



Post-migration food habits of New Zealand South Asian migrants: Implications for health promotion practice

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ABSTRACT

Introduction: South Asian migrants in western countries have a high risk for diet related diseases post-migration. Hence knowledge on food habits that change post-migration, which are detrimental to health, are critical for health promotion initiatives to reduce this disease burden.

Objective: to describe food consumption changes post-migration according to sex and duration of residence in New Zealand among South Asian migrants.

Methods: A cross-sectional mail survey of 150 self-selected people of South Asian ethnicity aged 25–59 years in New Zealand.

Results: The study achieved responses from 112 participants (75%) with a mean age of 36 (7.5) years. Consumption of green leafy vegetables reduced post-migration for females and in new migrants ($P < 0.05$). Fruit consumption increased in both genders and across duration of residence ($P < 0.05$). Only 15% of males and 36% of females met the 3 + a day recommendation for vegetable consumption. Consumption of traditional breads, breakfast items and rice (males) decreased whilst that of breakfast cereals increased ($P < 0.05$). Consumption of low-fat milk, cheese, ice-cream, butter (females) and margarine increased, whilst ghee decreased ($P < 0.05$). Consumption of fish, lentils, traditional sweets and savouries decreased, whilst meat, processed meat, chicken, potato chips, cakes and pastries (females) and alcohol (males) increased ($P < 0.05$), post-migration. Thirty-three percent of males and 24% of females consumed takeaways “weekly or more often”, with the majority (male: 51%; female: 36%) consuming European foods such as pizzas and pastas. Thirteen percent of males and 26% of females consumed festival foods “weekly or more often.” More than half the participants were obese with BMI increasing with duration of residence ($P = 0.025$).

Conclusions: A food-based health promotion initiative focused on inadequate consumption of fruits and vegetables, increased consumption of dairy foods such as cheese and ice cream, and high fat European takeaway foods would be warranted particularly in new South Asian migrants.

1. Introduction

Post-migration changes in food habits of immigrants are a result of dietary acculturation, defined as “the process that occurs when members of a minority group adopt the food choices and eating habits of the host country” (Satia et al., 2001). The process of migration has been postulated as a turning point for changed food habits (Terragni et al., 2014). Dietary acculturation is influenced by the strength of ties maintained with the country of origin, social context of migration, formation of new social networks, fluency in the host language, age at migration, phase of life, work or school attendance, socioeconomic status, duration of stay in the host country, employment, availability and affordability of cultural foods, disposable income available for food purchase, dietary laws, and

religion (Gilbert and Khokar, 2008; Satia-About et al., 2002). The degree of exposure to the host culture in turn leads to changes in psychological factors, taste preferences and changes in food procurement and preparation (Satia-About et al., 2002). Longer duration of residence in the host country, higher levels of English language skills, having no religious affiliations and having higher levels of income have been shown to be associated with adopting “assimilation” and “integration” acculturation strategies in contrast to a “separation” acculturation strategy (Needham et al., 2017). Identity issues among Asian migrants have also been postulated as a trigger for changing food habits as duration of residence increases, leading to a decline in the nutritional quality of the foods consumed (Guendelman et al., 2011).

Dietary acculturation leads to the adoption of a “western” diet

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typically high in meat and dairy and low in grains, lentils, fruit and vegetables and has serious implications for the onset of diet related chronic diseases in the South Asian diaspora (Bhupathiraju et al., 2018; Creatore et al., 2010; Jenum et al., 2012; Parackal et al., 2015), both among first (Garduño-Díaz and Khokhar, 2012) and subsequent (Edwards et al., 2006) generations. Hence, designing health promotion initiatives to reduce this disease burden is imperative and requires understanding of the food consumption patterns that change post-migration which are detrimental and protective to health. Ethnic specific dietary acculturation scales such as the Asian Indian Dietary Acculturation measure (Venkatesh and Weatherspoon, 2018) have been used to understand dietary acculturation and the associated factors, nevertheless the findings of such studies have limited impact on designing food-based health promotion initiatives. This is primarily because an understanding of what foods change and when the consumption of these foods changes post-migration is critical to enable designing a targeted food-based health promotion initiative. Further, studies that have investigated changes in food habits post-migration that have considered the impact of nutrition transition in migrant source countries are also sparse or absent. Such understanding is also critical to enable designing a targeted food-based health promotion initiative, as nutrition transition in Asian countries has changed food procurement and dietary practices (Popkin, 2003) and hence, migrants arriving from Asian countries to a western country are already exposed to western foods.

The current study opportunistically used the dietary habits data collected as part of a study that developed an ethnic specific food frequency questionnaire for South Asian migrants in New Zealand (Parackal et al., 2021). The study aimed to describe changes in food habits post-migration, taking into consideration the changes that have occurred due to the nutrition transition in countries of origin. Specific study objectives were to describe the post-migration changes in food consumption according to sex and duration of residence in New Zealand among South Asian migrants.

Methods

1.1. Research design and participant recruitment

To achieve the aim of the study, data on post-migration changes in food habits were collected from a self-selected convenience sample of South Asian migrants in NZ, recruited via a respondent driven sampling method (Badowski et al., 2017). Extensive engagement with the South Asian community was undertaken to facilitate community buy-in and participant recruitment. The study rationale, aims, scope and community benefits were discussed at two workshops following which the community was invited to register their interest in the study. The majority of the participants were recruited during these community meetings. Participants were also encouraged to share the study flier with their networks which resulted in recruiting 150 participants for the study. No incentive was offered for facilitating participant recruitment for the study. The inclusion criteria for the study were 1) South Asian 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 (for example, type 2 diabetes or coeliac disease). In order to enhance the external validity (generalizability) of the study results, the study had two sites, namely Auckland (North Island) and Dunedin (South Island). Ethics approval for the study was obtained from the University of Otago Human Ethics Committee (Ref: 17/028; date 1/05/2017).

1.2. Data collection

Data collection was achieved via a self-administered study specific questionnaire which contained questions on demographics including

country of birth and year arrived in NZ. Duration of residence in NZ was derived by subtracting year of arrival in NZ from the year of the study and participants were categorised as living in NZ for 5 years or less, 6–10 years, and more than 10 years. The study questionnaire also contained questions on food habits such as vegetarianism, meeting the fruit and vegetable consumption guideline, consumption of traditional pickles, fast foods, festival foods (defined as celebratory foods such as biriyani, milk and sugar based sweets, fried sweets etc. that are considered nutritionally “rich” and are high in fat and sugar), alcoholic and non-alcoholic beverages and a battery of questions on frequency of consumption of thirty food items previously identified using qualitative methods on 30 South Asian first-generation migrants living in the Auckland region (an unpublished smaller study). Eight frequency descriptors with pre-determined scores were used by participants to score their frequency of consumption of each of the listed foods in NZ and back in their country of origin (“Home Country”). These descriptors were i) Never (score = 0) ii) Occasionally (score = 1) iii) Less than once a month (score = 2) iv) Once or twice a month (score = 3) v) Once or twice a week (score = 4) vi) 3–4 times a week (score = 5) vii) 5–6 times a week (score = 6) viii) Daily (score = 7). Participants were asked to allocate the appropriate score to each of the listed food items separately for “New Zealand” and “Back home.” Participants were also asked to self-report their height and weight measurements using centimetres or metres and kilograms respectively. Body Mass Index (BMI) was calculated, and participants were categorised as normal, overweight, or obese using the World Health Organisation’s ethnic specific definitions (WHO Expert Consultation 2004).

2.3. Statistical analysis

All statistical analysis was done using IBM SPSS version 22. Descriptive statistics (counts, percentages and means with SD) were used to describe the sample characteristics. Paired *t*-test was used to describe frequency changes in consuming specific food items in NZ and in the country of origin prior to migration according to gender and duration of residence.

2. Results

Of the 150 participants recruited, 112 (75%) self-completed the questionnaire. As shown in Table 1, the mean (SD) age of the participants was 36 (7.5) years, 59% were female, 58% had lived in NZ five years or less, 50% practised the Hindu religion, 68% were from India and 86% had a tertiary qualification. Fifty-two percent of females were employed in contrast to 94% of males ($P = 0.003$). Twenty three percent were overweight and 57% were obese and BMI progressively increased as duration of residence increased ($P = 0.025$).

Seventy percent of the sample were non-vegetarian with only half meeting the guideline for fruit consumption and 28% for vegetable consumption. A sex difference was observed for meeting the guidelines for vegetable consumption with only 15% of males doing so in contrast to 36% of females ($P = 0.011$). Twenty-eight percent consumed takeaways weekly or more often with 42% usually eating European foods such as pizzas, pastas and fried chicken. One in five consumed festival foods weekly or more often and males were significantly more likely to consume sugar sweetened beverages ($P = 0.03$) and alcohol ($P = 0.000$) weekly or more often.

Changes in the frequency of consuming specific foods post-migration according to sex and duration of residence are tabulated in Tables 2 and 3 respectively. Consumption of green leafy vegetables was significantly reduced for females ($P = 0.007$; Table 2) and those who had lived in NZ five year or less ($P = 0.001$; Table 3). In contrast, consumption of fruit post-migration, increased for both male and female participants ($P = 0.000$; Table 2) and was consistent across all three levels of duration of residence ($P < 0.05$; Table 3).

Consumption of traditional breakfast items decreased, whilst

Table 1Demographic, dietary and anthropometric characteristics of participants ($n = 112$).

Characteristics Demographic	% (n)
Sex	
Male	41 (46)
Female	59 (66)
Age (years), mean (SD)^a	36 (7.5)
Age categories (years)^a	
25–35	65 (72)
36–45	23 (25)
46–59	13 (14)
Education^a	
Completed tertiary	86 (95)
Some tertiary	10 (11)
Completed secondary school	4 (4)
Some secondary school	1 (1)
Employment^a	
Full time employed	56 (62)
Part time employed	15 (17)
Running own business	8 (9)
Not employed in paid job	2 (2)
Not employed	19 (21)
Income^a	
Less than 20,000	4 (4)
20,000–50,000	29 (32)
50,000–70,000	12 (13)
More than 70,000	32 (35)
Do not want to answer	24 (27)
Religion	
Hindu	50 (56)
Christian	30 (33)
Muslim	13 (15)
Buddhist	1.0 (1)
Other/none	6 (7)
Study Site	
Auckland	46 (52)
Dunedin	54 (60)
Country of Birth	
India	68 (76)
Sri Lanka	12 (13)
Nepal	10 (11)
Pakistan	7 (8)
Bangladesh	4 (4)
Duration of residence in New Zealand	
≤ 1–5 years	58 (65)
6–10 years	28 (31)
More than 10 years	14 (16)
Dietary	
Non-Vegetarian	70 (78)
Meeting fruit consumption guideline (2 + a day)	47 (53)
Meeting vegetable consumption guideline (3 + a day)^b	28 (31)
Traditional Pickle consumption^a	
Sometimes	54 (60)
Regularly/Always	18 (20)
Take Away Consumption	
Less than weekly	63 (70)
Weekly or more often	28 (31)
Type of Take Away usually consumed^c	
European (Pizza, Pasta, Fried Chicken)	42 (46)
Asian/other	58 (69)
Consumption of festival foods^d	
Less than weekly	36 (40)
Weekly or more often	21 (23)
Sugar Sweetened Beverage Consumption^e	
Less than weekly	58 (65)
Weekly or more often	18 (23)
Alcoholic Beverage Consumption^e	
Less than weekly	35 (39)
Weekly or more often	13 (14)
Anthropometric	
Body mass Index (kg/m²), mean (SD)^f	26 (3.8)
Ethnic specific BMI categories^f	
Normal	20 (22)
Overweight	23 (25)
Obese	57 (63)

Table 1 (continued)

Characteristics Demographic	% (n)
Mean Body Mass Index (kg/m²) according to duration of residence^g	
≤ 1–5 years	24.9 (3.5)
6–10 years	26.0 (4.5)
More than 10 years	27.8 (2.5)

^a missing $n = 1$.^b significantly lower in males ($P = 0.011$).^c missing $n = 3$.^d defined as celebratory foods high in fat and/or sugar.^e Weekly or more often" consumption higher in males ($P < 0.05$).^f missing $n = 2$.^g $P = 0.025$.

consumption of breakfast cereals increased significantly post-migration in both males and females ($P = 0.000$; Table 2) and in all levels of duration of residence ($P < 0.05$; Table 3). Rice consumption post-migration decreased only in males ($P = 0.004$; Table 2) and was consistent across all levels of duration of residence ($P < 0.05$; Table 3).

Consumption of low-fat milk, cheese, ice-cream, and margarine increased whilst consumption of ghee decreased post-migration in both males and females ($P < 0.05$; Table 2). Consumption of low-fat milk increased only in those who had lived in NZ for more than five years ($P < 0.05$; Table 3), whilst cream and paneer consumption increased only in those who lived in NZ for more than ten years ($P < 0.05$; Table 3). Cheese consumption increased in all levels of duration of residence ($P < 0.05$; Table 3). Interestingly, consumption of curd (plain yoghurt) did not decrease among those who had lived in NZ for five years or less but a trend towards decreased consumption was observed in those who had lived in NZ for longer than five years ($P = 0.091$) and significantly decreased among those who had lived in NZ for more than ten years ($P = 0.024$; Table 3). Ice-cream consumption significantly increased in those who had lived in NZ for ten years or less ($P < 0.05$; Table 3). Ghee consumption decreased in those who had lived in NZ for five years or less only ($P = 0.000$) and consequently butter consumption increased ($P = 0.000$) in this group (Table 3). Increased consumption of margarine was consistent across all levels of duration of residence ($P < 0.05$; Table 3).

Consumption of fish and lentils decreased, whilst meat, processed meat and chicken increased post-migration in both males and females ($P < 0.05$; Table 2). Increased meat consumption and decreased lentil consumption was only significant in those who had lived in NZ for ten years or less ($P < 0.05$; Table 3). Increased consumption of processed meat and chicken and decreased consumption of fish was consistent in all levels of duration of residence ($P < 0.05$; Table 3).

Consumption of traditional sweets and savouries decreased, and savoury chips increased in both males and females ($P < 0.05$; Table 2), whilst consumption of cakes and pastries only increased among female participants ($P = 0.001$; Table 2). Increased consumption of cakes and pastries and potato chips and decreased consumption of traditional sweets and savouries were significant only in those who had lived in NZ for ten years or less ($P < 0.05$; Table 3). Alcohol consumption increased significantly post-migration among male participants ($P = 0.006$; Table 2) but was only significant for those who had lived in NZ for more than five years ($P < 0.05$; Table 3).

3. Discussion

The current study aimed to describe post-migration changes in food consumption among South Asian migrants in NZ. Gaining an understanding of these food related issues specific to the South Asian diaspora is critically important to address the higher risk of diet-related chronic diseases observed in this population, nevertheless such studies are currently sparse. The findings of the current study contribute to an understanding of what foods change and when these food consumption

Table 2Post-migration changes in food consumption according to Sex ($n = 112$)^{a,b}.

Food Item	Mean Difference NZ-Home Country	SEM	95% CI Lower	Upper	t	df	P value
Green Leafy Vegetables							
Male	-0.457	0.27	-0.99	0.08	-1.72	45	0.092
Female	-0.462	0.17	-0.80	-0.13	-2.76	64	0.007
Other Vegetables							
Male	0.000	0.23	-0.46	0.46	0.00	45	1.000
Female	-0.138	0.12	-0.39	0.11	-1.12	64	0.268
Fruits							
Male	1.457	0.26	0.93	1.99	5.53	45	0.000
Female	1.323	0.22	0.88	1.76	6.00	64	0.000
White Bread ^c							
Male	0.565	0.37	-0.17	1.30	1.55	45	0.128
Female	0.516	0.29	-0.04	1.07	1.85	63	0.068
Wholemeal Bread							
Male	1.717	0.96	-0.22	3.66	1.78	45	0.081
Female	2.031	0.28	1.48	2.59	7.32	64	0.000
Traditional breads							
Male	-0.630	0.26	-1.15	-0.11	-2.44	45	0.019
Female	-1.169	0.51	-2.20	-0.14	-2.28	64	0.026
Rice ^c							
Male	-0.609	0.20	-1.01	-0.20	-3.04	45	0.004
Female	-0.250	0.14	-0.54	0.04	-1.73	63	0.088
Breakfast Cereals							
Male	2.587	0.35	1.88	3.29	7.37	45	0.000
Female	2.477	0.34	1.79	3.16	7.23	64	0.000
Traditional breakfast							
Male	-1.630	0.31	-2.26	-0.10	-5.19	45	0.000
Female	-1.723	0.26	-2.24	-1.21	-6.70	64	0.000
Standard Milk							
Male	0.457	0.36	-0.27	1.18	1.27	45	0.211
Female	-0.231	0.34	-0.91	0.45	-0.68	64	0.502
Low Fat milk							
Male	0.848	0.39	0.05	1.64	2.15	45	0.037
Female	0.677	0.30	0.08	1.27	2.26	64	0.027
Cream							
Male	0.130	0.22	-0.32	0.58	0.58	45	0.562
Female	0.262	0.20	-0.14	0.67	1.29	64	0.201
Cheese ^c							
Male	2.044	0.29	1.46	2.63	7.02	44	0.000
Female	1.646	0.26	1.13	2.16	6.38	64	0.000
Paneer (cottage cheese) ^d							
Male	0.178	0.68	-1.20	1.55	0.26	44	0.795
Female	0.188	0.20	-0.22	0.59	0.93	63	0.359
Curd (Plain Yoghurt) ^c							
Male	0.089	0.23	-0.38	0.56	0.38	44	0.705
Female	-0.415	0.24	-0.90	0.07	-1.71	64	0.092
Ice Cream ^c							
Male	0.844	0.32	0.21	1.48	2.69	44	0.010
Female	0.415	0.15	0.11	0.72	2.74	64	0.008
Ghee ^c							
Male	-0.956	0.21	-1.38	-0.54	-4.59	44	0.000
Female	-0.692	0.23	-1.16	-0.23	-2.96	64	0.004
Butter ^c							
Male	0.444	0.31	-0.19	1.07	1.42	44	0.162
Female	0.846	0.27	0.31	1.38	3.17	64	0.002
Margarine ^c							
Male	0.778	0.26	0.26	1.29	3.04	44	0.004
Female	0.800	0.19	0.42	1.18	4.24	64	0.000
Meat							
Male	0.587	0.23	0.13	1.05	2.58	45	0.013
Female	0.415	0.14	0.13	0.70	2.93	64	0.005
Processed meat							
Male	1.413	0.30	0.81	2.02	4.73	45	0.000
Female	0.462	0.18	0.11	0.82	2.61	64	0.011
Chicken							
Male	0.652	0.17	0.31	0.10	3.82	45	0.000
Female	0.492	0.13	0.23	0.76	3.69	64	0.000
Fish							
Male	-1.022	0.27	-1.59	-0.49	-3.83	45	0.000
Female	-0.677	0.22	-1.12	-0.24	-3.09	64	0.003
Lentils							
Male	-0.978	0.23	-1.44	-0.52	-4.26	45	0.000

Table 2 (continued)

Food Item	Mean Difference NZ-Home Country	SEM	95% CI Lower	Upper	t	df	P value
Female	-0.492	0.19	-0.88	-0.11	-2.56	64	0.013
Traditional Sweets ^c							
Male	-0.756	0.17	-1.09	-0.42	-4.56	44	0.000
Female	-0.492	0.24	-0.98	-0.01	-2.02	64	0.047
Cakes and Pastries ^c							
Male	0.422	0.24	-0.06	0.90	1.77	44	0.084
Female	0.646	0.19	0.28	1.02	3.49	64	0.001
Traditional Savouries ^c							
Male	-1.178	0.27	-1.72	-0.64	-4.39	44	0.000
Female	-0.769	0.17	-1.10	-0.44	-4.62	64	0.000
Potato Chips ^c							
Male	1.222	0.21	0.79	1.65	5.74	44	0.000
Female	1.154	0.22	0.72	1.59	5.26	64	0.000
Non-Alcoholic Beverages ^c							
Male	0.156	0.28	-0.40	0.71	0.57	44	0.575
Female	-0.154	0.16	-0.47	0.17	-0.96	64	0.340
Alcohol ^d							
Male	0.378	0.13	0.11	0.64	2.86	44	0.006
Female	0.156	0.11	-0.06	0.37	1.47	63	0.150

^a Paired t-test.^b missing data $n = 1$.^c missing data $n = 2$.^d missing data $n = 3$.

changes occur post-migration enabling the delineation of the impact of the nutrition transition in South Asian countries.

The impact of nutrition transition experienced in Asian countries in the last few decades (Popkin, 2003) was clearly seen with respect to vegetable consumption. Only 36% of female and 11% of male participants met the 3 + a day serving of vegetable consumption in NZ ($P = 0.011$; Table 1). In a global study of 52 countries, 74% of Indians, 67–68% of Sri Lankans, 98–99% of Nepalese, 99% of Pakistanis and 46–48% of Bangladeshis did not meet the recommended 5 + a day consumption of fruit and vegetables (Hall et al., 2009). Country specific studies have also echoed these findings with only 2% of Nepalese (Vaidya et al., 2013), 3.5% of Sri Lankans (Jayawardena et al., 2012), meeting the 5 + a day fruit and vegetable servings and 70% of Indians consuming less than 3 servings of fruit and vegetables (Gupta et al., 2012).

Although only half the sample met the recommendation for fruit consumption, post-migration consumption of fruits increased with duration of residence in NZ ($P = 0.007$; Table 3). Similar results were observed in a Canadian study, where both fruit and vegetable consumption increased with duration of residence and consequently those who had the longest duration of residence in Canada also had a lower BMI (Lesser et al., 2014). These observations are encouraging and provide the impetus to further investigate ways of improving fruit and vegetable consumption among South Asian migrants as adequate fruit and vegetable consumption is an established protective factor against chronic diseases (Lock et al., 2005). Increased consumption of low-fat milk post-migration ($P < 0.05$; Table 2) was also encouraging, nevertheless was only significant for migrants who had lived in NZ for more than five years, indicating the adoption of certain healthy food habits as duration of residence increases ($P < 0.05$; Table 3). Similar findings were observed for Pakistani migrant women in Oslo, Norway (Oslo study) who switched to low-fat milk post-migration (Mellin-Olsen and Wandel, 2007).

Adopting unhealthy food habits post-migration was also evident in the sample. A significant change was lower consumption of green leafy vegetables post-migration (Female: $P = 0.007$; Male: $P = 0.092$; Table 2), especially among those who had lived five years or less in NZ ($P = 0.001$; Table 3). Similarly, lower consumption of rice, traditional breads, traditional breakfast and increased consumption of bread and breakfast cereals among both sexes ($P < 0.05$; Table 2) was noteworthy.

Table 3Post-migration changes in food consumption according to duration of residence ($n = 112$)^{ab}.

Food Item	Duration of Residence 0–5 years ($n = 66$)			6–10 years ($n = 29$)			Above 10 years ($n = 16$)		
	Mean difference (SEM)	<i>t</i>	<i>P</i>	Mean difference (SEM)	<i>t</i>	<i>P</i>	Mean difference (SEM)	<i>t</i>	<i>P</i>
Green Leafy Vegetables	−0.712 (0.21)	−3.35	0.001	−0.103 (0.14)	−0.72	NS	−0.063 (0.41)	−0.15	NS
Fruit	1.015 (0.20)	5.06	0.000	2.069 (0.33)	3.15	0.000	1.625 (0.52)	3.15	0.007
White Bread	0.530 (0.30)	1.80	0.077	0.586 (0.42)	1.40	NS	0.467 (0.58)	0.81	NS
Wholemeal Bread	1.242 (0.68)	1.83	0.072	3.138 (0.38)	8.32	0.000	2.375 (0.55)	4.28	0.001
Traditional Breads	−0.667 (0.24)	−2.77	0.007	−0.414 (0.26)	−1.62	NS	−3.063 (0.50)	−1.62	NS
Rice	−0.318 (0.18)	−1.80	0.077	−0.448 (0.16)	−2.78	0.010	−0.667 (0.25)	−2.65	0.019
Breakfast Cereals	1.803 (0.28)	6.35	0.000	3.483 (0.52)	6.77	0.000	3.750 (0.64)	5.90	0.000
Traditional breakfast	−1.470 (0.25)	−5.92	0.000	−2.103 (0.43)	−4.95	0.000	−1.813 (0.50)	−3.61	0.003
Low Fat milk	0.152 (0.27)	0.56	NS	1.172 (0.47)	2.52	0.018	2.438 (0.75)	3.26	0.005
Cream	−0.152 (0.17)	−0.90	NS	0.172 (0.19)	0.93	NS	1.750 (0.57)	3.09	0.007
Cheese	1.769 (0.24)	7.28	0.000	1.828 (0.38)	4.88	0.000	1.938 (0.61)	3.18	0.006
Paneer	−0.016 (0.49)	−0.032	NS	−0.069 (0.17)	−0.40	NS	1.438 (0.45)	3.22	0.006
Curd (Plain Yoghurt)	0.231 (0.20)	1.15	NS	−0.586 (0.34)	−1.75	0.091	−1.313 (0.52)	−2.51	0.024
Ice-cream	0.615 (0.23)	2.63	0.011	0.724 (0.27)	2.67	0.013	0.250 (0.17)	1.46	NS
Ghee	−1.123 (0.22)	−5.08	0.000	−0.448 (0.37)	−1.45	NS	−0.125 (0.27)	−0.46	NS
Butter	0.785 (0.2)	4.01	0.000	0.345 (0.54)	0.63	NS	0.875 (0.61)	1.43	NS
Margarine	0.538 (0.16)	3.37	0.001	1.103 (0.37)	3.02	0.005	1.250 (0.47)	2.66	0.018
Meat	0.515 (0.17)	3.02	0.004	0.586 (0.25)	2.34	0.027	0.188 (0.25)	0.76	NS
Processed meat	0.515 (0.22)	2.36	0.021	1.379 (0.29)	4.81	0.000	1.313 (0.45)	2.82	0.011
Chicken	0.455 (0.11)	4.11	0.000	0.724 (0.29)	2.51	0.018	0.688 (0.24)	2.91	0.011
Fish	−0.727 (0.24)	−3.09	0.003	−0.724 (0.25)	−2.92	0.007	−1.375 (0.49)	−2.80	0.013
Lentils	−0.788 (0.23)	−3.46	0.001	−0.655 (0.18)	−3.62	0.001	−0.375 (0.27)	−1.38	NS
Traditional Sweets	−0.862 (0.18)	−4.88	0.000	−0.586 (0.24)	−2.49	0.019	0.438 (0.66)	0.66	NS
Cakes and Pastries	0.662 (0.21)	3.09	0.003	0.448 (0.26)	1.75	0.091	0.313 (0.22)	1.43	NS
Traditional savouries	−1.231 (0.20)	−6.29	0.000	−0.724 (0.24)	−2.71	0.011	−0.125 (0.34)	−0.37	NS
Potato chips	1.231 (0.19)	6.58	0.000	1.345 (0.32)	4.27	0.000	0.688 (0.50)	1.38	NS
Non-alcoholic beverages	−0.092 (0.16)	−0.59	NS	0.276 (0.30)	0.92	NS	−0.313 (0.57)	−0.55	NS
Alcoholic beverages	0.063 (0.10)	0.63	NS	0.345 (0.12)	2.77	0.010	0.813 (0.31)	2.66	0.018

In the Oslo study, traditional breads were eaten only on weekends and were replaced during the week with bread and spreads (Mellin-Olsen and Wandel, 2007). Although the current study did not collect data on the dietary habits of household members, in the Oslo study, children were more likely to eat breakfast cereals and bread for breakfast and as sandwiches for lunch (Mellin-Olsen and Wandel, 2007), indicating a possible generational difference and influence on changing food habits. A longer length of residence in America was also associated with lower intakes of breads, grains and flour products and rice, among other foods among South Asian migrants (Talegawkar et al., 2016). In the current study increased consumption of wholemeal bread ($P = 0.072$) and decreased consumption of traditional breads ($P = 0.077$) showed only a trend in those who had lived in NZ five years or less, whilst it was statistically significant for those who lived for more than five years ($P < 0.05$; Table 3), indicating that these changes in food consumption may not be immediate on migration. In contrast, increased consumption of breakfast cereals was significant for all migrants ($P < 0.001$; Table 3). In an Australian study on South Asian women, breakfast was the meal most likely to be “Australianised” (Gallegos and Nasim, 2011). A study on food, culture and identity in multicultural societies identified convenience as a factor for adopting western food practices (Reddy and van Dam, 2020), which may explain the adoption of western breakfast items even in early post-migration years.

Increased consumption of cheese and ice-cream among both male and female participants ($P < 0.05$; Table 2) was worrying, especially as traditional sources of dietary fats such as “paneer” (cottage cheese) and curd (plain yoghurt) did not change post-migration ($P > 0.05$; Table 2). This finding indicates that participants were consuming more cheese and ice-cream over and above their traditional dairy foods. In the Oslo study, cheese which was never consumed prior to migration increased post-migration (Mellin-Olsen and Wandel, 2007). Increased consumption of ice-cream post-migration in the current study was significant only for those who lived in NZ for ten years or less ($P < 0.05$; Table 3). This could be an effect of ease of access and affordability of “novelty” foods in the first few years, post-migration.

The consumption of meat, processed meat and chicken increased

significantly whilst consumption of fish and lentils, a traditional source of protein for South Asians, reduced post-migration ($P < 0.05$; Table 2). These results are similar to those found in the Oslo study, in which participants indicated that “meat is everyday food, freezer filled with meat” in Norway in contrast to “Meat dish, 1–2 per week...” prior to migration (Mellin-Olsen and Wandel, 2007; Wandel et al., 2008). Similarly, lentil consumption also reduced post-migration in this study (Mellin-Olsen and Wandel, 2007; Wandel et al., 2008). In most Asian countries, meat is an expensive food item. Hence, increased affordability of meat in western countries can be a motivating factor for increased consumption post-migration. Interestingly, in the current study, increased meat and decreased lentil consumption were only significant for those who had lived in NZ for ten years or less ($P < 0.05$; Table 3). A linear association was observed for beans and legume consumption and longer duration of residence among South Asians in the UK (Garduno-Diaz and Khokhar, 2012), indicating health promoting dietary changes in the later years of life as a migrant in a western society.

Increased alcohol consumption post-migration ($P < 0.01$; Table 2, Table 3) again provides evidence for adopting unhealthy dietary habits, especially among men. Interestingly, increased alcohol consumption post-migration was only significant among those who had lived in NZ for more than five years ($P < 0.05$; Table 3), which clearly indicates the influence of the host culture as duration of residence increases. Similar findings were observed for South Asians in America, where increased duration of residence was significantly associated with increased consumption of alcohol (Talegawkar et al., 2016).

The finding that nearly half of the sample usually consumed “European” foods is also clearly indicative of adoption of unhealthy food habits. In addition, female participants increased cake and pastry consumption post-migration ($P = 0.001$; Table 2). Other studies have also found that in addition to consuming eastern sweets, consumption of western desserts and cakes also increased (Garduno-Diaz and Khokhar, 2014), possibly due to easy access to “novelty” foods.

In the current study, one in five consumed traditional festival foods that are very high in refined sugar and fat “weekly or more often” (Table 1). A review on the role of festival foods in the immigrants’ diet

clearly highlights the importance it plays in their lives, especially as a comfort food with emotional associations such as childhood memory, self-identity, nationalism or a means of improved socioeconomic status and wealth (Azar et al., 2013). Hence it is possible that frequent consumption of festival foods is a behavior to retain cultural identity and social connectedness. Nevertheless, this finding is concerning as a study on immigrants in Canada found that social connectedness is a significant contributing factor for overweight and obesity among Asian immigrants (McDonald and Kennedy, 2005), possibly because it results in more social gatherings, where “festival foods” could be consumed more frequently.

In the current study, more than half were obese using the WHO ethnic specific categorisations (WHO Expert Consultation 2004). In addition, a linear relationship of higher BMI with duration of residence ($P = 0.025$; Table 1) was also observed, which strengthens the evidence for a negative health impact of changing food habits post-migration. Similar findings are reported for South Asians in the UK, where BMI and waist circumference increased as duration of residence increased (Garduño-Díaz and Khokhar, 2012), possibly due to higher levels of acculturation.

The findings of this study have many implications for health promotion practice especially for new migrants in the first five years post-migration. A review on dietary transition among South Asian migrants has indicated that the first five years since migration maybe a window of opportunity to provide targeted interventions to ensure maintenance of healthy dietary habits (Parackal, 2017). The findings of the current study indicates that interventions targeting new migrants should focus on increasing vegetable and fruit consumption, promote low fat dairy options, increase lentil consumption, decrease high fat and sugar snacks, takeaways and festival foods.

The strength of this study is that changes in food consumption post-migration are described taking into consideration the changes that already occurred due to nutrition transition experienced in Asian countries. This approach has the potential to address poor food habits that pre-existed prior to migration, for example poor adherence to fruit and vegetable consumption guidelines in addition to those adopted post-migration, for example ice-cream and cheese consumption. To the best of the author's knowledge, studies using this approach are sparse or absent. The study has several limitations such as a small sample size, non-inclusion of those with poor proficiency in the English language and the self-report of dietary information and other key variables such as height and weight. Recall bias of frequency of consuming the listed food items especially in the home country cannot be overruled. Since, this was an opportunistic study, a future larger scale study would be warranted to strengthen the findings reported here. Further, the sample size did not allow for sex specific analysis for identifying changes in food habits according to the duration of residence in NZ. As many dietary behaviours were sex specific, such analysis would be key to inform health promotion activities to reduce diet related burden of disease in this population and should be a focus of a future study with an adequate sample size. Nevertheless, the findings of the current study have contributed to improve our understanding of post-migration changes in food consumption among migrants that are detrimental to their health.

4. Conclusions

Overall, the findings of the current study clearly indicate the need for addressing health promoting food habits among South Asian migrants in New Zealand, especially inadequate consumption of fruits and vegetables, increased consumption of dairy foods such as cheese and ice cream, high fat European takeaway foods particularly in new migrants. Established migrants would also benefit from health promotion initiatives especially on alcohol consumption guidelines. The observation that fruit consumption increased post-migration provides the impetus for targeted health promotion initiatives to counteract the effects of the food habits that changed due to the nutrition transition in migrant source countries

and those that are adopted post migration.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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