Original Article

Body fatness, physical activity, and nutritional behaviours in Asian Indian immigrants to New Zealand

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Body fatness, physical activity, and nutritional behaviours were assessed in 112 (50 male, 62 female) Asian Indians living in New Zealand. Participants were aged 44-91 years (mean 67.5 ± 7.6) and had lived in New Zealand on average 51 months. Height, weight, and waist circumference were measured to determine body mass index (BMI) and central adiposity. Bioelectrical impedance was used to derive fat free mass, fat mass, and percentage body fat. Pedometers were worn to record daily steps taken over each of seven consecutive days. A lifestyle and health questionnaire was administered to collect information on nutrition behaviours. Average BMI for the sample was 27.2 ± 4.7 kg/m^2 with females (28.0 ± 5.4 kg/m^2) significantly higher than males (25.6 ± 5.4 kg/m^2). Using Asian Indian specific cut-offs 69% of the sample was obese (BMI≥25 kg/m^2) and a further 13.7% overweight (23≥BMI<25 kg/m^2). Average percentage body fat for the sample was 41.1 ± 9.1 with females significantly higher than males. The majority (74%) reported some form of chronic condition, with 35% diagnosed with diabetes. Physical activity levels for the sample were low (5,977 ± 3,560 steps/day) and significantly different between males (6,982 ± 4,426) and females (5,159 ± 2,401). Higher pedometer steps were associated with lower waist circumference. After adjustment for age, physical activity was lower, but nutritional habits better for those who had spent a longer time in New Zealand. In summary, Asian Indian immigrants to New Zealand have low physical activity levels and high levels of overweight/obesity and lifestyle disease.

Key Words: obesity, body mass index, physical activity, Asians, nutrition

INTRODUCTION

Obesity and physical inactivity are two of the most significant health issues affecting our globally aging population. The prevalence of obesity has reached epidemic proportions in both developed and developing countries, with the World Health Organization estimating greater than 300 million obese people worldwide.[1] Prevalence of obesity is set to rise even further over the next 20 years and could reach 50% in the US, 40% in other developed countries such as Australia and the UK, [2] and even more in Asian countries. The very substantial increase in prevalence and severity of obesity over the past 25 years, and its consequences on health and mortality, have contributed to recent forecasts that the steady rise in life expectancy during the past two centuries may soon end.[3]

Obesity is integrally linked to physical activity. That is, obesity can negatively impact on physical activity participation, and conversely, levels of physical activity can influence the development and management of obesity. Global changes in physical activity participation, however, are difficult to understand, due to the large number of and varied methods used to assess activity. Despite this, there is evidence that prevalence of insufficient physical activity is increasing,[4] physical activity rates are declining,[5] and that engagement in sedentary pursuits is increasing.[6,7] A recent review of physical activity rates in the US found that declining work-related activity, transportation activity, and activity in the home, in combination with increasing sedentary activities such as television viewing are contributing to an overall trend of declining total physical activity.[7]

In response to the rising rates of obesity and declining physical activity participation, government and other health agencies worldwide are developing and adopting policy targeted at reversing these trends. In New Zealand, for example, the *Healthy Eating – Healthy Action* strategy[8] provides a framework to bring about changes in the environment in which New Zealanders live, work, and play, related to physical activity, nutrition, and ultimately obesity. The strategy responds to 3 of the 13 priority population health areas in the *New Zealand Health Strategy*, [9] namely, increasing the level of physical activity, reducing obesity,

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and improving nutrition. Other health strategy documents such as the *Health of Older People Strategy*[10] also identify increasing physical activity and improving nutrition as national priorities.

The importance of investigating obesity and physical inactivity lies in their relationship to the development of many non-communicable lifestyle diseases such as Type 2 diabetes and coronary heart disease. A particular population group of interest in relation to such diseases is Asian Indians. Asian Indians have rapidly escalating prevalence of Type 2 diabetes and coronary heart disease. The prevalence of Type 2 diabetes in adults in urban India increased from less than 3% in the 1970's to greater than 12% in 2000.[11]

As well, the prevalence of coronary heart disease for adults living in urban regions of India increased from approximately 1% in 1960 to nearly 10% in 1995.[12] It has also been estimated that by 2025, coronary heart disease will be the leading cause of death in adults in India.[13, 14] This phenomenon is not isolated to Asian Indians living in India. In fact, it has been suggested that expatriate Asian Indians living in their newly adopted countries have far worse risk factor profiles (e.g., obesity, waist circumference) for cardiovascular disease and diabetes,[15] and a far greater risk of developing coronary heart disease, than the local population or other immigrant groups.[16-20] Studies that have examined coronary heart disease and diabetes risk factors in Asian Indians living in countries other than India have identified physical activity levels, sedentary pursuits, cultural issues concerning stress and acculturation, environmental and lifestyle changes, nutrition, and obesity (especially central adiposity) as key contributing factors.[17,21,22]

New Zealand is one country that has seen sizable migration from India over the past 20 years, with Asian Indians making up close to 2% of the population (an increase of greater than 100% over 10 years.[23] The majority of Asian Indian immigrants to New Zealand live in Auckland.[24] Despite recent growth of the Asian (including Asian Indian) population in New Zealand, a gap in health information and health policy exists for this group. Given the high risk that Asian Indians have for coronary heart disease and diabetes, the aim of the current research was to assess body fatness, physical activity, and nutritional behaviors of Asian Indian adults living in New Zealand.

METHODS

Participants

Participants (N = 112, 50 male and 62 female) were recruited through two Auckland-based Asian Indian community organizations. The age of participants ranged from 44 to 91 years (mean 67.5 ± 7.6y). Males (mean age 70.3 ± 7.3y) were older on average than females (mean age 65.8 ± 6.7y). All participants self-identified as being of Asian Indian ethnicity and had emigrated from Asian Indian countries (e.g., India, Sri Lanka, Pakistan, Fiji) with the majority (74%) from India. The average time in New Zealand since immigration was 51 ± 47 months (range, 1-214).

Measures

Adiposity Measures. Height (±0.5 cm) without shoes, weight (± 0.1kg) in light clothing, and waist circumference (± 0.5cm) at the midpoint between the lower rib and upper iliac crest in the mid axillary line were measured to understand health risk by body mass index (BMI) and central adiposity. These measurements were taken by an accredited anthropometrist. Bioelectrical impedance (BIA, ± 1 ohm) was used to gain an objective estimate of fat free mass (FFM) and to derive fat mass (FM) and percentage body fat. Duplicate measures of resistance, reactance, impedance, and phase were made at 50kHz using an Impedimed bioimpedance analyser (Model BIM4, Impedimed, Capalaba, Australia) with a tetrapolar arrangement of self-adhesive electrodes (Red Dot 2330, 3M Healthcare, St Paul, MN). Subjects were asked to empty their bladder before measurement and were allowed to drink water ad-libitum to ensure normal hydration. BIA measurement was conducted by qualified health professionals following the standardized protocol. The above methods had been piloted in a smaller sample from the same population group previously.[25]

BIA has been shown to be a valid measure of body fatness given an ethnically-appropriate fit equation is used.[26, 27] Regression equations for FFM recently validated by dual X-ray absorptiometry using the same BIA meter in 211 (110 male, 101 female) adults aged 19-74 years with a similar range of fatness from the Auckland Asian Indian population were applied.[28] Intraindividual day to day variability of resistance in our hands is in the order of 1.5%.

Physical Activity. A New Lifestyles NL2000 sealed pedometer was used to record the number of daily steps taken over each of seven consecutive days. Pedometers provide a useful and accurate estimate of total daily physical activity.[29] The NL2000 model is validated as reliable and accurate for measuring free-living adult step counts.[28] Such objective measures are now the standard for understanding how much movement is achieved each day.[30] A compliance survey was administered to verify that pedometers had been worn during the study period. If a pedometer had not been worn on a particular day for one hour or more then the data from that day were not included. When the step count for a day was less than 500 it was also removed from the data.

Lifestyle and Health Questionnaire. A lifestyle and health questionnaire was developed from the Behavioural Risk Factors Surveillance Survey[31] and the Central Queensland Social Survey.[32] This questionnaire requested information on demographics including gender, age, immigration date, modes of transportation, and nutrition habits (e.g., consumption of takeaway foods and carbonated sugar-based beverages, failure to eat breakfast). Perception of weight status was collected to understand whether participants in different weight categories (especially higher weight categories which are a risk for chronic disease) actually perceive themselves to be in these categories, however, these findings are reported elsewhere.[33] All participants also reported the presence of lifestyle-related chronic disease as previously diagnosed by a physician. The lifestyle and health questionnaire was piloted on a small group of Asian Indian adults for comprehensibility by this group.

Procedure

Data were collected at the weekly meetings of two Asian Indian community organizations. The study was carried out in two phases. In Phase 1, potential participants were recruited and had the study explained to them. Those interested in participating (approximately 90% of those in attendance at the usual weekly meeting) provided informed consent before having their anthropometric measures taken. Pedometers were then fitted and instructions were provided regarding their use. Seven days later (Phase 2), the research team returned to the same venue to administer the lifestyle and health questionnaire, collect pedometers, administer the pedometer compliance survey, and answer any further questions about the research. All questionnaires were administered in English with one of the research team (NKC) available to translate any questions into Hindi on request. Verbal instructions and explanations were given in both English and Hindi. This study was approved by the Auckland University of Technology Ethics Committee.

Statistical methods

Data were coded and entered into SPSS V12 for windows for analysis. The study was cross-sectional. As such, descriptive statistics were used to understand the overall health status of the sample, especially factors relating to lifestyle (overweight/obesity, physical inactivity, and the presence of lifestyle-related chronic diseases). Bivariate and partial correlation coefficients (controlling for age and gender) were calculated to understand how selected variables were associated with adiposity (percent body fat by BIA) and physical activity (pedometer steps). Classification of associations as trivial ($r < 0.1$), weak ($r < 0.3$), and moderate ($r > 0.3$) were used. Confidence intervals (95%) were also calculated for all correlation coefficients to understand the range in strength of association in a wider population.

RESULTS

Overweight and obesity

BMI was calculated as a gross measure of body composition and to understand body composition as a health risk. BMI ranged from 16.6-49.0 kg/m^2 with a mean of 27.2 ± 4.7 kg/m^2. Males had a significantly lower average BMI (25.6 ± 5.4 kg/m^2) than females (28.0 ± 5.4 kg/m^2) (t = 2.5, p = 0.01). Figure 1 shows the percentage of the sample classified as normal weight, overweight, or obese using two different sets of cut-off points: the first being that typically used for European populations where a BMI of greater than 25 kg/m^2 indicates overweight and greater than 30 kg/m^2 indicates obesity[34] and the other being specific to Asian Indian populations where a BMI of 23 kg/m^2 and 25 kg/m^2 indicate overweight and obesity, respectively.[34] From Figure 1 it is clear the majority of Asian Indians studied were either overweight or obese regardless of cut-off points used. Shifting the cut-offs, however, to Indian specific levels meant that 69.2% were classified as obese with a further 13.7% in the overweight category.

Percent body fat, as estimated by BIA, ranged from 13.2% to 58.8% (mean = 41.1, SD = 9.1). Males (mean = 34.6%, SD = 7.7) were significantly leaner than their female (45.7%, SD=6.8) counterparts (t = 11.1, p < 0.001). Cut points of greater than 25% body fat (males) and 30% body fat (females) have been suggested to define Indian people as being at increased risk of co-morbidities associated with excess body fat.[35] Using this definition, 90% of males and 74% of females in the present sample were identified as being at increased health risk because of their body fatness.

Central adiposity has been identified as a risk factor for metabolic syndrome. For the total sample, waist circumference ranged from 68.0-126.5 cm (mean = 95.1, SD = 11.2), with no significant difference (t = 1.62, p = 0.11) between males (mean = 96.9, SD = 9.7) and females

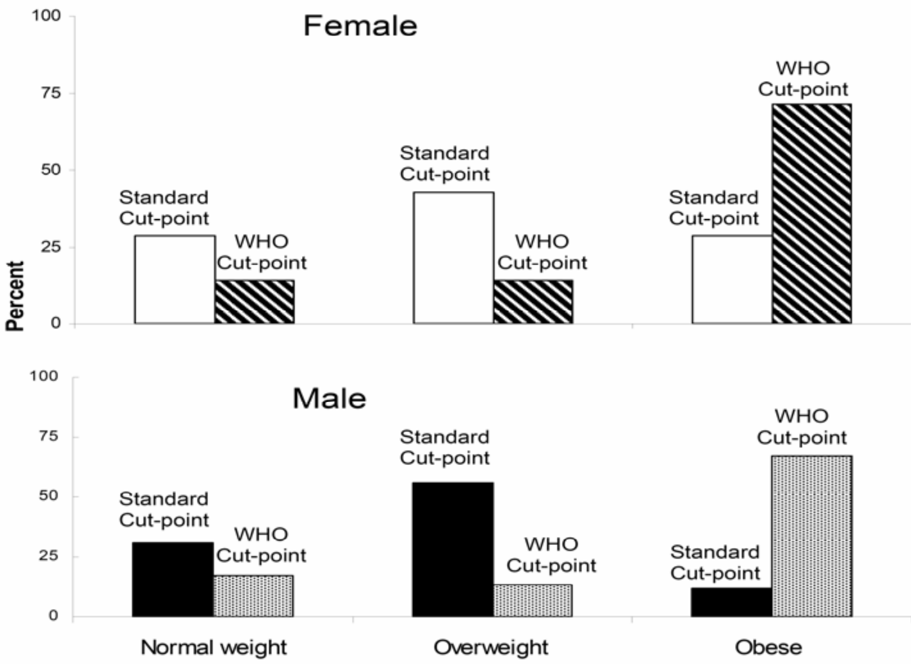

Figure 1. Percent of females and males in the sample classified as normal weight, overweight, or obese using both standard BMI cut-offs and Asian Indian specific cut-offs

(mean = 93.2 cm, SD = 12.2). When using waist circumference cut-off points specific to Asian Indians (i.e., greater than 90cm for males and 80cm for females),[36] 82% of males and 90% of females in our sample exceeded these levels.

Physical activity

Physical activity levels for the sample (as indicated by steps/day) were low and with large variability (mean daily steps = 5,977, SD = 3,560). Males (mean daily steps = 6,982, SD = 4,426) were significantly more active and showed a higher variability in daily pedometer steps compared to their female counterparts (mean daily steps = 5,159, SD = 2,401) ($t = 2.5$ [unequal variance], $p = 0.01$). According to recommendations for daily accumulated physical activity,[30] 48% of the sample would be classified as sedentary (i.e., < 5,000 steps/day) and 33% as low active (i.e., 5,000-7,500 steps/day). Using step indices developed for "adults", however, may not be appropriate for this sample where a majority (92%) were aged over 60 years, and considered as older adults within the Asian Indian community. Only 33% of participants who provided pedometer data did more than 10,000 steps (i.e., defined as active according to Tudor-Locke & Bassett[30]) on at least one of the seven days of data collection, and only 6% of the sample recorded an average of more than 10,000 steps/day. In summary, the majority of the sample had physical activity levels which could be considered low.

Chronic health conditions

The majority of the sample (74.4%) reported some sort of diagnosed chronic health condition, with the most prevalent being diabetes, arthritis, and heart disease (see Table 1).

Health and risk factor associations

Central adiposity, as measured by waist circumference, was examined for associations with physical activity and a number of self-reported nutritional markers (e.g., days of take-out meals, number of sweet drinks, days of breakfast in the last week) (Table 2). Participants ate breakfast on average 4.6 days per week (SD = 1.0), had take-out meals on average 1.3 times each week (SD = 0.5), and consumed on average 2.2 sweet drinks per week (SD = 1.4). Any associations found were weak ($r < 0.3$) and the 95% confidence limits were wide enough that we could not be confident that the associations were only trivial ($r < 0.1$). Higher pedometer steps, however, were associated with a lower waist circumference with and without the covariates of age, gender, and months since migration to New Zealand. The nutritional markers were only trivially associated with waist circumference.

Table 2 also shows that time in New Zealand since migration was associated weakly with a decrease in pedometer steps and a decrease in unhealthy nutritional markers. That is, there is some evidence, albeit with confidence intervals that crossed into trivial associations ($r < 0.1$), that physical activity was worse but nutritional habits were better (i.e., less takeout food consumption, more breakfast consumption, less sweet drinks consumed) for immigrants who had spent more time in New Zealand. This relationship was still evident even after adjustment for age and gender.

DISCUSSION

The findings from this study highlight the considerable prevalence of risk factors for lifestyle diseases including cardiovascular disease and diabetes in a sample of older Asian Indians living in urban New Zealand. When considering ethnic-specific cut-off values, over two-thirds were classified as obese, and over 80% had waist circumference values that were associated with increased risk factors for metabolic syndrome. Nearly three-quarters of females, and almost all (90%) of males had body fat percentages that were associated with an increased health risk. Indeed, most of the sample reported that they already had one or more chronic diseases, with diabetes the most commonly reported. Compared to other older New Zealanders, this group had a much higher prevalence of obesity. The 2003 New Zealand Health Survey[37] showed that, in a representative sample of more than 10,000 people, 38.3% of 65-74 year olds were overweight with a further 28.0% obese. The current research demonstrates the importance of using ethnic-specific cut points for body fatness in order to more accurately establish the proportion

Table 1. Number of participants (and percentage of sample) who reported diagnosed chronic health conditions. Note that the total percentages add up to greater than 100 due to some participants reporting more than one diagnosed chronic condition

Chronic health condition	Total sample (N = 112) n (%)	Males (N = 50) n (%)	Females (N = 62) n (%)
Any chronic condition	87 (77.7)	41 (82.0)	46 (74.2)
Diabetes	40 (35.7)	17 (34.0)	23 (37.1)
Arthritis	21 (18.8)	7 (14.0)	14 (22.6)
Heart disease	18 (16.1)	13 (26.0)	5 (8.1)
Osteoporosis	11 (9.8)	2 (4.0)	9 (14.5)
Hypertension	36 (32.1)	20 (40.0)	16 (25.8)
Asthma	4 (3.6)	0 (0.0)	4 (6.5)
Depression	4 (3.6)	2 (4.0)	2 (3.2)
Stroke	3 (2.7)	1 (2.0)	2 (3.2)
Anxiety disorder	2 (1.8)	1 (2.0)	1 (1.6)
Colon cancer	1 (0.9)	1 (2.0)	0 (0.0)
Thrombosis	1 (0.9)	1 (2.0)	0 (0.0)

Table 2. Correlates of central adiposity and months since migration to New Zealand for older Asian Indians. Partial correlation coefficients were also calculated with covariates of age, sex, and duration since migration to New Zealand. Associations were classified as trivial (r < 0.1), weak (r < 0.3), and moderate (r > 0.3).

	Pearson's r (95% CI)	Partial r
	Central adiposity (waist circumference)	
Pedometer steps	-0.19 (-0.39, -0.03) $p = 0.04$	-0.18 $p = 0.02$
Number of days of participating in exercise	-0.06 (-0.25, 0.13) $p = 0.19$	-0.13 $p = 0.18$
Number of days of takeout food consumption	-0.08 (-0.29-0.14) $p = 0.23$	-0.09 $p = 0.21$
Number of days of breakfast consumption	-0.04 (-0.25, 0.15) $p = 0.37$	-0.07 $p = 0.28$
Number of sweet drinks consumed	-0.12 (-0.33, 0.10) $p = 0.15$	-0.13 $p = 0.12$
Months in New Zealand since migration	0.28 (0.09, 0.45) $p = 0.01$	–
	Months since migration to New Zealand	
Pedometer steps	-0.23 (-0.43, -0.01) $p = 0.02$	-0.19 $p = 0.05$
Number of days of takeout food consumption	-0.25 (-0.44, -0.03) $p = 0.01$	-0.24 $p = 0.02$
Number of days of breakfast consumption	-0.21 (-0.41, 0.01) $p = 0.03$	0.22 $p = 0.02$
Number of sweet drinks consumed	-0.29 (-0.48, -0.08) $p < 0.01$	-0.28 $p = 0.01$

of people with risk factors.[38]

One-third of this population group could be considered low active, and nearly half sedentary, in terms of number of steps accumulated each day.[30] Given that physical inactivity is an independent risk factor for lifestyle related disease, including cardiovascular disease,[39] this is cause for concern. As very few studies have measured steps in older adults (and none for Asian Indians), comparison of our findings to other relevant data is difficult. Croteau et al.[40] found that for a sample of 155 community dwelling older adults in the US (mean age = 72.8 years) average daily steps ranged from 4,655 to 5,164. Talbot et al.[41] investigated a pedometer-driven walking program in 34 community-dwelling older adults with osteoarthritis and reported average daily steps before intervention ranging from 3,519 to 4,652. Despite our findings indicating higher levels of physical activity than in other studies of older adults, the majority of the sample can still be considered as sedentary to low active. Hayes et al.,[42] while not directly assessing steps, measured time spent in physical activity in a cross-sectional population-based study in the UK. They found that a large majority of those of Asian Indian and Pakistani descent (71% and 87%, respectively) did not meet guidelines of five episodes of moderate activity of 30 minutes duration per week. This compared with 52% of Europeans in their sample not meeting guidelines.

Physical activity levels decreased even further when individuals had lived in New Zealand for longer, even when adjusting for age and sex effects. Education regarding appropriate activity levels for health gain may enhance the likelihood of intervention success. Explanations for the relationship between reduced activity levels and time spent in New Zealand are not known, however, it is clear that this immigrant population requires support to become, and remain, sufficiently active for health gain. In contrast, immigrants who have been in New Zealand for a longer time showed some evidence of improvements in nutritional habits, with increases in breakfast consumption, and a reduction in takeaway and sweet drink consumption. It is possible that recent migrants adopt unhealthy nutritional habits such as takeaway consumption until such time that they adjust to their new environment and/or the environment changes to suit specific needs (e.g., an increased number of ethnic specific food outlets). These environmental adjustments may allow immigrants to regain healthier nutritional habits such as being able to shop for and cook meals at home.

Understanding the perceptions of physical activity and cardiovascular risk factors in Asian Indian immigrant groups is vital to designing interventions to reduce the risk of disease. Older Asian Indians living in the US rated health and medical reasons as the most important motive for participating in physical activity, whilst at the same time identifying a fear of causing ill health as a barrier to participating in greater levels of activity.[43] The latter finding has also been identified by Asian Indian immigrants living in New Zealand.[44]

The findings from this study should be considered in light of two limitations. First, the associations found were weak to moderate at best, with wide confidence intervals, and as such, should not be over-interpreted. Second, the convenience sampling procedure resulted in a non-representative and somewhat small sample. While a more representative sample would have been ideal, the two largest Asian Indian community groups for older adults in

Auckland participated in the study. It was felt this would provide an adequate depiction of body fatness, physical activity patterns, and nutrition behaviours of this population.

The present study has identified that a high prevalence of risk factors for lifestyle related diseases exist in older Asian Indian immigrants to New Zealand. In particular, inactivity and body composition are concerns. Clearly, this population stands to gain from both weight reduction and increased physical activity participation. New Zealand health policy has most commonly concentrated on Maori and Pacific peoples as at-risk groups for lifestyle disease.[8,9] The Asian and South Asian demographic is one that has grown rapidly in recent times and makes up an increasing proportion of the New Zealand population. Those who advocate for and develop health policy need to consider the specific needs of such groups,[45] and identify best practice approaches for intervention for this population.

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AUTHOR DISCLOSURES

Gregory S. Kolt, Grant M. Schofield, Elaine C. Rush, Melody Oliver and Narender K. Chadha, no conflicts of interest.

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Original Article

Body fatness, physical activity, and nutritional behaviours in Asian Indian immigrants to New Zealand

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紐西蘭之亞洲印度移民之身體肥胖度、體能活動及營養行為

對 112 名（50 名男性，62 名女性）住在紐西蘭的亞洲印度人評估身體肥胖度、體能活動及營養行為。參與者的年齡從 44 至 91 歲（平均 67.5 ± 7.6），並且住在紐西蘭平均 51 個月。為了測定身體質量指數(BMI)及中央形肥胖測量身高、體重和腰圍。以生物阻抗法推算非脂肪質量、脂肪質量和體脂肪率。連續 7 天配戴記步器用來記錄每日步行數。以生活形態和健康問卷收集營養行為的訊息。本樣本的平均 BMI 為 27.2 ± 4.7 kg/m^2，女性(28.0 ± 5.4 kg/m^2)顯著高於男性(25.6 ± 5.4 kg/m^2)。採用亞洲印度人特殊切點，有 69％的人肥胖(BMI≥25 kg/m^2)和 13.7％過重(23≥BMI<25 kg/m^2)。平均體脂肪率為 41.1 ± 9.1，而女性顯著高於男性。多數 (74％)報告有一些慢性疾患，35％被診斷出有糖尿病。體能活動的程度不高（5,977 ± 3,560 步/天），男(6,982 ± 4,426)女(5,159 ± 2,401)之間有顯著差異。較高的記步數與較小的腰圍相關。校正年齡之後，體能活動仍低，但是營養行為比居住在紐西蘭較久的人好。總結，紐西蘭之亞洲印度移民體能活動程度低及高比例的過重和肥胖及與生活型態相關的疾病。

關鍵字：肥胖、身體質量指標、體能活動、亞洲人、營養。