reported correlation coefficients for fructose and sucrose of
0.55 and 0.46, respectively which were weaker than the correlations we found; 0.67 and 0.7 for fructose and sucrose, respectively (30). Barrett et al. validated a 297 item FFQ with four 7-day food diaries over 12 months used as the reference method. The reported correlation coefficients for all sugars were also weaker than we reported (42). Similarly Barclay et al. validated a 145 item FFQ against three 4-day weighed diet records collected over eight months. They reported a correlation coefficient of 0.46 for total sugar, again weaker than our correlation of 0.72 (44). A reason for our stronger correlation coefficients and weighted kappa scores, and more accurate classification into correct intake quartiles than in previous research could be due to the specificity and overall length of our FFQ. Sam et al., Barrett et al. and Barclay et al. assessed more than one nutrient and had significantly more questions in their FFQ compared to ours (30, 42, 44). With longer questionnaires comes participants fatigue and boredom which could affect validity of responses (39). Our sugars FFQ is only 33 questions long and was designed to assess only sugars; these factors could have resulted in higher correlation coefficients, kappa scores and correct classification within one quartile compared to the previously mentioned studies.

Bland-Altman analyses showed good agreement for total sugars, fructose and glucose at the group level between the sugars FFQ2 and 24-hour recalls however sucrose intakes were overestimated by the sugars FFQ in comparison to 24-hour recall intakes. Individual level agreement was however poor. However the sugars FFQ was not designed to assess
individual intakes and due to measurement errors it is unlikely that strong agreement would be seen between two methods at an individual level.

A feature of our sugars FFQ was the ability to examine sugars from different sources. Similar kappa scores, correct classification within intake quartiles and correlation coefficients were found for sugars from sugar-sweetened beverages as well as for sugars from all sources, indicating good relative validity for the sugars FFQ to assess SSB intakes. Generally in cohort studies SSB intake is estimated from one or two questions from a larger questionnaire, however ours is more in-depth as seven questions are used to estimate SSB intake (10). The category sugar sweetened beverages in this sugars FFQ is of importance as estimating sugar intakes from SSBs will benefit any future research conducted around the controversial topic of;’f associations between sugar intakes from SSBs and health outcomes (45).

The question as to whether sugars from fruit have the same health effects as sugars from other sources has become one of interest in recent times. Fruits contain fructose and sucrose the same sugars present in SSB and other sugar sweetened foods (46). Therefore the ability to distinguish between sugar intakes from fruit and other sources when using our sugars FFQ could facilitate further research in this area. Estimates of sugar intakes from fresh and canned fruit however were less reliable with lower kappa scores, less accurate quartile classification and lower correlation coefficients. The reduced reliability may be due to fruit intake being more
variable day to day making it a more difficult category to measure via a FFQ (43).

One issue in validating tools is the reference method used. 24-hour recalls were used in this study and in the ANS to measure intakes. Median sugar intakes from our 24-hour recalls were slightly lower compared to intakes from the ANS 08/09. Unlike the ANS methods our study included the forgotten food list in the dietary recall, a method used in the NHANES survey in the US (28). The forgotten food list can be criticised as it uses leading questions which should be avoided in 24-hour recalls and there is the potential for participants to agree with interviewers (i.e. social desirability bias), however the NHANES method has been shown to increase the validity of total energy intake assessment (17, 28). Moreover it does not appear that intakes have been overestimated in our study due to use of the forgotten foods list as median sugar intakes from the 24-hour recalls were only slightly lower than the ANS estimates of sugar intakes amongst Pacific adults.

Another feature of the sugars FFQ is that it allows us to estimate fruit servings. Our findings indicate that it is comparable (in terms of relative validity) to an FFQ developed specifically with the purpose of estimating fruit servings by Mainvil et al. (43). Although both FFQs do not perform well at an individual level, our sugars FFQ showed good agreement at the group level for estimating fruit servings consumed.
6.2 Reliability

The sugars FFQ shows very good reliability between two repeat administrations for sugars from all sources, sugar-sweetened beverages and fresh and canned fruit. Intraclass correlation coefficients were greater than 0.7 for each category which is better than reported in previous studies (30, 42). We administered the sugars FFQ only four weeks apart; therefore the high correlations could be due to the short time period between administrations. It is possible that a learning effect could have occurred whereby participants remembered their answers from the previous sugars FFQ (32). It is notable that estimates of intakes of sugar from all sources were lower in the second sugars FFQ administration compared to the first administration. This could be due to an “intervention effect” rather than the sugars FFQs’ reliability. By taking part in the study participants may have heightened awareness of their sugar intakes leading to a reduction in sugar consumption over the four week period.

6.3 Strengths and Limitations

A potential limitation of this study is that repeat 24-hour dietary recalls were used as the reference method with which to compare the sugars FFQ. FFQs and 24-hour dietary recalls have a similar set of errors associated with them; ideally the gold standard method would have different errors associated with it. 24-hour recalls and FFQs both rely on participants memory and ability to quantify intake, foods or drinks may be forgotten and deliberate under-reporting may occur in 24-hour recalls due to a
participants fear of being judged critically by the interviewer (17). All interviewers were 5th year dietetics students who had formal training in completing 24-hour dietary recalls with adequate prompting which is a strength of this study. 24-hour recalls were used as the reference method rather than weighed food records as they are considered more appropriate for collecting accurate data in populations with low literacy and income levels, such as Pacific ethnicities in New Zealand (25, 26, 31, 32). In this study participants required assistance with sugars FFQs and some had limited English, thus providing some confirmation that repeated 24-hour recalls were an appropriate reference method to use in this population. Use of repeated 24 hour recalls also reduced the response burden for participants and researchers, thus enabling a larger number of participants to be recruited for the study.

Every effort was made to ensure the sugars FFQ was culturally appropriate. The sugars FFQ was designed and pretested for use amongst Pacific people. All participants were of Pacific Island ethnicity originating from a range of Pacific islands, with a mix of ages and including both men and women. Therefore we consider that the study population was representative of the target population. To enhance accurate data collection the sugars FFQ uses culturally appropriate foods, Pacific Island language and pictures of food and drink items are provided as visual aids. However a limitation of the sugars FFQ is that it only assesses sugar intakes over a one month period; consequently seasonal variation of sugar intakes is not accounted for.

Further research should be conducted to determine if having a one-month
FFQ is a limiting factor in our study. As fruit availability in New Zealand is seasonal we cannot be sure what effect time of year has on sugar intakes from fruit e.g. locally grown fruit such as feijoas are only available around April to June. This is an area that would benefit from future research. On the other hand a strength of assessing intakes over one month is that the short time period means participants are better able to recall what they have consumed.

6.4 Conclusion

We have created a FFQ to assess sugar intakes in Pacific populations living in New Zealand that has moderate-good relative validity and repeatability. We believe that the sugars FFQ could now be used in New Zealand-based population studies to assess sugar intakes of Pacific people. However it should not be used to assess intakes in individuals. With such information the effect of sugar intakes on health outcomes in Pacific people living in New Zealand and whether sugar intake is a reasonable target for public health strategies in this population could be investigated. The current literature provides no clear conclusions on the effect of increased sugar intakes on chronic disease; therefore more research is needed to form robust evidence to ascertain if there is an association.
7 Application to Practice

Findings from future research using the sugars FFQ to estimate sugar intakes in Pacific Islanders could enable dietitians to have a clearer picture of sugar intakes and their effect on health outcomes in Pacific people. With this information dietitians working with Pacific people or in Pacific communities would be able to advise individuals on suitable sugar intakes for optimal health. The sugars FFQ would provide Dietitians with an idea of the main sources of sugar in Pacific Islanders diets and therefore be able to give more specific advice at a population level about what parts of their diets to adapt to change sugar intakes. Future research could also help the public health sector in advising if sugar intakes are a suitable strategy to focus on especially for Pacific people. This could see the start of new public health campaigns and give dietitians an opportunity to educate especially younger generations of Pacific people on optimal sugar intakes to help them live long and healthy lives.
8 References

9 Appendices

A– Pacific Diet Study FFQ

B – Information and Consent Sheet

C – Demographic Questionnaire
Appendix A - Pacific Diet Study FFQ
The Pacific Diet Study

We would like to learn more about Pacific 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.)

Fa’afetai (thank you very much) for helping us with this important project!
INSTRUCTIONS: This is how you answer the questions

Think about your usual eating pattern over the past month...

Tālofa lava, Malo e lelei, Bula vinaka, Fakaalofa lahi alu, I am Tere and over the past month I usually drank water 4 times a day. I have about a cup each

Tere writes:
Over the last 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?
☐ 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:
Think about your usual drinking pattern over the past month…

1. On average, how often do you drink fruit drink (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  OR  
___ ml  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  OR  
___ ml  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)
☐ following packet instructions (1 packet = 1 litre)
☐ weak (more water)

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

**How much** do you usually drink each time?  ___ cup OR
___ ml 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

**How much** do you usually drink each time?  ___ cup OR
___ ml OR
___ litre
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?  ____ cup OR  ____ ml OR  ____ litre

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
PLEASE NOTE: For the following questions:
- 1 nip=30ml
- 1 standard wine glass=100ml
- 1 large wine glass=150ml
- 1 pint or handle=400ml
- 1 wine bottle=750ml
- 1 jug=1000ml

This photos may help you estimate how much you usually drink:

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?  ____ ml  OR  ____ litre

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?  ____ standard glass (100ml) OR  ____ large wine glass (150ml) OR  ____ wine bottle (750ml)
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
☐ standard wine glass (100ml)
☐ large wine glass (150ml)

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)
☐ double nip (60ml)

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 one nip
☐ spirit glass (150ml) with two nips OR
☐ tall glass (200ml) with one nip OR
☐ tall glass (200ml) with two nips OR
☐ one bottle (330ml)

..........................................................................................................................................................
PLEASE NOTE: For the following questions:

- 1 teaspoon=5ml
- 1 heaped teaspoon=14ml
- 1 big spoon=15ml

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  
____ big spoon  
____ ml

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  
____ big spoon  
____ ml

17. On average, **how often** do you **add** Milo, powder drinking chocolate or other milk mix (e.g. Nesquik, Pams, Hansells) **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  
____ big spoon  
____ mL
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 much** do you usually eat each time? (Please circle)

Photo A  Photo B  Photo C

19. On average, **how often** do you put 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  ____ big spoon  ____ ml

20. On average, **how often** do you eat dried fruit (eg. raisens, 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  ____ handful=1/2 cup
21. On average, how often do you eat canned fruit, stewed or baked fruit or frozen 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
____ cup

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
____ cup

24. On average, how often do you eat ice cream, ice blocks, jelly, frozen dairy dessert 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? (please circle)

Photo A  Photo B  Photo C  OR______ ice block
25. On average, **how often** do you put sugar, jam, honey, syrup or sweet sauce on other foods like 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

___ dessert spoon

___ 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

**Circle** the type of cereal you eat most often:

Weetbix  Comflakes  Ricies

Coco pops  Nutra-grain  Porridge

Other:__________________

**How much** do you usually eat each time? (please circle)

Photo A  Photo B  Photo C

OR ___ weetbix

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

☐ never (go to next question)

☐ times a day

☐ times a week

☐ times a month

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

___ bar

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

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

How much do you usually eat each time? _____ biscuit

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.Round wine)
☐ small double biscuit (eg. Cameo cream)
☐ large cookie

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? (please circle)

Photo A   Photo B   Photo C   OR   _____ g
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
____ family pack

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
____ g

- 45g
- 50g
- 100g
- 200g
- 350g
If you have been diagnosed with high blood pressure, high cholesterol, heart disease or angina, diabetes or gout has your diet changed since diagnosis? ☐ Yes ☐ No

How has it changed? (tick as many that apply)

☐ I eat less ☐ I eat more
☐ 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 choose diet drinks ☐ I choose fruit juice

Other: ______________________________________________________

Have you lost weight since diagnosis? ☐ Yes ☐ No

THE END...please check every page to see if you have answered every question

Fa’afetai (thank you very much) for helping us with this important project!
Appendix B - Information and Consent Form
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 30 Pacific volunteers who are currently living in the 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 in your own home or, if you prefer, we will arrange a meeting place somewhere else suitable. In the first interview, after we get to know you, 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:

*Vanessa Blyth* and/or *Dr. Lisa Te Morenga*

Department of Human Nutrition
020 4036 5370
blyva468@student.otago.ac.nz

Department of Human Nutrition
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)
Appendix C- 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 Īwi: _________________________)
   ○ 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!