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Stepwise tailoring and test–retest of reproducibility of an ethnic-specific FFQ to estimate nutrient intakes for South Asians in New Zealand

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Abstract

Objective: To develop and test–retest the reproducibility of an ethnic-specific FFQ to estimate nutrient intakes for South Asians (SA) in New Zealand (NZ).

Design: Using culturally appropriate methods, the NZFFQ, a validated dietary assessment tool for NZ adults, was modified to include SA food items by analysing foods consumed by SA participants of the Adult Nutrition Survey, in-person audit of ethnic food stores and a web scan of ethnic food store websites in NZ. This was further refined via three focus group discussions, and the resulting New Zealand South Asian Food Frequency Questionnaire (NZSAFFQ) was tested for reproducibility.

Setting: Auckland and Dunedin, NZ.

Participants: Twenty-nine and 110 males and females aged 25–59 years of SA ethnicity participated in the focus group discussions and the test–retest, respectively.

Results: The development phase resulted in a SA-specific FFQ comprising of 11 food groups and 180 food items. Test–retest of the NZSAFFQ showed good reproducibility between the two FFQ administrations, 6 months apart. Most reproducibility coefficients were within or higher than the acceptable range of 0·5–0·7. The lowest intraclass correlation coefficients (ICC) were observed for β-carotene (0·47), vitamin B_{12} (0·50), fructose (0·55), vitamin C (0·57) and selenium (0·58), and the highest ICC were observed for alcohol (0·81), iodine (0·79) and folate (0·77). The ICC for fat ranged from 0·70 for saturated fats to 0·77 for polyunsaturated fats. The ICC for protein and energy were 0·68 and 0·72, respectively.

Conclusions: The developed FFQ showed good reproducibility to estimate nutrient intakes and warrants the need for validation of the instrument.

Keywords
Ethnic specific FFQ
Reproducibility
Nutrient intakes
South Asians
New Zealand

The South Asian (SA) diaspora, that is, people from the Indian subcontinent namely, India, Sri Lanka, Pakistan, Nepal, Bangladesh and Afghanistan, continues to increase in size, and currently people identifying with this ethnic group comprise about 6 % of the total population of New Zealand (NZ)[1]. SA are at high risk for diet-related chronic diseases, especially diabetes and cardiovascular diseases[2–4]. In the most recent Adult Nutrition Survey (ANS) in NZ, conducted in 2008/09, about 23 % of male and 21 % of female SA reported being diagnosed with diabetes[2]. In contrast, 5 % of European males and 3 % of European females and less than 1 % in males and females of other Asian subgroups reported being diagnosed with diabetes[2]. Similar patterns are observed for SA in the USA[5], Canada[6], UK[7] and Norway[8], indicating that the SA diaspora have over fivefold higher risk for diabetes and cardiovascular diseases in comparison to the majority population and other migrant groups.

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In epidemiological studies, dietary information is most frequently collected using FFQ as they are cost-effective and impose a relatively low respondent burden compared to weighed records and 24-h recalls. In addition, FFQ provide an estimate of usual dietary intake without requiring repeat application[9]. Data from FFQ can be used to generate dietary patterns which may enable more robust assessment of diet–disease relationships[10] that has the potential to translate research findings into food-based guidelines[11] to better combat diet-related chronic diseases. This would be particularly important for SA as dietary pattern is an important independent risk factor for many chronic diseases among first generation[12], and among subsequent generations of SA[13].

One of the most commonly used FFQ is the European Prospective Investigation into Cancer and Nutrition (EPIC) FFQ, which has been validated against weighed records and biomarkers in different populations, adapted for a variety of settings, and been extensively used throughout the world[14–18]. The EPIC FFQ has been modified and validated for use in the general NZ population (NZFFQ) against weighed dietary records and biomarkers of key nutrients[19]. The NZFFQ had, for most nutrients, reliability coefficients between 0·6 and 0·88 (intraclass correlation coefficients (ICC)), relative validity using weighed food records as the reference method between 0·56 and 0·65 (Spearman's correlation coefficients) and showed a high agreement with the reference method in ranking individuals according to nutrient intakes[19]. However, the challenge facing migrant-receiving countries such as NZ is the diversity in food habits reflective of the countries of origin of migrants. Ethnic food stores are a major source of food for migrant populations, and frequent consumption of festival foods has been indicated as a possible reason for increase in diet-related diseases among migrant populations[20]. This raises the concern of whether FFQ developed for the majority population is appropriate for migrant populations with respect to inclusion of ethnic foods commonly consumed by the migrant group of interest. In response to this concern, other migrant-receiving countries such as Canada[21] and UK[22] have developed and validated FFQ specific for SA; however, these cannot be used for SA in NZ due to differences in food composition data and food availability.

Most studies overseas on the SA population have been done in small localities and are very likely to produce an FFQ biased towards the particular population studied. For example, the study by Garduno-Diaz and Khokar (2013; 2014) was done in Leeds (UK) which predominantly have Indians from Gujarat and Punjab (Northern India) and a small proportion of Pakistanis[12,23]. The study by Sevak *et al.* (2004) was done on women only, as part of a Breast Cancer Study[22]. The use of FFQ developed for the SA population in one country without adaptation or validation in another is also practised. For example, diet–disease relationships for SA people in the USA[5] are based on dietary data collected using a FFQ developed for SA in a Canadian city[21]. Moreover, extrapolation of findings of dietary associations with disease trajectories in SA from other countries and other ethnic groups has limitations due to differences found in diet and health associations between ethnic groups[24] and region of residence within ethnic groups[25]. Therefore, the aim of the present study was to tailor the already validated FFQ for NZ adults for SA in NZ and test the reproducibility of the FFQ to estimate nutrient intakes. In this paper, we report the stepwise tailoring process adopted and the reproducibility of the New Zealand South Asian Food Frequency Questionnaire (NZSAFFQ).

Methods

Research design

The study used a mixed methods design. The inclusion criteria for the study were (1) SA adults defined as people from India, Sri Lanka, Pakistan, Nepal, Bangladesh and Afghanistan, (2) aged 25 to 59 years, and (3) able to communicate in English. An exclusion criterion for the study was having an existing disease condition that resulted in a modified dietary intake (e.g. type 2 diabetes or coeliac disease). In order to enhance the external validity (generalisability) of the study results, the study had two sites, namely Auckland (North Island) and Dunedin (South Island). The study had five distinct steps in developing the NZSAFFQ (Fig. 1). These steps are depicted in concentric circles, each emerging from the core circle namely 'community engagement' with the target population.

Development of the New Zealand South Asian Food Frequency Questionnaire

Step 1: Community engagement and participant recruitment

Extensive engagement with the SA community (*n* 76) was done in the two specific study sites (Auckland & Dunedin) for the purpose of obtaining community buy-in, a key building block towards addressing health disparities[26]. This was achieved by collaborating with a pan-Asian community organisation, The Asian Network Incorporated (TANI), that has the mandate for working towards improving wellbeing, lifestyle and public health needs of the Asian community in NZ and personal links of the investigators of SA ethnicity. Advertisements outlining the purpose of the community meetings were widely circulated through TANI's networks, social and religious groups and personal contacts. Three community meetings were held in a culturally appropriate manner and included the attendance of community leaders and cultural food. These meetings also facilitated participant recruitment via respondent-driven sampling method[27] for the focus group discussions as well as for testing the reproducibility of the FFQ.

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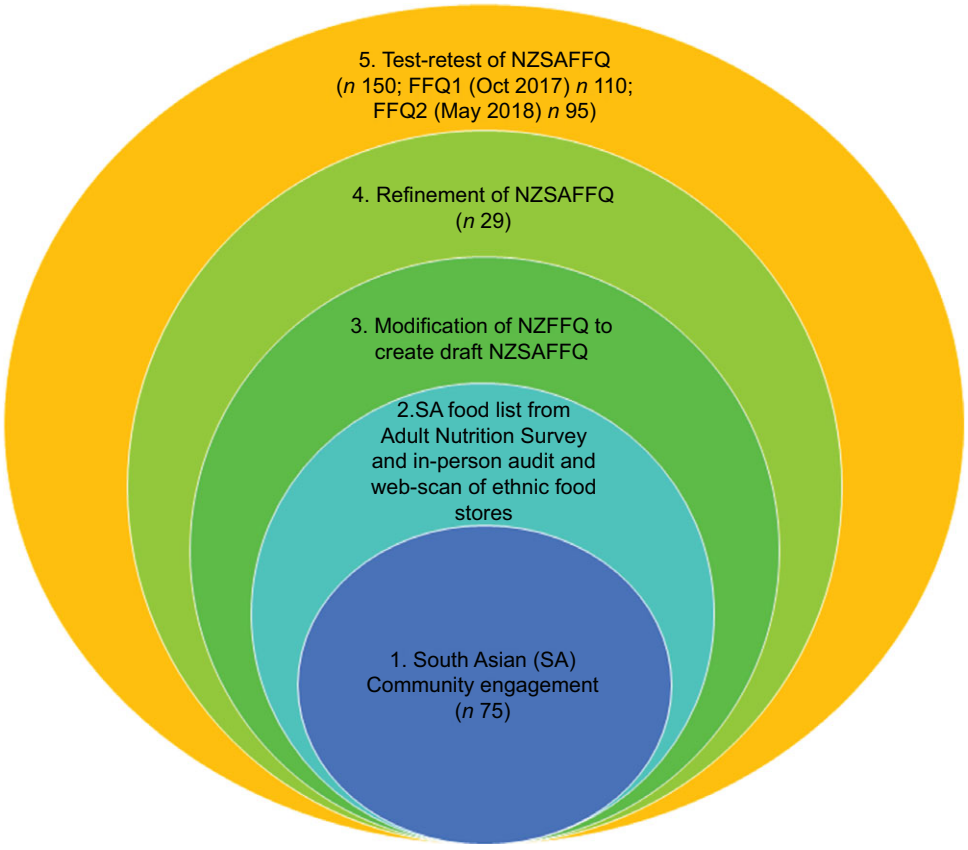

Fig. 1 Diagrammatic representation of the study design

Step 2: Food list

The 2008/09 Adult National Nutrition (ANS)[28] food group data were analysed to identify commonly consumed foods by the SA population in NZ. Food group data from people identifying as SA were extracted from the main database to create a food list.

SA ethnic food stores in NZ stock food items common to all SA cuisine, as well as some specific to a particular SA cuisine. For example, a Sri Lankan food store would stock 'old country' favourites but also have food items from India, Pakistan, etc, to make the business viable. As NZ is a small country, most ethnic stores are located in the four large cities namely, Auckland, Wellington, Christchurch and Dunedin. In-person audits of two ethnic food stores in Auckland and two in Dunedin were conducted. Further, the websites of all other SA ethnic food stores in NZ were scanned. The purpose of the audits and web scan was to identify any foods not commonly sold in mainstream supermarkets. For example, ready-to-drink milk-based beverages, country-specific cordials, canned and bottled fruit juice, sweet and savoury snacks, and frozen, canned and fresh ethnic vegetables and fruits.

Step 3: Modification of NZFFQ

The NZFFQ, a 154-item semi-quantitative questionnaire, developed to assess the habitual intake of multiple nutrients of NZ adults over the preceding 12-month period[19] was modified to include the SA-specific foods under the same food group categories from the above food list and a NZSAFFQ was drafted. Frequency of habitually consuming the listed foods was captured using seven frequency options ranging from 'never or less than once per month' to 'two or more every day'.

Step 4: Refining of New Zealand South Asian Food Frequency Questionnaire

The resulting NZSAFFQ was further refined via three focus group discussions (Auckland = 2; Dunedin = 1). Efforts were made to ensure that there was a good representation of people from the various countries and religious backgrounds of the SA diaspora in the focus groups (*n* 29). Participants were asked to complete a short demographic questionnaire on gender, year of birth, religious affiliation, country of origin and duration of residence in NZ, prior to commencing each focus group discussion. The primary purpose of the focus groups was to identify foods most commonly consumed by the SA people that significantly contributed to nutrient intakes. As very little information existed for NZ SA on average portion sizes of the included food items, especially those that were added, portion sizes were also collected using pre-defined standard measures such as teaspoon, tablespoon and cups which resulted in a quantitative FFQ.

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Step 5: Test–retest of the New Zealand South Asian Food Frequency Questionnaire

This was achieved using a self-selected sample of participants meeting the inclusion criteria. The NZSAFFQ was mailed out to 150 participants recruited for the study, at 2 time points 6 months apart (October 2017 and May 2018). Clear instructions were provided on how to complete the FFQ and a project-specific telephone number was also provided on the FFQ for any assistance if needed. Quality control was achieved by checking the completed FFQ immediately on receiving for completeness as well as for unusual values. Most discrepancies were resolved via telephone. Demographic information of the participants was collected using a separate demographic and dietary habits questionnaire that was mailed prior to the test–retest of the NZSAFFQ.

Development of the nutrient database

A nutrient line was developed for each food item. Nutrient data for all food items including those retained from the original FFQ were re-calculated using the FOODfiles 2014. The food items retained from the original FFQ were weighted by the proportion of New Zealanders who consumed each of the individual variations in a particular food item using food consumption data from the NZ 2008/09 ANS. It was not possible in this study to disaggregate the frequency data for each food consumed by ethnic status. The overall frequency for foods consumed was used to assign the weightings, for example, Berry fruit = Strawberries, fresh 59 %, Blueberries, unsweetened, frozen 26 %, Boysenberry, fresh 8 %, Blackberries, fresh 5 %, Raspberries, fresh 4 %. With respect to nutrient data, for example, the food item 'Ice cream' was weighted as 60 % of the nutrient data for 'Vanilla ice cream', 20 % 'Fruit Ripple ice cream', 10 % 'Hokey Pokey ice cream' and 10 % 'Ice cream stick/bar chocolate and almond coated' as consumption of 'Vanilla ice cream' was 3 times higher than 'Fruit Ripple ice cream' and 6 times higher than the latter two in the ANS. Twenty-eight new recipes were developed for the ethnic food items added to the FFQ. These recipes were standardised for the unit of measurement given for each of the food item. For example, one 'Naan/Chappathy/Roti', one milk-based sweet such as 'Cashew burfi', one handful of 'Aloo chivida' (deep fried potato sticks), one teaspoon of ethnic pickles, one cup of beef curry, etc. Two standardised curry gravy recipes were created: (1) basic curry with coconut milk and (2) basic curry with no coconut milk as people from Southern India and Sri Lanka usually add coconut milk to all their curries in contrast to people from the northern parts of South Asia. Curry with and without coconut milk were separate food items on the FFQ. Recipes for meat and vegetarian options were created to include 65 % meat or alternative and 35 % gravy. For example, the recipe for 'Soy meat coconut curry' was entered as 65 g 'cooked Soy meat' and 35 g 'basic curry with coconut' in the dietary assessment software Kai-culator. The nutrient content of one cup of 'Soymeat coconut curry' was then generated. Recipes for similar food items grouped as one were developed by averaging the quantity of the main ingredients. For example, low-fat flat breads such as Naan, Chappathy and Roti were grouped as one. Since Roti and Chapatthy are more frequently eaten than Naan, the main ingredient was assumed to be whole wheat flour. The quantity of flour used for one medium-sized Naan, Chappathy or Roti was averaged to produce the quantity of flour in one of the combined food items. The recipe for high-fat flat bread such as 'Parata' was developed separately and was included as a separate food item. Nutrient data for the ethnic foods were calculated from the recipe; however, where a suitable match from the FOODfiles was possible, this was done. For example, ghee was matched to butter, salted.

Estimation of nutrient intakes

Daily intake of nutrients was estimated by multiplying the reported frequency of consumption of individual FFQ items by the corresponding nutrient composition and then converting weekly intakes to daily nutrient intakes. Where applicable, the midpoint of the frequency categories was used, so that 2 to 4 times/week was assigned a frequency of 3. For the extreme categories, Never or less than once per month was assigned a frequency of 0·5 and two or more times every day was assigned a frequency of 2.

Statistical analysis (test–retest of FFQ)

For the participants with usable data at both time points (n 95), ICC were calculated using the two-way mixed-effects model for absolute agreement based on a single measurement. Stata 16.1 was used for these calculations.

Results

The original NZFFQ had 154 food items[19]. Table 1 shows the changes made to the validated NZFFQ to produce the NZSAFFQ. Review of foods consumed by participants of SA ethnicity in the 2008/09 ANS did not result in the addition of any new food items. The in-person audit of ethnic stores and scan of ethnic food store websites in NZ resulted in adding 20 new food items to the NZFFQ. The draft NZSAFFQ was further refined using three focus group discussions (Auckland = 2; Dunedin = 1) with the target population (n 29). The majority of those who participated in the focus group discussions were female (62 %), aged 25–35 years (45 %), practised Hindu religion (48 %), were from India (48 %) and had lived in New Zealand for 5 years or less (48 %) (Table 2).

The focus group discussions resulted in creating a new food group 'Lentil, Dhals and Meat Substitutes', adding 'potato' except for French fries under the 'Vegetable food

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Table 1 Food group and food item changes made to the New Zealand South Asian FFQ (NZSAFFQ)

Food group	Food items
1. Dairy products and eggs	Low-fat yoghurt, fromage frais were removed. Low-fat, standard and full-fat options of yoghurt/curd of a traditional brand 'Gopala' and paneer (Indian cottage cheese) were added
2. Dairy and fat spreads	No food items were removed; ghee and vanaspati (fully or partially hydrogenated vegetable cooking oil) were added
3. Fruit	No food items were removed; mango, pineapple and papaya were added
4. Vegetables	Okara, drumsticks-vegetable (Moringa oleifera), egg plant, gourds and potato (except consumed as fries) were added; lentil, chickpea and pulses were removed.
5. Meat, poultry and fish	Meat substitutes were removed; goat meat was added; pies and sausage rolls were combined. Curry with coconut milk and without coconut milk were separated into two food items.
6. Lentil, dhals and meat substitutes	A new food group was added. Curry with coconut milk and without coconut milk were separated into two food items.
7. Bread and savoury biscuits	Naan, poppadoms, flour tortillas (one food item) was deleted and naan and roti, parota, puris, dosas (rice and pulse pancake) and idlis (rice and pulse steamed dumpling) were added as separate food items. Poppadom was listed as a separate food item.
8. Soups, sauces, chutneys and spreads	Pickles and chutney (one food item) was deleted and listed as pickles, chutneys without coconut and chutneys with coconut separately.
9. Sweets and snacks	Traditional options were provided for 'milk puddings'. Milk-based, lentil-based, nut-based sweets were listed separately. Savoury items such as samosas, lentil-based snacks and banana chips were added as separate food items
10. Cereal, rice, pasta, pizza and French fries	Cereal was a separate food group in the NZFFQ. Potatoes, rice and pasta were also a separate food group in the NZFFQ. These two groups were combined to form the cereal, rice, pasta, pizza and French fries food group. Rice dishes were separately listed as 'plain cooked brown rice', 'plain cooked white rice', 'flavoured rice', 'rice and meat/fish' (e.g. Biriyani). 'Spiced semolina dry porridge' was added as a food item.
11. Drinks	Milk-based tea, milk-based Ready to Drink (RTD) (e.g. Amul Kool, Badam milk), and fruit drink (e.g. Just Juice, Frooti, Maaza Mango) were added as separate food items

group', 'Goat meat' in the 'Meat, Poultry and Fish' food group, adding other rice and wheat-based traditional breads and porridges in the 'Bread and Savoury biscuit' group, listing pickles and chutneys separately in the 'Soups, Sauces, Chutneys and Spreads' food group, providing traditional options for 'milk puddings' (for example, Payasam, Kheer and Shola-e-zard) and milk-based tea in the 'drinks' food group. Foods not eaten by the target population were also removed based on the feedback from the focus group discussion (Table 1). The final NZSAFFQ resulted in 11 food groups and 180 food items.

Of the 150 participants recruited to test–retest the NZSAFFQ, 110 completed the first FFQ (73 %) and 95 (85 % of those recruited) completed the FFQ at both time points. The mean (SD) age of the participants was 36 (7·3) years, 59 % were female, 58 % were new migrants (5 years or less in NZ), 50 % practised Hindu religion, 68 % were from India and 86 % had a tertiary qualification (Table 2). Those who did not participate in the retest (n 15) were not different to those who participated in the test–retest (n 95) with respect to age (36·7 (6·7) years $v.$ 35·8 (7·5) years; $P = 0·657$, gender ($P = 0·414$), duration of residence in NZ ($P = 0·608$), country of origin ($P = 0·651$), study site ($P = 0·598$), employment ($P = 0·429$) and BMI (26·8 (4·2) $v.$ 25·5 (3·7)). Analysis for selection bias could not be done for educational level and income due to small cell numbers (<5) even after collapsing the categories.

Table 3 presents the reproducibility of the NZSAFFQ administered 6 months apart for selected nutrients. The lowest ICC were observed for β-carotene (0·47), vitamin B_{12} (0·50), fructose (0·55), vitamin C (0·57) and selenium (0·58), and the highest ICC were observed for alcohol (0·81), iodine (0·79) and folate (0·77). The ICC for fat ranged from 0·70 for saturated fats to 0·77 for polyunsaturated fats. The ICC for protein and energy were 0·68 and 0·72, respectively.

Discussion

The current study was designed and carried out in response to a lack of an ethnic-specific FFQ for SA, an ethnic minority in NZ, who are at high risk for diet-related chronic diseases. The study followed a culturally appropriate approach to develop and test the reproducibility of the ethnic-specific tool. To ensure that the research is relevant to NZ SA and to build a sound researcher–community partnership[26], engagement with the SA community was central to the process adopted to develop an ethnic-specific FFQ for this population. This methodology resulted in the stepwise tailoring of an FFQ developed for the NZ population, specific for the NZ SA population (NZSAFFQ). The results of the study indicate that the NZSAFFQ had a high level of reproducibility for estimating nutrient intakes.

Inclusion of ethnic foods in population-based dietary surveys is paramount as evidence indicates that these foods are habitually consumed by migrant ethnic groups and hence contribute significantly to nutrient intakes and variability in nutrient intakes between population subgroups[29]. However, when adapting dietary assessment tools for migrant subgroups, it is inherently difficult to extend the food list to reflect ethnic food items and

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Table 2 Characteristics of participants of the focus group discussions (*n* 29) and reproducibility study (*n* 110)

Characteristics	%	*n*
Focus group discussions		
Gender		
Male	38	11
Female	62	18
Age categories (years)		
25–35	45	13
36–45	31	9
46–59	24	7
Religion		
Hindu	69	20
Christian	3·5	1
Muslim	24	7
Buddhist	3·5	1
Country of origin		
India	48	14
Sri Lanka	24	7
Nepal	7	2
Pakistan	10·5	3
Bangladesh	10·5	3
Duration of residence in New Zealand		
≤ 1–5 years	48	14
6–10 years	21	6
More than 10 years	31	9
Reproducibility study		
Gender		
Male	41	45
Female	59	65
Age (years), mean (SD)*	36	7·3
Age categories (years)*		
25–35	66	71
36–45	23	25
46–59	11	12
Education*		
Completed tertiary	86	94
Some tertiary	10	11
Completed or some secondary school	4	4
Employment		
Full-time employed	56	61
Part-time employed	15	17
Running own business	8	9
Not employed in paid job	2	2
Not employed	19	21
Income*		
Less than 20 000	4	4
20 000–50 000	28	31
50 000–70 000	12	13
More than 70 000	32	35
Do not want to answer	24	27
Religion		
Hindu	50	55
Christian	30	33
Muslim	13	14
Buddhist	1·0	1
Other/none	6	7
Country of origin		
India	69	76
Sri Lanka	11	12
Nepal	10	11
Pakistan	6	7
Bangladesh	4	4
Duration of residence in New Zealand*		
≤ 1–5 years	59	64
6–10 years	28	30
More than 10 years	13	15
BMI (kg/m^2), mean (SD)	26	3·8
Ethnic-specific BMI categories*		
Normal	20	22
Overweight	23	25
Obese	57	62
Study site		
Auckland	46	52
Dunedin	54	60

*Missing *n* 1.

quantify portion sizes of traditional foods[30]. This has resulted in adopting differing methodologies to develop ethnic-specific dietary assessment tools to collect dietary data from migrant groups[21,22,31–33]. Sevak *et al.* (2004) developed an FFQ for SA women in the UK using twelve 24-h recalls over a 1-year period, which resulted in an FFQ with 207 food items[22]. Khokar *et al.* (2013) developed a 278-item FFQ for migrant SA in the UK using a complex approach[32]. In contrast, for the current study, the SA-specific FFQ was developed from one validated for NZ adults. Nevertheless, as the NZFFQ was developed for the population as a whole, the majority of the participants (81 %) were of European origin[19] and hence, representation of other NZ ethnicities in the study was inadequate. Further, since the study was done in one locality[19], generalisability of the findings to NZ as a whole was poor. In contrast, to enhance external validity of the findings, the current study was done in two separate sites, Auckland which has the majority of SA living in NZ (64 %)[1] and Dunedin a smaller city (~2 % of the total SA in NZ)[1].

Using population-based dietary survey data as a source for including ethnic-specific foods is a commonly adopted approach[33]. A similar approach was also used in the current study; however, this did not result in the addition of any new food items. This may be because the 2008/09 ANS data were also used to refine the EPIC FFQ to develop the NZFFQ[19], and hence, SA-specific foods may have already been included.

Standard procedures for developing ethnic-specific FFQ such as pre-testing via interviews and focus group discussions with specific ethnic groups have been adopted in other studies[34]; however, to the best of our knowledge, there are no other studies that has used a community-centric approach as done in the current study. Using this novel approach enabled obtaining responses from participants of various SA subgroups in NZ. Although this study was not designed to achieve a statistically representative sample, the majority of the participants were of Indian origin (68 %; Table 2), which is similar to the trend seen nationally[1]. The age distribution of the sample also followed a similar trend to that seen nationally with the majority being those aged 25–35 years (65 % *v.* 49 %), followed by those aged 36–45 years (23 % *v.* 36 %) and 46–59 years (13 % *v.* 14·5 %)[1]. However, the distribution according to gender did not match that of the population, as the study had more female participants (59 % *v.* 46 %) than male (41 % *v.* 54 %). This gender bias maybe because in Asian

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Table 3 Reproducibility of the NZSAFFQ (*n* 95)

Nutrient	Intraclass correlation coefficients (ICC)*	95 % CI
Energy	0·72	0·61, 0·80
Protein	0·68	0·55, 0·77
Total fat	0·74	0·63, 0·82
Saturated fat	0·70	0·58, 0·79
Monounsaturated fat	0·76	0·66, 0·83
Polyunsaturated fat	0·77	0·67, 0·84
Cholesterol	0·69	0·56, 0·78
Carboydrate	0·70	0·58, 0·79
Sucrose	0·74	0·63, 0·82
Fructose	0·55	0·39, 0·67
Fibre	0·66	0·53, 0·76
Alcohol	0·81	0·73, 0·87
Total vitamin A	0·56	0·40, 0·68
β-carotene	0·47	0·30, 0·61
Retinol	0·66	0·54, 0·76
Thiamin	0·65	0·52, 0·75
Riboflavin	0·63	0·49, 0·74
Niacin equivalents	0·68	0·56, 0·78
Vitamin B_6	0·68	0·56, 0·78
Folate	0·77	0·67, 0·84
Vitamin B_{12}	0·50	0·33, 0·64
Vitamin C	0·57	0·42, 0·69
Vitamin E	0·72	0·61, 0·81
Ca	0·67	0·54, 0·77
K	0·73	0·62, 0·81
Fe	0·68	0·55, 0·77
I	0·79	0·70, 0·86
Se	0·58	0·43, 0·70
Na	0·73	0·62, 0·81
Mg	0·71	0·59, 0·80
Mn	0·63	0·49, 0·74
Zn	0·64	0·51, 0·75

*ICC between the first and second administrations of the NZSAFFQ.

cultures women are typically more responsible for purchasing and preparing food and hence more likely to be engaged in diet-related research than men.

Overall, the NZSAFFQ showed good reproducibility between the two FFQ administrations, 6 months apart, for estimating nutrient intakes. Most reproducibility coefficients were within or higher than the acceptable range of 0·5–0·7[9,34] and was similar (0·47–0·81) to that reported for the NZFFQ (0·47–0·83)[19], despite the fact that the NZSAFFQ was a quantitative FFQ in contrast to the semi-quantitative nature of the NZFFQ. Further development of the NZSAFFQ with pre-determined portion sizes derived from the current study may be useful to reduce respondent burden in future studies.

One of the strengths of this study is using a culturally appropriate method for the targeted population to ensure adequate participation and building of long-term relationships. In addition, the study used an instrument validated for NZ adults as a starting point. Nevertheless, due to time and funding constraints repeat administration of the FFQ was done only 6 months apart, and hence seasonal variation of food intake due to differing seasonal availability of foods was less likely to be accounted for. However, this did not impact on the reproducibility coefficients for most nutrients compared to the NZFFQ which was administered 9 months apart. Further, for the reasons stated above, conducting food group analysis was also beyond the scope of the study. Nevertheless, such analysis would be important to generate dietary patterns and its associations with diet-related diseases and develop ethnic-specific food-based guidelines.

As changes in the design of an FFQ can impact its performance[35], the next phase of this research is to validate the NZSAFFQ with an appropriate dietary assessment method for estimating nutrient intakes and also conduct food group analysis to generate dietary patterns. It would also be useful to develop a short NZSAFFQ as was done with the NZFFQ[36] to enable easier participation in epidemiological studies on diet and disease, critical for the SA diaspora.

Conclusions

The current study has laid the foundation for addressing diet-related chronic disease among SA in NZ. The developed FFQ showed good reproducibility for most nutrients and warrants the need for validation of the instrument.

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