Ethnicity & Health

ISSN: 1355-7858 (Print) 1465-3419 (Online) Journal homepage: https://www.tandfonline.com/loi/ceth20

Exploring reasons for ethnic disparities in diet- and lifestyle-related chronic disease for Asian sub-groups in New Zealand: a scoping exercise

Sherly Parackal, Joanna Stewart & Elsie Ho

ETHNICITY & HEALTH, 2017
VOL. 22, NO. 4, 333–347
http://dx.doi.org/10.1080/13557858.2016.1246424

Exploring reasons for ethnic disparities in diet- and lifestyle-related chronic disease for Asian sub-groups in New Zealand: a scoping exercise

Sherly Parackal, Joanna Stewart and Elsie Ho

School of Population Health, Faculty of Medical and Health Science, The University of Auckland, Auckland, New Zealand

ABSTRACT

Objectives: The current study aimed to explore if the impact of various risk factors for chronic disease differed for people of Chinese, Indian and New Zealand European and Other (NZEO) ethnicities.

Design: Data analysed for this paper was extracted from the 2003–04 and the 2006–07 NZ Health surveys for adults aged 25–70 which used a cross-sectional survey design. Data from both the survey waves were combined and all statistical analysis was done using SAS version 9.2 or 9.3. Ethnicity of participants was coded using a priority-based classification system as (1) Indian, (2) Chinese, (3) Other Asian, (4) NZEO, (5) Maori and (6) Pacific. Only data for Indians, Chinese and NZEO were used for the current study. Prevalence estimates and 95% confidence intervals for chronic disease and the associated risk factors were generated to describe the sample. Logistic regression analysis was used to examine whether the difference in the change in risk of chronic disease with different exposures was different according to ethnicity.

Results: Higher deprivation resulted in increased risk of chronic disease in Indian and Chinese males but not in NZEO males ($p = .03$). There was a weak evidence for a differing effect of physical activity ($p = .10$) on chronic disease with the protective effect not seen in Indian or Chinese participants.

Conclusion: The results of the current study indicate that some factors such as socio-economic deprivation and physical activity may impact differently on the prevalence of chronic disease according to ethnicity. The authors recommend further investigation of these factors using improved and innovative methodology and high-quality ethnicity data to better understand the factors underpinning ethnic disparities in disease prevalence among Asian sub-groups.

ARTICLE HISTORY
Received 21 October 2015
Accepted 3 June 2016

KEYWORDS
Asian sub-groups; chronic disease; duration of residence; socio-economic; anthropometry; diet and lifestyle factors; New Zealand

Introduction

In recent years, the health status and health needs of the New Zealand (NZ) Asian population, which is the fastest growing population group in NZ, have received much attention.

CONTACT Sherly Parackal sherly.parackal@otago.ac.nz School of Population Health, Faculty of Medical and Health Science, The University of Auckland, Bldg 730, 261 Morrin road, Glen Innes, Pvt Bag 92019, Auckland, New Zealand

It is projected that by 2026, 15% of the NZ population will be people of Asian ethnicity, a figure similar to that projected for the indigenous people of NZ (Statistics NZ 2010).

The major source countries for Asian immigrants are China and India. Diet-related chronic disease contributes to 80% of total deaths in China (Wang et al. 2007) and in India to about 50% of total deaths (Sharma 2013). This exponential increase in the prevalence of non-communicable disease is a consequence of nutrition transition observed in these countries (Popkin and Gordon-Larsen 2004). However, due to health screening enforced by NZ immigration authorities, immigrants have better standard of health than the majority population upon arrival. Nevertheless, evidence indicates that the 'healthy migrant effect' of new migrants due to such selection criteria mitigates as the duration of residence increases (McDonald and Kennedy 2004).

Investigating differences in prevalence and correlates of diet- and lifestyle-related diseases among Asian sub-groups is critical as they are a heterogeneous group and sub-group differences can be masked by grouping (Rasanathan, Craig, and Perkins 2006). Only a few epidemiological studies have explored differences in a disease risk profile among Asian sub-groups. In NZ, the prevalence of reported diagnosed diabetes was 22% in male and 20% in female South Asian in contrast to negligible proportions in East and South East Asian (predominantly Chinese) males and females (Parackal, Smith, and Parnell 2014). The prevalence of markers of cardiovascular disease has also been found to be high among South Asians in comparison to Europeans and Chinese residents of Canada (Anand et al. 2000). In contrast, the prevalence of cancer was found to be higher among Canadians of Chinese origin in comparison to Canadians of South Asian origin (Sheth et al. 1999). Other international studies also indicate that the risk for various cancers is higher among Chinese immigrants than in South Asians (Virk et al. 2010). Intergenerational differences in the prevalence of risk factors for disease (e.g. Obesity) and diseases such as juvenile diabetes and cancer have been observed for both South Asian (Edwards et al. 2006; Smith, Kelly, and Nazroo 2012) and Chinese (Hanley, Choi, and Holowaty 1995) migrant populations.

Although the prevalence of cancer among Chinese migrants has been reported to be higher than South Asian migrants, the reported prevalence rates are markedly lower than the majority population (Sheth et al. 1999). In contrast, the scenario for South Asian migrants is alarming with many studies reporting higher levels of risk factors for and prevalence of cardiovascular disease and diabetes than the majority population (Bhopal et al. 2002; Scragg 2010; Kanya et al. 2010; Creatore et al. 2010). With regard to mortality due to circulatory diseases, countries of residence differences were observed for Chinese but not South Asian migrants (Bhopal et al. 2012). Furthermore, slow declines in mortality from cardiovascular diseases over two decades were observed for South Asian migrants in comparison to migrants from other countries (Harding, Rosato, and Teyhan 2008). The findings of these studies provide evidence for ethnic disparities within Asian sub-groups for diet- and lifestyle-related chronic diseases and hence provide the impetus to investigate possible reasons for such disparities.

Increased duration of residence in Western host countries has been associated with loss of health. A Canadian study has shown that the prevalence of obesity due to increased duration of residence to be more prevalent for South Asians in contrast to Chinese migrants (Mcdonald and Kennedy 2005). However, among second-generation migrants, similar risk for obesity has been reported for both Indian and Chinese migrants in England

(Smith, Kelly, and Nazroo 2012). In NZ, a higher prevalence of overweight and obesity with increased duration of residence was reported for 'Asians' as an ethnic group (Scragg 2010), however, a much needed ethnic specific disaggregated information is lacking.

Traditionally, more focus has been on biological differences between population groups of interest to explain differences in disease prevalence. Many biological theories have been postulated to explain the higher prevalence of cardiovascular disease and diabetes among South Asian migrants (McKeigue, Shah, and Marmot 1991; Sniderman et al. 2007; Bhopal and Rafnsson 2009).

There is also some evidence that biological factors alone may not explain the excess cardiovascular and diabetes risk (Sattar et al. 2008). The effect of social factors on NCDs especially cardiovascular disease has been topical in recent years. A Norwegian study reported ethnic differences in associations between socio-economic status and health between the majority population (Norwegians) and a South Asian migrant group (Pakistanis) (Syed et al. 2006). Studies have also shown an inverse association between social class of migrants from the Indian sub-continent to the UK and the prevalence of cardiovascular diseases (Bhopal et al. 2002; Tillin et al. 2008).

Migration-related risk factors have also been associated with increased risk for NCDs among South Asian migrants (Davies, Blake, and Dhavan 2011). A review on the impact of migration on adiposity and type 2 diabetes has highlighted the role of environmental factors such as urbanisation, mechanisation and changes in dietary habits and lifestyle behaviours on chronic disease (Misra and Ganda 2007).

Evidence from the literature reviewed above seem to indicate that there are ethnicity-dependent factors, i.e. interaction between ethnicity and other contributing factors that may predispose some ethnic groups in contrast to others to diet-related chronic disease. However, there is a dearth in studies that have explored these issues which may contribute to explain the higher prevalence of diabetes for example in South Asians in comparison to Chinese migrants (Parackal, Smith, and Parnell 2014). The current study aimed to address this gap and explore reasons for ethnic disparities in diet- and lifestyle-related chronic disease among Asian sub-groups in NZ. More specifically, the objective was to explore if the difference in the change in risk of chronic disease with different exposures was different according to ethnicity.

Methods

Data analysed for this paper was extracted from the 2003–04 and the 2006–07 NZ Health survey for adults aged 25–70. The NZ health surveys are a key component of the New Zealand Health Monitor (Ministry of Health 2005) run every 3 years on usually resident civilian population 15 years and over living in permanent private dwellings in NZ. Within each household, all eligible adults (those aged 15 and over who usually reside at that dwelling) were identified and one eligible adult was chosen using a sampling Kish grid (Kish 1949 cited in Ministry of Health 2007, 2008a) for the computer-assisted personal interview. The survey had a complex sample design and estimation weights were used to ensure that no group is under- or over-represented in the survey estimates (Ministry of Health 2007, 2008a). The detailed methodology of these national health surveys has been published elsewhere (Ministry of Health 2007, 2008b). In both surveys, ethnicity of participants was recorded by self-identification using the standard census question which allows identifying with multiple ethnic groups. However, the number of options provided for the ethnicity question for the Asian sub-groups differed between the two surveys. In contrast to the 2003–04 survey, the 2006–07 survey contained only three Asian sub-group options, namely Indian, Chinese and Other Asian. Hence, to maintain consistency in the Asian sub-group classification, in this paper participants were coded using a priority-based classification system with the following order: (1) Indian, (2) Chinese, (3) Other Asian, (4) New Zealand European/other European/African/Middle Eastern (New Zealand European and other [NZEO]), (5) Maori and (6) Pacific. For the 2003–04 survey data, included in the Other Asian group were participants who identified as Korean, Japanese, Indonesian, Sri Lankan and Other Asian (unspecified). As this group comprised people with various levels of risk for chronic disease, this Asian sub-group is not included in the analyses. Data from participants coded as Maori and Pacific were also not included in the current analyses.

The outcome variable of interest for the current study was 'prevalence of any diet-and lifestyle-related chronic disease' (hereafter referred to as chronic disease), which is defined as self-report of diagnosed heart disease and/or stroke and/or diabetes and/or cancer (all causes) and/or on medication for hypertension and/or on medication for hypercholesterolemia. Explanatory variables of interest were duration of residence, socio-economic, anthropometric, dietary habits and lifestyle behaviour variables. Three categories for duration of residence were developed using data on 'country of birth' and 'year of arrival in New Zealand', namely 'long-term migrants' (born in New Zealand/more than 10 years of residence), 'recent migrants' (5–10 years in NZ) and 'new migrants' (less than 5 years in NZ). Socio-demographic variables of interest were ethnicity, gender, age, highest qualification, household income and deprivation index. NZ Dep2001 is an area-based index of deprivation that measures the level of deprivation for each mesh block, according to income, access to car, living space, home ownership, employment status, qualifications, support and access to a telephone (Ministry of Health 2007, 2008b). Questions used to collect data on employment status differed between the two surveys; hence, this variable was omitted in all the analyses.

Anthropometric data available from the surveys were weight and waist measurements. The World Health Organization (WHO) classifications for overweight and obesity were used for categorising overweight and obesity for the NZEO (overweight: BMI 25.0–29.9; obese: ≥30.0) (WHO 2007) and the Asian (overweight: BMI 23.0–24.9; obese: ≥25) (WHO Expert Consultation 2004) groups. Abdominal obesity was defined as having a waist circumference of >94 cm for NZEO males and >90 cm for Asian males and >80 cm for females (International Diabetes Federation 2006).

Lifestyle behaviour data used were physical activity levels, current smoking and alcohol consumption data from the Alcohol Use Disorder Identification Test (AUDIT). Physical activity levels were defined using the Sport and Recreation NZ guidelines as 'Inactive' (adults who over 7 days achieved less than 30 minutes of moderate-intensity physical activity in total), 'Some activity' (adults who did not meet the 30X5 recommendation but did achieve at least 30 minutes of moderate-intensity physical activity over seven days) and 'Regularly physically active' (30X5 guideline met) (Sport and Recreation NZ 2005). Current smoking was categorised as a dichotomous variable (yes and no). This variable was derived from two different questions in the 2003–04 survey and the 2006–07 survey questions. In the 2003–04 survey, the question asked was 'smoke one or more cigarettes a day?' and all those who answered 'yes' were categorised as 'current smokers'. In the 2006–07 survey, the question asked was 'how often do you now smoke?' and all those who answered an option other than 'you don't smoke now', 'don't know' or 'refused' were categorised as 'current smokers'. Data from other questions on past smoking, ever smoked, type and number of cigarettes smoked, smoking habits and quitting attempts were not included in the current study. Alcohol consumption data for both surveys were collected using the AUDIT. Harmful consumption of alcohol was defined as a score of ≥8 on the AUDIT scale (Babor et al. 2001).

Statistical analysis

All statistical analysis was done using SAS version 9.2 or 9.3. The sampling design of the NZ health surveys which incorporated clustered stratified sampling with different probabilities of selection was accounted for with the analysis performed using the SAS procedures Surveylogistic or SurveyFreq including the strata, cluster and weights. Data from the two surveys were combined for all the analyses. Prevalence estimates and 95% confidence intervals for chronic disease and the associated risk factors were generated to describe the sample. Logistic regression analysis was used to examine whether the difference in the change in risk of chronic disease with different exposures was different according to the ethnic group (European, Chinese or Indian) in those 70 or younger. The outcome was the binary variable of presence or absence of any chronic disease.

Investigating ethnic difference in the effect of duration of residence on chronic disease risk

The explanatory variables included were year, ethnicity, duration of residence, their interaction and the possible confounding variables of sex, age, deprivation index, income and education. Initially, the three-way interaction with sex was also included to investigate whether this effect differed by gender. An analysis was also run including anthropometric, dietary and lifestyle factors to investigate whether any effect demonstrated remained when these intermediary variables were adjusted for.

Investigating ethnic difference in the effect of socio-economic variables on chronic disease risk

The explanatory variables included were year, ethnicity, deprivation index, income and education, the interaction of ethnicity with deprivation index, income and education and possible confounding variables of sex, age and duration of residence. Initially, the three-way interaction with sex was also included to investigate whether these effects differed by gender. An analysis was also run including anthropometric, dietary and lifestyle factors to investigate whether any effect demonstrated remained when these intermediary variables were adjusted for.

Investigating ethnic difference in the effect of anthropometric, dietary and lifestyle factors on chronic disease

The explanatory variables included were year, ethnicity, BMI, waist circumference, fruit intake, vegetable intake and physical activity, the interaction of ethnicity with these five risk factors and possible confounding variables of sex, age category, duration of residence, deprivation index, income and education. Initially, the three-way interaction with sex was also included to investigate whether these effects differed by gender. The numbers of Asians with an Audit score of 1 or smoking score of 2 were too small to investigate differences in these risk factors (particularly in Chinese) and hence these variables were omitted in the analysis.

Results

Sample characteristics of the participants from the two surveys are presented in Table 1. The Chinese and Indian participants were on average younger and had higher education than the NZEO. Nearly, 23% (18.6–26.8) of Indians had a post-graduate qualification in comparison to 16% (12.7–19.5) of Chinese and 8% (8.1–9.5) of NZEO (Table 1). Despite this, 27% (20.1–33.4) of Indians lived in highly deprived areas compared to Chinese (19%; 95% CI 13.8–24.8) and NZEO (12.7%; 95% CI 11.2–14.1). Higher proportion of Indians (52%; 95% CI 46.6–57.0) were new migrants compared to the Chinese (40%; 95% CI 34.7–44.5) (Table 1).

Similar proportions of Indians (62%; 95% CI 56.8–66.8) and NZEO (61%; 95% CI 59.4–61.9) had abdominal obesity. In contrast, 77% (72.8–81.4) of Indians were either overweight or obese in comparison to 50% (44.3–54.9) of Chinese and 65% (63.8–66.1) of NZEO (Table 1). The proportion of Chinese (53%; 95% CI 47.5–58.1) and Indians (44.3%; 95% CI 39.2–49.4) who met the guidelines for vegetables was lower than the NZEO (72%; 95% CI 70.5–72.7) (Table 1). Similarly, the proportion of Chinese (58%; 95% CI 53.2–62.5) and Indians (61%; 95% CI 56.7–66.2) who were regularly physically active was lower than NZEO (78%; 95% CI 76.6–78.5) (Table 1). About 10% of Chinese (7.5–12.9) and Indians (7.7–13.5) were current smokers in contrast to 20% (19.8–21.9) of NZEO. Similarly, 15% (14.6–16.4) of NZEO exhibited harmful alcohol consumption patterns in contrast to 5% (3.0–7.8) of Indians and less than 2% (0.4–2.8) of Chinese participants (Table 1).

The prevalence of chronic disease as defined in the current study was similar among Indians (24%; 95% CI 19.5–28.3) and NZEO (24%; 95% CI 23.3–25.2), in contrast to only 13% (9.6–16.2) of Chinese participants (Table 1). The results of the analyses done to investigate differences in the effect of duration of residence, socio-economic, anthropometric, dietary and lifestyle factors on the prevalence of chronic disease among Chinese, Indian and New Zealand European/other participants aged 25–70 are presented in Table 2. For all analyses, sex interactions were also investigated where appropriate while investigating differences in the effect of different risk factors for chronic disease in different ethnic groups.

The current study was unable to demonstrate a gender difference in the difference in the effect of duration of residence in different ethnic groups on chronic disease risk (p = .15) nor a difference in the effect of duration of residence on chronic disease rates

Table 1. Sample characteristics of those aged 25–70 according to ethnicity ($n = 12{,}482$).

Sample characteristics	Ethnicity % (95% CI)		
	Chinese $n = 720$	Indian $n = 690$	NZEO $n = 11{,}072$
Prevalence of chronic disease[a,b]			
Yes	12.9 (9.6–16.2)	23.9 (19.5–28.3)	24.3 (23.3–25.2)
Duration of residence			
NZ born/>10 years (*long-term migrant*)	38.1 (33.4–42.8)	31.0 (25.9–36.1)	94.2 (93.6–94.8)
5–10 years (*recent migrant*)	22.3 (18.3–26.3)	17.2 (13.6–20.9)	1.8 (1.5–2.1)
Less than 5 years (*new migrant*)	39.6 (34.7–44.5)	51.8 (46.6–57.0)	4.0 (3.6–4.5)
Socio-economic characteristics			
Gender			
Male	50.1 (45.3–54.8)	41.2 (36.5–45.8)	48.5 (47.3–50.1)
Female	49.9 (45.2–54.7)	58.8 (54.2–63.5)	51.5 (50.3–52.7)
Age category			
25–39 years	44.9 (39.6–50.2)	49.2 (44.1–54.2)	34.8 (33.6–36.1)
40–54 years	38.4 (33.3–43.5)	37.2 (32.1–42.4)	38.8 (37.6–39.9)
55–70 years	16.7 (13.0–20.4)	13.6 (9.6–17.5)	26.4 (25.4–27.4)
Highest qualification[c]			
High school only	34.1 (29.4–38.8)	28.9 (24.2–33.7)	40.2 (39.0–41.4)
Trade certificate	12.7 (9.8–15.6)	19.6 (15.3–23.8)	33.5 (32.4–34.5)
Bachelor degree	37.1 (32.5–41.8)	28.8 (24.4–33.3)	17.6 (16.7–18.5)
Post-graduate degree	16.1 (12.7–19.5)	22.7 (18.6–26.8)	8.7 (8.1–9.5)
Household income[d]			
≤15,000	10.8 (7.7–13.8)	4.8 (2.6–6.8)	5.5 (5.0–6.0)
15,001–25,000	16.9 (12.7–21.1)	11.6 (8.4–14.8)	8.4 (7.7–9.0)
25,001–40,000	17.1 (13.6–20.6)	19.3 (15.3–23.4)	14.3 (13.5–15.2)
40,001–70,000	27.0 (22.5–31.5)	34.9 (29.8–40.1)	28.6 (27.6–29.8)
>70,000	28.2 (23.4–33.0)	29.4 (24.3–34.6)	43.2 (41.8–44.5)
NZ Dep2001[e]			
1 (low deprivation)	17.3 (12.5–22.1)	8.6 (5.7–11.5)	24.2 (22.1–26.4)
2	22.7 (17.1–28.4)	15.1 (10.3–19.9)	22.0 (20.1–24.1)
3	21.7 (16.0–27.4)	19.7 (14.1–25.3)	21.4 (19.4–23.4)
4	19.0 (13.8–24.2)	29.8 (23.3–36.4)	19.7 (17.8–21.5)
5 (high deprivation)	19.3 (13.8–24.8)	26.8 (20.1–33.4)	12.7 (11.2–14.1)
Anthropometry			
Overweight/obesity[f]			
Yes	49.6 (44.3–54.9)	77.1 (72.8–81.4)	64.9 (63.8–66.1)
Waist circumference[g] (Male: >94 cm NZ European; >90 cm Asian; Female: > 80 cm)			
Yes	28.0 (23.6–32.3)	61.8 (56.8–66.8)	60.7 (59.4–61.9)
Dietary habits			
Fruit consumption (2+ a day)			
Yes	60.1 (55.2–65.0)	53.4 (48.6–58.1)	58.1 (56.8–59.2)
Vegetable consumption (3+ a day)			
Yes	52.8 (47.5–58.1)	44.3 (39.2–49.4)	71.6 (70.5–72.7)
Lifestyle behaviours			
Physical activity (PA)[h]			
Regular PA	57.9 (53.2–62.5)	61.4 (56.7–66.2)	77.6 (76.6–78.6)
Some PA	21.2 (17.7–24.8)	14.8 (11.7–17.6)	12.3 (11.5–13.0)
Inactive	20.9 (17.3–24.5)	23.8 (19.5–28.1)	10.1 (9.4–10.9)
Smoking[i]			
Yes	10.2 (7.5–12.9)	10.6 (7.7–13.5)	20.8 (19.8–21.9)
Audit score[j]			
≥8	1.6 (0.4–2.8)	5.4 (3.0–7.8)	15.5 (14.6–16.4)

[a]Chronic disease defined as diagnosed with heart disease and/or stroke and/or diabetes and/or cancer and/or on medication for hypertension and/or hypercholesterolemia.
[b]Missing 3.
[c]Missing 4.
[d]Missing: Chinese = 77, Indian = 50, NZEO = 437.
[e]Missing 4.
[f]Missing Chinese = 57, Indian = 46; NZEO = 923.
[g]Missing Chinese = 48, Indian = 39, NZEO = 11,072.
[h]Missing 14.
[i]Missing 2.
[j]Missing 15.

in different ethnic groups ($p = .28$). In this analysis, the estimates of the effect size differences remained very similar when the known risk factors for chronic disease, namely, anthropometric, dietary and lifestyle behaviours were included in the analysis. The least-square means presented in Table 2 are for the model without the inclusion of these risk factors.

There was no evidence of a gender difference on the difference in the effect of education in different ethnic groups ($p = .57$). No difference could be shown in the effect of education on chronic disease in different ethnic groups ($p = .30$). The strength of this effect was altered very little by inclusion of the anthropometric, dietary and lifestyle factors.

There was an indication of a gender difference in the differing effect of deprivation ($p = .03$) on chronic disease according to ethnicity and a possible weak evidence of income ($p = .11$). The analysis was therefore run separately for males and females to look at these variables. An ethnic difference in the effect of income could not be demonstrated in males or females (males $p = .58$, females $p = .24$) and the inclusion of the anthropometric, dietary and lifestyle factors had little effect on this. There was a weak indication that there could be a difference in the effect of deprivation in different ethnic groups in females ($p = .10$) but it could not be shown in males ($p = .20$). However, the inclusion of the anthropometric, dietary and lifestyle factors strengthened the evidence of a difference in the relationship of deprivation with chronic disease in the different ethnic groups within males ($p = .03$) with an indication that higher deprivation (deprivation 5) resulted in increased risk of chronic disease in Indian and Chinese males but not in NZEO males, when accounting for the known risk factors which deprivation could be associated with. Although the test for significance decreased, the pattern of the least square mean estimates was very similar to that seen without their inclusion. In females, while there was an indication of an increase in risk with increased deprivation in NZEO, this was not evident for Indians or Chinese as the estimated risk for chronic disease decreased with increasing deprivation in these groups. The least square means presented in Table 2 are for the model without the inclusion of the anthropometric, dietary and lifestyle factors.

No gender difference could be demonstrated on the difference in the effect of anthropometric, dietary and lifestyle factors on chronic disease risk in different ethnic groups (BMI $p = .51$, waist $p = .35$, fruit $p = .21$, vegetables $p = .23$, physical activity $p = .86$). No ethnic difference in the effect of any of the risk factors could be demonstrated (BMI $p = .39$, waist $p = .31$, fruit $p = .59$, vegetables $p = .66$, physical activity $p = .10$). The variable showing the most likelihood of affecting chronic disease risk differently in different ethnic groups was physical activity where the tendency to have reduced risk with increased activity in Europeans did not appear to be reflected in Chinese or Indians (Table 2).

Discussion

The findings in this paper are unique in that disaggregated information with respect to chronic disease and the associated factors are reported for Asian sub-groups. The prevalence of chronic disease among Indians (24%; 95% CI 19.5–28.3) was similar to the NZEO participants (24%; 95% CI 23.3–25.2) but was much higher than that observed for Chinese participants (13%; 95% CI 9.6–16.2). These results are consistent with other findings that have investigated the prevalence of chronic diseases for different Asian sub-groups (Parackal, Smith, and Parnell 2014).

Increased duration of residence is an established risk factor for chronic disease (Harding 2003). In the current study, the overall impact of duration of residence on chronic disease was similar across ethnicities ($p = .28$). However, it is possible that no marked differences in the effect of duration of residence were found between ethnicities as we used a composite measure for chronic disease which may have masked any differences for individual diseases. A recent New Zealand study that used census mortality data found that the cancer mortality in Chinese increased with increased duration of residence and in contrast a similar effect was seen for cardio vascular disease (CVD) mortality among Indians (Jatrana et al. 2014).

Table 2. Effect of duration of residence, socio-economic, anthropometric, dietary and lifestyle factors with prevalence of chronic disease in Chinese, Indian and New Zealand European/other ($n = 11,910$).[a]

	Least squares means (lower mean, upper mean)			
Factors	Chinese	Indian	NZ European/others	*p*-Value
Duration of residence				$p = .15$
Long-term NZ born/more than 10 years	0.12 (0.08,0.17)	0.32 (0.23,0.44)	0.21 (0.20, 0.22)	
5–10 years	0.08 (0.03, 0.18)	0.36 (0.23, 0.51)	0.16 (0.10,0.24)	
Less than 5 years	0.12 (0.06,0.23)	0.18 (0.13,0.25)	0.15 (0.11,0.20)	
Highest qualification				$p = .30$
High school only	0.13 (0.08,0.21)	0.32 (0.22,0.43)	0.18 (0.16,0.22)	
Trade certificate	0.12 (0.06,0.21)	0.19 (0.09, 0.35)	0.19 (0.16,0.22)	
Bachelor's degree	0.09 (0.04,0.18)	0.28 (0.20, 0.40)	0.16 (0.13,0.19)	
Post-graduate degree	0.03 (0.01,0.10)	0.21 (0.13,0.32)	0.16 (0.13,0.20)	
Household income (NZ $)				*Males: $p = .58$*
≤15,000				*Females: $p = .24$*
Male	0.07 (0.01,0.37)	0.31 (0.11,0.63)	0.23 (0.17,0.30)	
Female	0.18 (0.06,0.45)	0.18 (0.02,0.67)	0.23 (0.18,0.28)	
15,001–25,000				
Male	0.04 (0.01,0.18)	0.33 (0.13,0.61)	0.20 (0.15,0.26)	
Female	0.09 (0.01,0.42)	0.28 (0.07,0.65)	0.23 (0.18,0.28)	
25,001–40,000				
Male	0.08 (0.01,0.35)	0.35 (0.21,0.52)	0.17 (0.14,0.22)	
Female	0.07 (0.02,0.27)	0.11 (0.04,0.26)	0.16 (0.13,0.20)	
40,001–70,000				
Male	0.07 (0.02,0.20)	0.36 (0.21,0.53)	0. (0.13,0.20)	
Female	0.04 (0.01,0.30)	0.10 (0.04,0.23)	0.15 (0.12,0.19)	
>70,000				
Male	0.08 (0.03,0.19)	0.35 (0.21,0.52)	0.14 (0.12,0.17)	
Female	0.05 (0.01,0.30)	0.06 (0.02,0.22)	0.15 (0.13,0.19)	

(*Continued*)

Table 2. Continued.

Factors	Least squares means (lower mean, upper mean) Chinese	Indian	NZ European/others	*p*-Value
NZ Dep 2001				*Males: p = .03*
1 (low deprivation) Male	0.05 (0.01,0.19)	0.42 (0.16,0.74)	0.17 (0.13,0.21)	*Females: p = .10*
Female	0.17 (0.04,0.50)	0.33 (0.08,0.72)	0.16 (0.13,0.20)	
2 Male	0.04 (0.01,0.15)	0.26 (0.11,0.51)	0.19 (0.15,0.23)	
Female	0.05 (0.01,0.25)	0.06 (0.02,0.20)	0.18 (0.15,0.22)	
3 Male	0.09 (0.24,0.31)	0.36 (0.19,0.58)	0.18 (0.14,0.23)	
Female	0.06 (0.01,0.39)	0.29 (0.10,0.59)	0.17 (0.14,0.21)	
4 Male	0.03 (0.01,0.16)	0.20 (0.11,0.31)	0.19 (0.15,0.24)	
Female	0.05 (0.01,0.17)	0.15 (0.05,0.35)	0.19 (0.15,0.24)	
5 (High deprivation) Male	0.21 (0.10,0.43)	0.50 (0.30,0.71)	0.17 (0.14,0.22)	
Female	0.09 (0.03,0.24)	0.03 (0.01,0.17)	0.21 (0.17,0.26)	
Overweight or obese				*p= 0.51*
No	0.13 (0.06,0.23)	0.28 (0.15,0.48)	0.17 (0.14,0.20)	
Yes	0.11 (0.07, 0.18)	0.19 (0.12,0.27)	0.19 (0.15,0.22)	
Waist circumference				*p = .35*
Normal	0.08 (0.05,0.13)	0.15 (0.08,0.25)	0.14 (0.12,0.17)	
Above cut-offs	0.18 (0.09,0.31)	0.34 (0.22,0.48)	0.22 (0.19,0.25)	
Fruit 2+ guideline				*p = .21*
Met	0.14 (0.09,0.22)	0.24 (0.17,0.34)	0.18 (0.15,0.21)	
Not met	0.10 (0.05,0.17)	0.22 (0.13,0.34)	0.17 (0.14,0.20)	
Vegetables 3+ guideline				*p = .23*
Met	0.12 (0.07,0.20)	0.21 (0.13,0.31)	0.18 (0.15,0.21)	
Not met	0.11 (0.07,0.19)	0.26 (0.17,0.38)	0.17 (0.14,0.21)	
Physical activity (PA)				*p = .10*
Regular PA	0.11 (0.07,0.17)	0.27 (0.18,0.38)	0.16 (0.13,0.18)	
Some PA	0.17 (0.08,0.32)	0.24 (0.14,0.39)	0.17 (0.14,0.20)	
Inactive	0.09 (0.04,0.18)	0.18 (0.11,0.29)	0.20 (0.16,0.25)	

[a]Cases removed due to missing data = 572.

The finding that socio-economic deprivation may have a differing effect on the risk for chronic disease according to ethnicity and gender is interesting and warrants further investigation. Other studies have found socio-economic deprivation as a risk factor associated with coronary risk in a British-Punjabi (Indian) population (Williams, Bhopal, and Hunt 1994) and Pakistani migrants in Norway (Syed et al. 2006); however, neither studies reported on any gender differences.

Higher proportions of Indians in comparison to Chinese and NZEO were categorised as overweight or obese and had waist-to-hip ratios above the desired cut-off points for males and females. However, the effect of these anthropometric measurements on chronic disease risks was similar across ethnicities (all $p > .05$). Similarly, the effect of meeting the guidelines for fruit and vegetables on the prevalence of chronic disease was also similar across ethnicities (all $p > .05$). Although the main effects of these factors on chronic disease are well established (Lock et al. 2005), no studies were found that investigated ethnic differences as was done in our study.

Although with only a weak evidence ($p = .10$), the finding that the protective effect of regular physical activity on chronic disease risk may differ in different ethnic groups is interesting and needs further investigation. The protective effect of physical activity for chronic disease was not apparent for Indians and Chinese. No studies were found to corroborate this finding between the three different ethnic groups of interest. However, in the study by Hayes et al. (2002) some ethnic differences (European, Indian, Pakistani and Bangladeshi) were seen especially in men in the association of physical activity index and CVD and diabetes risk markers.

Overall, our study presents some interesting findings that require further investigation. The strength of the current study is the adequate sample of Asian sub-groups obtained by pooling data from the two survey waves. Inadequate sample size for Asian sub-groups is usually a limiting factor in attempting any meaningful analyses using national survey data to investigate the prevalence of disease and associated factors. One major limitation of the study is that since this was a secondary analysis, the research questions developed were limited to available data. Further, the Asian sub-group 'Other Asian' was excluded from the analyses as the sub-Asian groups in this group do not reflect disease profiles of the sub-groups in the category. Statistics New Zealand classifies Sri Lankan, Bangladeshi and Pakistanis as 'Other Asians' along with Japanese and Koreans (Statistics NZ 2005). The disease profile of Sri Lankans, Bangladeshis and Pakistanis is more similar to Indians than Japanese and Koreans and hence categorising them in one group will average out differences (Rasanathan, Craig, and Perkins 2006). Although in the 2003–04 survey wave, level 4 ethnicity data (a further breakdown of the 'Other Asian' group which allowed re-categorisation) was available, only level 2 ethnicity data (Chinese, Indian, Other Asian group with no further breakdown of sub-groups) was available in the 2006–07 survey wave. Hence for maintaining consistency, only level 2 categories were adopted and the 'Other Asian' group was excluded in the current study. Studies have raised issues with ethnicity categorisation as a limiting factor to understand the impact of various factors with chronic disease. Association of social class (categorised based on occupation of the head of the household as manual and non-manual), education and deprivation score with coronary heart disease was found to be similar for Indians and Europeans; however, this similarity did not exist for Pakistanis or Bangladeshis or South Asian combined group (Bhopal et al. 2002). A recent study on Asians in Australia has investigated the correlates of chronic disease for 'Asians' as a group (Pasupuleti, Jatrana, and Richardson 2015). Based on the results of the current study, using 'Asian' as a category may mask or distort the findings. Hence, further disaggregation of ethnicity data is essential to throw more light on any difference in the impact of the various factors with chronic diseases.

Errors due to self-reporting and other biases inherent in survey data may also have impacted the findings reported. Inconsistencies in the way questions were asked for example smoking and ethnicity questions may also have impacted on the findings of the current study. The use of a composite measure for chronic disease which included the diseases most prevalent in Chinese and Indians may also have biased the findings due to varied disease risk profiles of the two ethnic groups as was observed by Jatrana et al. (2014). However, due to sample size limitations especially for the Asian sub-groups, analysing for individual diseases was beyond the scope of the current study.

Despite these limitations, the current study highlights the need for improved and innovative methodology to better monitor and understand the many complex factors responsible for the loss of the healthy migrant status among Asian sub-groups. An epidemiological study investigating differences in social risk factors for chronic disease among Asian sub-groups has indicated that the absence of social cohesion may be a possible factor for the high prevalence of obesity in South Asians (predominantly Indians) in contrast to Chinese migrants (Mcdonald and Kennedy 2005). This study highlights the negative effect of social cohesion on dietary acculturation which has been implicated as a major cause of obesity and associated diet-related diseases among South Asians (Mcdonald and Kennedy 2005). A recent NZ study has shown marked differences in dietary habits, nutrient intakes and associated health outcomes among South Asians and East and South East Asians (predominantly Chinese) (Parackal, Smith, and Parnell 2014), which may in part explain the ethnic disparities in chronic disease profiles of Asian sub-groups. Use of appropriate research designs has also been highlighted as imperative to better understand risk factors and disease outcomes of migrants in Western countries (Spallek, Zeeb, and Razum 2011; Agyemang, de-Graft Aikins, and Bhopal 2012).

Conclusions

The results of the current study indicate that some factors such as socio-economic deprivation and physical activity may impact on risk prevalence of chronic disease differently according to ethnicity. The authors recommend further investigation of these factors using improved and innovative methodology and high-quality ethnicity data to better understand the factors underpinning ethnic disparities in disease prevalence among Asian sub-groups.

Acknowledgement

Access to the data used in this study was provided by Statistics New Zealand under conditions designed to keep individual information secure in accordance with requirements of the Statistics Act 1975.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Agyemang, C., Ama de-Graft Aikins, and Raj Bhopal. 2012. "Ethnicity and Cardiovascular Health Research: Pushing the Boundaries by Including Comparison Populations in the Countries of Origin." *Ethnicity and Health* 17 (6): 579–596.

Anand, S., Salim Yusuf, Vladmir Vuksan, Sudarshan Devanesen, Koon K. Teo, Patricia A. Montague, Linda Kelemen, et al. 2000. "Differences in Risk Factors, Atherosclerosis, and Cardiovascular Disease Between Ethnic Groups in Canada: the Study of Health Assessment and Risk in Ethnic Groups (SHARE)." *Lancet* 356 (9226): 279–284.

Babor, T. F., J. C. Higgins-Biddle, J. B. Saunders, M. G. Monteiro. 2001. *The Alcohol Use Disorders Identification Test (AUDIT): Guidelines for use in Primary Care*. Geneva: World Health Organization.

Bhopal, R., L. Hayes, M. White, N. Unwin, J. Harland, S. Ayis, and G. Alberti. 2002. "Ethnic and Socioeconomic In-equalities in Coronary Heart Disease, Diabetes and Risk Factors in Europeans and South Asians." *Journal of Public Health Medicine* 24: 95–105.

Bhopal, R. S., and S. B. Rafnsson. 2009. "Could Mitochondrial Efficiency Explain the Susceptibility to Adiposity, Metabolic Syndrome, Diabetes and Cardiovascular Diseases in South Asian Populations?" *International Journal of Epidemiology* 38 (4): 1072–1081.

Bhopal, R. S., S. B. Rafnsson, C. Agyemang, A. Fagot-Campagna, S. Giampaoli, N. Hammar, S. Harding, et al. 2012. "Mortality From Circulatory Diseases by Specific Country of Birth Across six European Countries: Test of Concept." *European Journal of Public Health* 22 (3): 353–359.

Creatore, M. I., R. Moineddin, G. Booth, D. H. Manuel, M. DesMeules, S. McDermott, and R. H. Glazier. 2010. "Age-and-sex Related Prevalence of Diabetes Mellitus among Immigrants to Ontario, Canada." *Canadian Medical Association Journal* 182 (8): 781–789.

Davies, A. A., Carolyn Blake, and Poonam Dhavan. 2011. "Social Determinants and Risk Factors for Non-Communicable Diseases (NCDs) in South Asian Migrant Populations in Europe." *Asia Europe Journal* 8: 461–473.

Edwards, S., Catherine Murphy, Richard G. Feltbower, Carolyn R. Stephenson, Janet E. Cade, Patricia A. McKinney, and H. Jonathan Bodansky. 2006. "Changes in the Diet of A South Asian Trans-Migratory Population may be Associated with an Increase in Incidence of Childhood Diabetes." *Nutrition Research* 26: 249–254.

Hanley, A. J. G., Bernard C. K. Choi, and Eric J. Holowaty. 1995. "Cancer Mortality among Chinese Migrants: A Review." *International Journal of Epidemiology* 24 (2): 255–265.

Harding, S. 2003. "Mortality of Migrants From the Indian Subcontinent to England and Wales: Effect of Duration of Residence." *Epidemiology* 14: 287–292.

Harding, S., M. Rosato, and A. Teyhan. 2008. "Trends for Coronary Heart Disease and Stroke Mortality among Migrants in England and Wales, 1979–2003: Slow Declines Notable for Some Groups." *Heart* 94: 463–470.

Hayes, L., M. White, N. Unwin, R. Bhopal, C. Fischbacher, J. Harland, and K. G. M. M. Alberti. 2002. "Patterns of Physical Activity and Relationship with Risk Markers for Cardiovascular Disease and Diabetes in Indian, Pakistani, Bangladeshi and European Adults in A UK Population." *Journal of Public Health Medicine* 24 (3): 170–178.

IDF (International Diabetes Federation). 2006. *The IDF Consensus Worldwide Definition of the Metabolic Syndrome*. Accessed March 2013. http://www.idf.org/webdata/docs/IDF_Meta_def_final.pdf.

Jatrana, S., Ken Richardson, Tony Blakely, and Saira Dayal. 2014. "Does Mortality Vary Between Asian Subgroups in New Zealand: An Application of Hierarchical Bayesian Modelling." *PLOS ONE* 9 (8): e105141. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4139320/pdf/pone.0105141.pdf.

Kanya, A. M., C. L. Wassel, D. Mathur, A. Stewart, D. Herrington, M. J. Budoff, V. Ranpura, and K. Liu. 2010. "Prevalence and Correlates of Diabetes in South Asian Indians in the United States: Findings From the Metabolic Syndrome and Atherosclerosis in South Asians Living in

America Study and the Multi-Ethnic Study of Atherosclerosis." *Metabolic Syndrome and Related Disorders* 8 (2): 157–164.

Lock, K., J. Pomerleau, L. Causer, D. R. Altmann, and M. McKee. 2005. "The Global Burden of Disease Attributable to low Consumption of Fruit and Vegetables: Implications for the Global Strategy on Diet." *Bulletin of the World Health Organisation* 83 (2): 100–108.

McDonald, J. T., and S. Kennedy. 2004. "Insights into the "Healthy Immigrant Effect": Health Status and Health Service Use of Immigrants to Canada." *Social Science and Medicine* 59: 1613–1627.

Mcdonald, J. T., and S. Kennedy. 2005. "Is Migration to Canada Associated with Unhealthy Weight Gain? Overweight and Obesity among Canada's Immigrants." *Social Science and Medicine* 61: 2469–2481.

McKeigue, P., B. Shah, and M. G. Marmot. 1991. "Relation of Central Obesity and Insulin Resistance with High Diabetes Prevalence and Cardiovascular Risk in South Asians." *Lancet* 337: 382–386.

Ministry of Health. 2005. *The New Zealand Health Monitor: Updated Strategic Plan*. Wellington: Ministry of Health. http://www.moh.govt.nz/notebook/nbbooks.nsf/0/7a865698b3478999cc2573b80008a9a4/$FILE/nzhm-updated-strategic-plan.pdf.

Ministry of Health. 2007. *Portrait of Health: Key Results of the 2002/03 New Zealand Health Survey*. Wellington: Ministry of Health.

Ministry of Health. 2008a. *Methodology Report for the 2006/07 New Zealand Health Survey*. Wellington: Ministry of Health. http://www.health.govt.nz/publication/methodology-report-2006-07-new-zealand-health-survey.

Ministry of Health. 2008b. *Portrait of Health: Key Results of the 2006/07 New Zealand Health Survey*. Wellington: Ministry of Health.

Misra, A., and O. P. Ganda. 2007. "Migration and its Impact on Adiposity and Type 2 Diabetes." *Nutrition* 23: 696–708.

Parackal, S. M., C. Smith, and W. R. Parnell. 2014. "A Profile of New Zealand "Asian" Participants of the 2008/09 Adult National Nutrition Survey: Focus on Dietary Habits, Nutrient Intakes and Health Outcomes." *Public Health Nutrition* 18 (5): 893–904.

Pasupuleti, S. S. R., S. Jatrana, and K. Richardson. 2015. "Effect of Nativity and Duration of Residence on Chronic Health Conditions among Asian Immigrants in Australia: A Longitudinal Investigation." *Journal of Biosocial Science* 48 (3): 322–341. http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=9821858&fileId=S0021932015000206 on CJO 2015 doi:10.1017/s0021932015000206.

Popkin, B. M., and P. Gordon-Larsen. 2004. "The Nutrition Transition: Worldwide Obesity Dynamics and Their Determinants." *International Journal of Obesity* 28: S2–S9.

Rasanathan, K., David Craig, and Rod Perkins. 2006. "The Novel use of "Asian" as an Ethnic Category in the New Zealand Health Sector." *Ethnicity & Health* 11: 211–227.

Sattar, N., Alex McConnachie, A. Gerald Shaper, Gerard J. Blauw, Brendan M. Buckley, Anton J. de Craen, Ian Ford, et al. 2008. "Can Metabolic Syndrome Usefully Predict Cardiovascular Disease and Diabetes? Outcome Data From two Prospective Studies." *Lancet* 371 (9628): 1927–1935.

Scragg, R. 2010. *Asian Health in Aotearoa in 2006–2007; Trends Since 2002–2003*. Auckland: Northern DHB Support Agency.

Sharma, K. 2013. "Burden of non-Communicable Diseases in India: Setting Priority for Action." *International Journal of Medical Science and Public Health* 2 (1): 7–11.

Sheth, T., C. Nair, M. Nargundkar, S. Anand, and S. Yusuf. 1999. "Cardiovascular and Cancer Mortality among Canadians of European, South Asian and Chinese Origin from 1979 to 1993: An Analysis of 1.3 Million Deaths." *Canadian Medical Association Journal* 161 (2): 132–138.

Smith, N. R., Y. J. Kelly, and J. Y. Nazroo. 2012. "The Effects of Acculturation on Obesity Rates in Ethnic Minorities in England: Evidence from the Health Survey for England." *European Journal of Public Health* 22 (4): 508–513.

Sniderman, A. D., R. Bhopal, D. Prabhakaran, N. Sarrafzadegan, and A. Tchernof. 2007. "Why Might South Asians be so Susceptible to Central Obesity and its Atherogenic Consequences? The Adipose Tissue Overflow Hypothesis." *International Journal of Epidemiology* 36: 220–225.

Spallek, J., Hajo Zeeb, and Oliver Razum. 2011. "What Do We Have to Know from Migrants' Past Exposures to Understand Their Health Status? A Life Course Approach." *Emerging Themes in Epidemiology* 8 (1): 6. http://www.ete-online.com/content/8/1/6

Sport and Recreation New Zealand. 2005. *Movement = Health Me Korikori Ka Ora*. Wellington: SPARC.

Statistics New Zealand. 2005. *Statistical Standards for Ethnicity*. Accessed June 2013. http://www.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/ethnicity.aspx.

Statistics New Zealand. 2010. *National ethnic population projections: 2006 (base)-2026 update*. Accessed October 2013. http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalEthnicPopulationProjections_HOTP2006-26.aspx.

Syed, H. R., Odd Dalgard, Akhtar Hussain, Ingvild Dalen, Bjorgulf Claussen, and Nora L. Ahlberg. 2006. "Inequalities in Health: A Comparative Study Between Ethnic Norwegians and Pakistanis in Oslo, Norway." *International Journal for Equity in Health* 5: 7. doi:10.1186/1475-9276-5-7.

Tillin, T., N. Chaturvedi, N. G. Forouhi, G. D. Smith, and P M. McKeigue. 2008. "Cardiovascular Disease Mortality in Relation to Childhood and Adulthood Socio-Economic Markers in British South Asian men." *Heart* 94: 476–481.

Virk, R., Sharlene Gill, Eric Yoshida, Simon Radley, and Baljinder Salh. 2010. "Racial Differences in the Incidence of Colorectal Cancer." *Canadian Journal of Gastroenterology* 24 (1): 47–51.

Wang, Y., J. Mi, X.-y. Shan, Q. J. Wang, and K.-y. Ge. 2007. "Is China Facing an Obesity Epidemic and the Consequences? The Trends in Obesity and Chronic Disease in China." *International Journal of Obesity* 31: 177–188.

WHO. 2007. *Global Database on Body Mass Index*. Geneva: World Health Organization.

WHO Expert Consultation. 2004. "Appropriate Body-Mass Index for Asian Populations and its Implications for Policy and Intervention Strategies." *Lancet* 363: 157–163.

Williams, R., Raj Bhopal, and Kate Hunt. 1994. "Coronary Risk in A British Punjabi Population: Comparative Profile of non-Biochemical Factors." *International Journal of Epidemiology* 23 (1): 28–37.