Short Communication

Prevalence and risk factors with overweight and obesity among Vietnamese adults: Caucasian and Asian cut-offs

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Objective: To determine the prevalence and factors associated with overweight/obesity among adults in Ho Chi Minh City (HCMC) using Caucasian and Asian cut-offs. Study design: A cross-sectional survey. Methods: In 2005, 1,971 adults aged 25-64 years in HCMC were randomly selected using a proportional to population size sampling method to estimate the prevalence of overweight and obesity, measured by body mass index (BMI) and waist circumference. Multivariable logistic models were used to examine associations between overweight/obesity and socioeconomic status, health-related behaviors, and biochemical indices of chronic disease risk. Results: The prevalence of overweight and obesity using the Caucasian BMI cut-offs were 13.9% and 1.8% respectively, and those with the Asian BMI cut-offs were 27.5% and 5.7%, respectively. The abdominal adiposity rates were higher than the BMI overweight and obesity rates in women, but not in men. Increasing age, low education, high household wealth index, high levels of sitting and reclining time, cholesterol and high blood pressure were significantly associated with overweight and obesity. Current smoking and sedentary leisure time was significantly negatively associated with this status in men. Conclusion: Associations between overweight/obesity and metabolic disorders were evident using both cut-offs. Asian cut-offs identified more risk factors and therefore could be considered for defining at-risk groups. The results highlight the importance of intervention programs to prevent overweight/obesity in young adults.

Key Words: Asians, adults, risk factors, developing countries, obesity

INTRODUCTION

Obesity is a worldwide problem with prevalence increasing globally.[1] Overweight/obesity are associated with considerable risks of chronic non-communicable disease (NCD), lower quality of life and premature mortality.[2]

Increasing evidence indicates that Vietnam is experiencing a double burden of communicable and NCDs not previously observed.[3,4] Data from two multi-purpose Vietnamese Living Standard Surveys showed that the rate of overweight in Vietnamese adults doubled between 1992 and 2002, from 2% to 5.5%, respectively.[5] Although these rates are still relatively low compared with countries such as the United States and Australia,[6,7] early prevention of obesity warrants attention.

Worldwide debates are continuing about using ethnic-specific or standard BMI cut-offs for defining overweight/obesity.[8] It has been argued that using standard BMI cut-offs for Asian populations may underestimate the overweight/obesity prevalence, and identifying different risk profiles.[9] Evidence to date indicates that Asian populations have higher body fat for the same BMI values compared with Caucasian populations. It is the level of body fat, as measured by waist circumference, that is associated with higher health risks for NCDs in Asian populations.[1,8] To address this issue, the World Health Organization (WHO) recommends using the standard BMI cut-offs for surveillance purposes and Asian cut-offs for country-specific public health actions.[8] In this cross-sectional population-wide study, we report the prevalence of overweight, obesity and abdominal adiposity. We also compared the risk factors for overweight/obesity using Caucasian and Asian cut-offs among adults in Ho Chi Minh City (HCMC).

MATERIALS AND METHODS

Sampling strategy and study population

In 2005, a representative sample of 1,971 adults aged 25-64 years living in HCMC was selected using a proportional to population size sampling method. Prospective participants were stratified by sex and age groups (25-34 years, 35-44 years, 45-54 years and 55-64 years), and 16 participants were randomly selected from each age-sex group within each ward/commune – an administrative

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system which divides HCMC into two levels: districts, and wards (urban area) /communes (rural area). Full details of the sampling method have been described in a separate publication.[10] The response and missing data rates were 84.1% and 0.5%, respectively. Consenting participants attended their local health centre for measurements and face-face-interviews. The study followed the WHO STEPSwise Approach for Surveillance of Non-communicable Disease protocol to ensure within and between country comparisons.

Ethical approval was granted by the Faculty of Public Health at the University of Medicine and Pharmacy of Ho Chi Minh, the local government as well as the local health centre authority.

Measurement of anthropometric and other variables

Height was measured using a Microtoise tape suspended from a wall, recorded to the nearest 0.1cm. Weight was measured by a SECA electronic scale, recorded to the nearest 100g. Waist circumference was measured at the

Table 1. Characteristics of the survey sample, by gender[†]

	Men		Women	
	n	%	n	%
Gender	908	47.7	1063	52.3
Age groups (years)	908		1063	
25-34	378	41.5	415	39.1
35-44	293	32.3	338	31.8
45-54	173	19.1	214	20.1
55-64	64	7.0	96	9.0
Area	908		1063	
Rural	235	25.9	269	25.3
Urban	673	74.1	794	74.7
Education**	907		1061	
Less than primary school	92	10.1	174	16.4
Primary school completed	266	29.3	346	32.6
Secondary school completed	234	25.8	263	24.8
High school completed	182	20.1	170	16.0
Some college education	133	14.7	108	10.2
Household wealth index	904		1062	
Poorest	157	17.4	245	23.1
Second	182	20.1	218	20.5
Middle	202	22.3	189	17.8
Fourth	185	20.5	209	19.7
Richest	178	19.7	201	18.9
Body Mass Index (mean)	908	21.7	1063	22.0
Waist circumference (mean)***	908	77.9	1051	74.4
Current smoker**	878	57.7	1019	1.6
Alcohol risk levels **	908		1063	
No risk	800	88.1	1017	95.7
Low risk	26	2.9	41	3.9
High risk	82	9.1	5	0.4
Sitting and reclining time per day**	878		1019	
Lowest (0-90min/day)	248	28.2	376	36.9
Moderate (91-180min/day)	373	42.5	431	42.3
Highest (181-1200min/day)	257	29.3	213	20.9
Physical inactivity at work	878	64.2	1019	67.2
Physical inactivity at commuting**	878	54.1	1019	38.2
Physical inactivity at recreation**	878	87.7	1019	93.4
Physical activity level**	878		1019	
Vigorous ¶	313	35.6	309	30.3
Moderate ¶	157	17.9	290	28.5
Light ¶	408	46.5	420	41.2
High blood pressure ‡	905	22.6	1060	13.6
High blood glucose ≥6.1mmol/l §	896	4.7	1056	3.8
High total cholesterol (≥5.2mmol/l)*	898	16.2	1057	17.3

† Data weighted for age and gender based on the HCMC CENSUS 2004

‡ High blood pressure (systolic blood pressure ≥140mmHg and/or diastolic blood pressure≥90mmHg)or taking anti-hypertension medicine; § High serum glucose or treating diabetes by medicine

* Chi-square test p-value<0.05;** p-value <0.001; *** t-test , p-value <0.001

¶ Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week OR 7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week. Moderate-intensity on 3 or more days of vigorous-intensity of at least 20 minutes per day OR 5 or more days of moderate-intensity and/or walking of at least 30 minutes per day OR 5 or more days of any combination of walking, moderate-or vigorous-intensity activities accumulating at least 600 MET-minutes/week. Light-intensity: no activity is reported or some activity is reported but not enough to meet high and moderate categories.

midpoint of the last palpable rib and the top of the hip bone to the nearest 0.1 cm using the non-stretch tape.[11] For both BMI and abdominal adiposity two cut-offs were considered in the analysis: (i) Caucasian BMI cut-offs: overweight (25-29.9 kg/m^2), obese (≥30 kg/m^2); and Asian BMI cut-offs: overweight (23-27.4 kg/m^2), obese (≥27.5 kg/m^2), (ii) abdominal adiposity cut-offs for Caucasian populations: overweight (men ≥94 cm, women ≥ 80 cm), and for Asian populations: overweight (≥90 cm for men, ≥80 cm for women).[8,12]

Measurements and analyses of all variables followed the STEPSwise Approach for Surveillance of Noncommunicable Disease study protocol.[11,13,14] The household wealth index was computed using the data on household assets and following methods recommended by the World Bank Poverty Network and UNICEF.[15]

Statistical analysis

To adjust for stratification during sampling, post-stratified weights were calculated based on the population distribution of adults aged 25-64 years living in HCMC (reference population from 2004 CENSUS for HCMC). Analyses were performed using Stata/SE software version 9.2 (STATA Corporation, College Station, TX, USA, 2006), with the survey commands used to adjust for the stratified cluster sampling design by use of Taylor linearized variance estimation.

The gender-specific prevalence of overweight/obesity was reported as proportions with 95% confidence interval (CI). Pearson chi-square test was performed to test the relationship between categorical variables. To examine dose-response relationships, tests for linear trend across categories were reported. Multivariable logistic models were used to estimate odds ratios (ORs) and to control for potential confounders as well as modeling interaction terms. The Wald test was reported at a significance level of 0.05.

RESULTS

There were significant gender differences in education levels, smoking, alcohol consumption, physical activity levels, sitting times, high total cholesterol and high blood pressure (p<0.05) (Table 1).

Using the Caucasian BMI cut-offs the prevalence of overweight/obesity was 13.9% and 1.8% respectively, compared with 27.5% and 5.7% when using the Asian BMI cut-offs (Table 2). There was no significant difference in the proportions of overweight/obesity between men and women, using either cut-offs. There was a relatively higher prevalence of abdominal adiposity among women using the Caucasian cut-offs compared with overweight/obesity prevalence based on BMI (24.6% versus 16.3%). An opposite relationship was observed for men (5.9% versus 15.1%). However, when using the Asian waist circumference cut-offs the abdominal adiposity rate in men was higher than when using the Caucasian cut-offs (11.3% versus 5.9%). There were significant differences between men and women in abdominal overweight using Caucasian cut-offs (p<0.001) as well as the Asian cut-offs (p<0.05).

Table 3 shows that among men, similar risk factors were found between the two cut-offs with one additional factor noted using the Asian cut-offs. Age, education, household wealth index, physical inactivity at work, and fasting blood glucose were insignificant (adjusted OR) in both cut-offs. With the Caucasian cut-offs, education and household wealth index showed a positive association but an inverse trend was found with the Asian cut-offs, except for the wealthiest group (OR=1.68, 95% CI=0.83-3.42). Meanwhile, the wealthiest individuals or the lowest educational attainment showed a tendency for being overweight and obese using the Asian cut-offs, but this did not reach significance. However, the household wealth index categories showed this significant trend for the Caucasian cut-offs (p<0.05). While current smoking appeared to protect against overweight/obesity (Caucasian cut-offs: OR=0.57, 95% CI=0.37-0.88; Asian cut-offs: OR=0.64, 95% CI=0.44-0.92), a positive association between high blood pressure, total cholesterol and overweight/obesity was noted in both cut-offs. However, a stronger association was observed using the Caucasian cut-offs. Physical activity levels, sitting and reclining

Table 2. Percentage of adults overweight and obese according to Caucasian and Asian cut-offs by gender

	Caucasian cut-offs				Asian cut-offs		
	Male (n=908)	Female (n=1063)	Total (n=1971)		Male (n=908)	Female (n=1063)	Total (n=1971)
Body Mass Index, kg/m^2 (%, 95% CI)							
Acceptable (18.5-24.9)	65.6 (61.3-69.8)	70.5 (67.5-73.6)	68.2 (65.2-71.1)	Acceptable (18.5-22.9)	47.2 (42-52.4)	53.7 (49.6-57.9)	50.6 (46.8-54.4)
Overweight (25-29.9)	13.5 (10.2-16.9)	14.3 (12.5-16.1)	13.9 (11.7-16.2)	Overweight (23-27.49)	27.9 (23.1-32.7)	27.1 (24.2-30.1)	27.5 (24.3-30.7)
Obese (≥30)	1.6 (0.7-2.4)	2.0 (1.1-2.8)	1.8 (1.2-2.4)	Obese (≥27.5)	5.6 (3.3-7.9)	5.9 (4.4-7.4)	5.7 (4.2-7.2)
Waist Circumference (%, 95%CI)	(n=908)	(n=1051)	(n=1959)		(n=908)	(n=1051)	(n=1959)
Normal *	94.1 (92.2-96.1)	75.4 (71.7-79.1)	84.3 (82.2-86.4)	Normal **	88.7 (85.6-91.8)	75.4 (71.7-79.1)	81.7 (78.8-84.6)
Overweight†	5.9 (3.9-7.8)	24.6 (20.9-28.3)	15.7 (13.6-17.8)	Overweight‡	11.3 (8.2-14.4)	24.6 (20.9-28.3)	18.3 (15.4-21.2)

CI: confidence interval; *Pearson chi-square p-value<0.05; ** Pearson chi-square p-value<0.001;
† Waist ≥94cm for male and ≥80cm for female; ‡ Waist ≥90cm for male and ≥80cm for female

Table 3. Adjusted odds ratios (ORs) and 95% confidence interval (CI) likelihood for overweight and obesity, by gender[†]

	Men		Women	
	Caucasian cut-offs (n=863)	Asian cut-offs (n=863)	Caucasian cut-offs (n=1005)	Asian cut-offs (n=1005)
Age groups (years)				
25-34	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)[§]	1.00 (ref.)
35-44	1.35 (0.53-3.41)	1.33 (0.81-2.19)	2.24 (1.10-4.53)[*]	1.72 (1.15-2.57)[*]
45-54	1.51 (0.74-3.07)	1.32 (0.83-2.08)	2.73 (1.40-5.51)[**]	2.38 (1.68-3.37)[***]
55-64	0.80 (0.37-1.73)	1.18 (0.70-1.98)	2.77 (1.60-4.80)[**]	1.96 (1.17-3.28)[*]
Area				
Rural	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
Urban	1.59 (0.58-4.37)	1.14 (0.74-1.75)	1.14 (0.83-1.57)	1.15 (0.76-1.74)
Education				
Less than primary school	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)[§]
Primary school completed	1.06 (0.33-3.41)	0.51 (0.21-1.25)	1.32 (0.85-2.05)	1.13 (0.65-1.96)
Secondary school completed	2.38 (0.47-11.90)	1.03 (0.45-2.39)	0.79 (0.40-1.53)	0.69 (0.40-1.20)
High school completed	1.36 (0.25-7.52)	0.81 (0.35-1.90)	0.71 (0.30-1.71)	0.58 (0.29-1.18)
Some college education	2.64 (0.42-16.64)	0.88 (0.39-2.00)	0.67 (0.29-1.55)	0.27 (0.13-0.61)[**]
Household wealth index				
Poorest	1.00 (ref.)[‡]	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)[§]
Second	1.02 (0.43-2.47)	0.82 (0.50-1.34)	0.76 (0.37-1.56)	1.10 (0.62-1.97)
Middle	1.13 (0.43-2.47)	0.76 (0.42-1.39)	0.88 (0.54-1.42)	1.24 (0.72-2.11)
Fourth	1.17 (0.38-3.64)	0.96 (0.47-1.96)	1.73 (1.04-2.89)[*]	1.84 (1.21-2.79)[**]
Wealthiest	2.54 (0.81-7.97)	1.68 (0.83-3.42)	1.32 (0.75-2.32)	2.41 (1.56-3.72)[**]
Current smoker				
No	1.00 (ref.)	1.00 (ref.)	NS	NS
Yes	0.57 (0.37-0.88)[*]	0.64 (0.44-0.92)[*]	NS	NS
Physical inactivity at recreation				
No	NS	1.00 (ref.)	NS	NS
Yes	NS	0.54 (0.31-0.95)[*]	NS	NS
Sitting and reclining time per day				
Lowest (0-90min/day)	NS	NS	NS	1.00 (ref.)
Moderate (91-180min/day)	NS	NS	NS	1.53 (1.08-2.18)[*]
Highest (181-1200min/day)	NS	NS	NS	1.39 (0.83-2.30)
Total cholesterol				
Normal	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
High total cholesterol[¶]	3.95 (2.36-6.59)[***]	3.15 (2.05-4.83)[***]	1.85 (1.15-2.98)[*]	1.80 (1.34-2.39)[**]
Blood pressure				
Normal	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
High blood pressure[††]	2.47 (1.44-4.26)[**]	2.13 (1.49-3.04)[***]	2.04 (1.26-3.30)[**]	2.01 (1.28-3.15)[**]

[†] Adjusted for the variables in the table; NS: Not Significant
[*] Wald-test, p-value<0.05; [**] Wald test, p-value<0.01; [***] Wald test, p-value<0.001
[‡] Test for linear trends across categories p-value<0.05, [§]p-value <0.01
[¶] High total cholesterol: total cholesterol ≥5.2mmol/l; [††]High blood pressure: systolic blood pressure ≥140mmHg and/or diastolic blood pressure≥90mmHg) or taking anti-hypertension medicine;

time were not associated with overweight/obesity among men.

Among women, using the Caucasian cut-offs the trends and strength of association between overweight/obesity were similar to those observed for men for age, household wealth index, high total cholesterol, and high blood pressure, but not for education levels.

However, there was an inverse significant association with education using the Asian cut-offs. That is, women with higher educational levels were less likely to be overweight or obese. The results indicated that women from wealthier households were more likely to be overweight and/or obese. This significant association occurred in the top two wealth index groups using Asian cut-offs but only the second top wealthiest group using Caucasian cut-offs. Tests for trends across the education (p<0.001) and wealth index categories (p<0.001) also confirmed this trend using the Asian cut-offs. Furthermore, those reporting moderate levels of sitting and reclining time per day showed a significant association with overweight/obesity when using the Asian cut-offs but not for the Caucasian cut-offs.

DISCUSSION

Overweight and obesity prevalence

This study found that using the Caucasian cut-offs, overweight/obesity rates in HCMC were still lower than those in other developing countries in the Asia-Pacific region,[16-22] and Latin-America,[23] but similar to urban areas in West Africa.[24] Compared to a survey conducted in urban HCMC in 2004,[25] the proportion of overweight adults in our study was slightly lower; but this may be explained by a relatively lower overweight rate in rural adults involved in this study. The lower rates of overweight/ obesity compared to those reported in other Asian countries indicate that HCMC is still at an earlier stage of a nutrition transition.[26]

An interesting point in this study is that the higher rate of abdominal adiposity suggests that abdominal adiposity occurred in advance of BMI obesity (24.6% compared to 16.3%) and that the distribution of body fat in Vietnamese adults, as with other Asians, might be concentrated around the abdominal area. It has been reported that Asian populations are more prone to visceral obesity and therefore at greater risk of cardiovascular disease at lower levels of BMI.[8,27] The association between BMI and comorbidities are probably not stable within populations overtime due to environmental changes,[8] and waist circumference is likely to be considered as a dominant predictor of cardiovascular disease and metabolic disorders because weight gain, duration of overweight and body fat distribution are more important factors than BMI alone.[1,9] This suggests that when using Caucasian cut-offs for gauging obesity related-risk, it would be necessary to also include waist circumference in the anthropometric measurement.

Biochemical characteristics, health-related habits, socio-economic status and overweight and obesity

Similar to findings from previous studies, we found that increasing age, low education, and high income were significantly associated with overweight/obesity.[16-18,28,29] However, as noted in research from developed countries, this study found that education level was inversely related to overweight/obesity among women but the relationship was inconsistent among men.[30] The results were also similar to findings from Brazil.[31] This difference could be explained by a high literacy level in Vietnam compared with other developing countries.[3] Furthermore, education could not be considered as the only socio-economic variable, but should be considered in combination with multiple socio-economic measures such as income or household wealth.[32] This is important since the different effects of education and income may become more apparent as energy-dense food, mechanised transport, and television become more accessible and available in developing countries.

In this study, an inverse trend between education and wealth index across genders was noted: positively correlated in men but negatively correlated in women. Considering the wealth index, the results in this study were similar to the review by Sobal and colleagues,[30] that is, higher socio-economic status in developing countries was directly associated with obesity among men and women, an opposite relationship to that observed in developed countries. Furthermore, using Asian cut-off points, the study showed more significant associations and inverse trends in individual education level and household wealth index compared with Caucasian cut-offs. Women were found to be at higher risk when using Asian cut-offs, suggesting that ethnic-specific cut-offs could lead to different conclusions about the population burden attributable to obesity. However, using different cut-offs might also affect the power to detect associations due to different sample sizes in subgroups. Further, the current associations found in developing countries like Vietnam may be temporary given that these countries are still undergoing a nutrition and demographic transition. It is possible that groups at risk could change, and the predicted increase in inactivity and unhealthy diets in lower socioeconomic groups may result in higher obesity prevalence and other chronic health problems.[33]

Current smoking rate in men was higher compared with those in women (57.7% and 1.6%, respectively), which might contribute to a different prevalence of overweight and obesity between genders.[17] Significant associations between current smoking and overweight/obesity were previously reported by authors,[16,17] smoking may be associated with weight loss.

The few studies that have reported associations between obesity, physical activity and sedentary status found no association or clear relationships between physical activity, and overweight/obesity.[17,34] This study found no such relationship when using the Caucasian cut-offs. However, using the Asian cut offs we found significant associations between overweight/obesity and physical inactivity during recreation in men, and for sitting and reclining time in women. A high level of sitting time was also a risk factor in women. Similarly, previous studies have found prolonged TV watching was associated with obesity in adults.[35,36] Hu and colleagues in a 6-year prospective study noted that 7.5% of women became obese. In multivariate analyses adjusting for age, smoking, exercise levels, dietary factors, and other covariates, each 2-hour per day increment spent in television watching was associated with a 23% increase in obesity, and each 2-hour per day increment spent in sitting at work was associated with a 5% increase in obesity.[36] The authors concluded that 'the more time spent viewing TV, the greater likelihood of having a higher weight status.'[37] However, physical inactivity during recreation was negatively associated with overweight/obesity in men. This may be due to overweight individuals increasing their leisure-time activities to control their weight. This could also explain differences in correlates observed between the two cut-offs: pre-obese men chose to be more active during leisure time rather than during work and commuting time. Self-reporting might also bias the response, however, with men likely to over-report and women under-report their physical activity.

A number of limitations in this study need to be noted. The cross-sectional nature of the data limits causality interpretation. Also, although physical activity and sedentary time were investigated, dietary intake was not collected thus limiting our ability to examine the energy intake and expenditure balance issue. Furthermore, we did not assess weight control strategies which might have

confounded the association between overweight/obesity, physical activity levels and sedentary time. This study however offered some strengths. Unlike previous research, this study examined the relationships between BMI, abdominal adiposity, health-related behaviours and biochemical characteristics with wealth index, education and income.

In summary, association between overweight/obesity and metabolic disorders were evident using both cut-offs. While both Caucasian and Asian cut-offs identified similar risk factors associated with overweight/obesity, using the Asian cut-offs revealed more risk factors related to socio-economic characteristics, health-related behaviors with different strengths and trends, especially among women. The use of Asian cut-offs is therefore recommended for public health action, especially for defining at-risk groups and for programs aimed at preventing overweight/obesity.

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AUTHOR DISCLOSURES

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Short Communication

Prevalence and risk factors with overweight and obesity among Vietnamese adults: Caucasian and Asian cut-offs

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越南成年人過重與肥胖的盛行率與危險因子：白人和亞洲人的切點

目的：探討胡志明市的體重過重和肥胖的盛行率與相關因子，用白種人及和亞洲人的切點。研究設計：橫斷性研究。研究方法：2005 年，使用人口規模比例抽樣方法，隨機選取在胡志明市中 1971 位的成人，年齡為 25-64 歲，用以評估過重和肥胖的盛行率，測量包括身體質量指數（BMI）和腰圍。多變量羅吉斯迴歸用以評估過重/肥胖與社經地位、健康相關行為、慢性疾病危險因子的生化指標之相關。結果：若利用白種人 BMI 切點，過重和肥胖的盛行率，分別為 13.9%與 1.8%；採用亞洲人 BMI 切點，則分別為 27.5%與 5.7%。女性中，腹部肥胖比例高於 BMI 過重和肥胖率，但此現象不發生於男性中。年齡越大、教育程度低、家庭財富指數高、長時間久坐和斜倚、膽固醇和血壓高，皆與過重和肥胖有顯著相關。男性中，目前抽菸和閒暇時間少運動與過重和肥胖有顯著的逆相關。結論：使用兩種切點，都證實過重和肥胖與代謝疾病是相關的。用亞洲人的切點判定更多的危險因子，因此可確認高危險族群。此結果更突顯，對於年輕的成人，應有介入的計畫予以預防過重及肥胖。

關鍵字：亞洲人、成人、危險因子、發展中的國家、肥胖