Educational inequalities associated with health-related behaviours in the adult population of Singapore

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ABSTRACT

Introduction: Socioeconomic differences in health-related behaviours have been widely studied in the Western populations, but are seldom considered in Asian populations. We examined the effect of education attainment on health-related behaviours (physical activity, cigarette smoking and alcohol consumption) among non-institutionalised Singaporeans aged 18-69 years.

Methods: We used data from the Singapore National Health Survey 2004. Information on physical activity, cigarette smoking, alcohol consumption and sociodemographic characteristics was collected from 4,084 adults. Age-adjusted prevalence of the three health-related behaviours by educational attainment was calculated by the direct method. Logistic regression models, adjusted for age, gender, ethnic group and employment status, were used to estimate the odds ratios and 95% confidence interval, in order to study the prevalence of health-related behaviours according to educational attainment.

Results: The prevalence of physical inactivity, daily smoking and regular alcohol consumption was found to be consistently highest among men and women with the least education. Prevalence of physical inactivity and smoking was inversely related to educational attainment for both genders. However, no clear gradient was found between education and alcohol consumption for men and women.

Conclusion: Less-educated Singaporeans were more likely to smoke daily, drink alcohol regularly or not to exercise regularly. Health promotion policies or programmes aimed at encouraging healthy lifestyles in the Singapore population should take into account the educational inequalities in these health-related behaviours.

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INTRODUCTION

Epidemiological research consistently demonstrates health inequalities between people in relation to their socioeconomic status (SES). These inequalities, expressed in a variety of health outcomes, including chronic disease morbidity and mortality, and subjective health, mostly point to the disadvantage of people in lower socioeconomic groups. The casual relations through which SES are translated into differential health outcomes have not yet been clearly established, although a wide array of behavioural, social, psychological and biological pathways have been posited.[1-7] However, lifestyle factors, such as physical inactivity, alcohol consumption and cigarette smoking, are likely to play an important intermediate role. Physical inactivity has been associated with lower SES. Several studies have shown that individuals with lower levels of education, income or occupational prestige typically report lower levels of physical activity in their leisure time than those with higher educational level, income level or occupational status.[8-14] In several general population studies, it has been found that SES (education) was negatively associated with heavy alcohol consumption in both genders. Lower SES groups have also been found to smoke more frequently. An inverse relation between SES and smoking in adults has been noted in both European and American populations.[12,13,15-17]

Information on the prevalence of health-related behaviours, such as physical inactivity, alcohol consumption and smoking, by SES in the general population is of great public health importance. The information would enable the identification of high-risk subpopulations in terms of SES and the development of appropriate preventive programmes and health promotion activities. However, to the best of our knowledge, socioeconomic differences in health-related behaviours based on representative samples in

Asian populations, have not been reported before. It would be of public health interest and local relevance to test the hypothesis that inverse relationships between health-related behaviours and education, often found in Western populations, are also similarly observed in the Singapore population. The aims of this study are two-fold. First, we aimed to report the prevalence of three health-related behaviours, namely: physical activity, alcohol consumption and smoking, by SES in terms of education attainment in the Singapore adult population. Second, we aimed to determine whether Singaporean adults who had less education, were more likely to be physically inactive, consume more alcohol or smoke more, compared to their counterparts who had more education. Education was chosen as the SES indicator over other commonly-used factors like income and occupation, because it is generally stable after adulthood and less susceptible to being modified by the onset of illness.

METHODS

The prevalence of the three health-related behaviours (leisure-time physical activity, cigarette smoking and alcohol consumption) was derived from the Singapore National Health Survey 2004. The survey was a cross-sectional study conducted by the Ministry of Health between September and December 2004 in Singapore to determine the current prevalence of major non-communicable diseases and their risk factors among adult Singaporeans. Ethic clearance to conduct the survey was obtained from the Singapore's Health Promotion Board Ethics Committee and written consent was obtained from all participants before they took part in the survey. The details of the survey methods have been described elsewhere.[18] Briefly, the survey sample comprised 7,500 persons, aged 18–74 years selected from a sample of all household units in Singapore. The sample of household units, obtained from the Department of Statistics' National Database on Dwellings in Singapore, was representative of the housing distribution of Singapore's population. Households were enumerated and the household members were stratified according to age and ethnic group. Based on the sample size of 7,500, the number of subjects from each age-ethnic specific group was determined according to the respective age-ethnic distribution in the 2004 Singapore population, and then selected by systematic sampling.

A total of 4,168 persons out of an eventual sample of 7,275 eligible Singapore residents participated in the survey. 225 persons from the original sample were ineligible for the survey for reasons such as pregnancy, recent delivery, death and overseas sojourn during the survey period. The study refers to 4,084 respondents (1,901 men and 2,183 women) aged 18–69 years, and the response rate for this age group was 57.7%. Data on the sociodemographic characteristics and health-related behaviours (leisure-time physical activity, cigarette smoking and alcohol consumption) were collected using a structured questionnaire administered by trained nurses at designated survey centres. Information on physical exercise, smoking and alcohol consumption was missing in 0.3% of the respondents. Education was used as a measure of SES. Educational level of respondents was ascertained by asking "What is the highest level of education that you have attained?" and grouped into four categories: primary or no education (reflecting zero to six years of formal education); secondary education or attaining the General Certificate of Education, Ordinary level (reflecting seven to ten years of formal education); General Certificate of Education, Advanced level or polytechnic diploma (reflecting 11–13 years of formal education); and university degree or other professional qualification (reflecting at least 14 years of formal education).

Respondents were asked to state the sports or exercises that they participated in their leisure time, in the past three months preceding the survey, and for each sport or exercise, the number of sessions per week and the duration (in minutes) per session. Physical activity status of respondents was assessed using the physical activity frequency standard adapted from the American College of Sports Medicine's classification.[19] Respondents who participated in any form of sports or exercise for at least 20 minutes per occasion, for three or more days a week during their leisure time, were considered as exercising regularly. Those who participated in any form of sports or exercise for at least 20 minutes per occasion, for less than three days a week, were regarded as exercising occasionally. Respondents who did not participate in any form of sports or exercise that lasted for 20 minutes per occasion were deemed to have no exercise or physically inactive.

Information on smoking was gathered from respondents by asking them whether they had ever smoked cigarettes, and if they had, the frequency at which they smoked. The World Health Organization's classification criteria for smoking status[20] were used in the survey analysis. Respondents who smoked cigarettes at least once a day were classified as daily smokers; those who smoked cigarettes, but not every day, were considered as occasional smokers; those who were formerly daily smokers but currently do not smoke at all, were classified as ex-smokers; and those who never smoked before or smoked too little in the past to be regarded as ex-smokers were classified as non-smokers. Next, information on alcohol consumption

Table I. Sample distributions of socioeconomic variables and health-related behaviours by gender among Singaporeans aged 18–69 years, Singapore National Health Survey, 2004.

Variable	Men n (%)	Women n (%)	Chi-square p-value
Age (years)			0.436
18–29	404 (21.3)	441 (20.2)	
30–39	433 (22.8)	508 (23.3)	
40–49	555 (29.2)	680 (31.1)	
50–59	331 (17.4)	377 (17.3)	
60–69	178 (9.4)	177 (8.1)	
Ethnic group			0.102
Chinese	1,241 (65.3)	1,412 (64.7)	
Malay	360 (18.9)	463 (21.2)	
Indian	300 (15.8)	308 (14.1)	
Educational level (years of formal education)			< 0.001
No education / primary (≤ 6)	305 (16.0)	540 (24.7)	
Secondary / GCE "O" level (7–10)	812 (42.7)	903 (41.4)	
GCE "A" level / polytechnic diploma (11–13)	336 (17.7)	327 (15.0)	
University / professional qualifications (≥ 14)	445 (23.4)	404 (18.5)	
Not available	3 (0.2)	9 (0.4)	
Employment status			< 0.001
Working	1539 (81.0)	1284 (58.8)	
Student (full time)/National Service*	192 (10.1)	119 (5.5)	
Housewife / homemaker	19 (1.0)	701 (32.1)	
Retired	84 (4.4)	24 (1.1)	
Unemployed	63 (3.3)	46 (2.1)	
Not available	4 (0.2)	9 (0.4)	
Leisure-time physical activity[1]			< 0.001
Regular exercise	559 (29.4)	460 (21.1)	
Occasional exercise	542 (28.5)	501 (23.0)	
No exercise	796 (41.9)	1213 (55.6)	
Not available	4 (0.2)	9 (0.4)	
Cigarette smoking[2]			< 0.001
Daily smoker	429 (22.6)	76 (3.5)	
Occasional smoker	59 (3.1)	13 (0.6)	
Ex-smoker	207 (10.9)	26 (1.2)	
Non-smoker	1202 (63.2)	2059 (94.3)	
Not available	4 (0.2)	9 (0.4)	
Alcohol consumption[3]			< 0.001
Regular drinker	77 (4.1)	38 (1.7)	
Frequent drinker	164 (8.6)	87 (4.0)	
Occasional drinker	807 (42.5)	639 (29.3)	
Non-drinker	848 (44.6)	1410 (64.6)	
Not available	5 (0.3)	9 (0.4)	

* National Service refers to Singaporean males who are enlisted by law into the Singapore's armed forces for full-time conscription.

[1] Regular exercise: participation in any form of sports or exercise for at least 20 minutes per occasion, for ≥ 3 days a week; Occasional exercise: participation in any form of sports or exercise for at least 20 minute per occasion, for < 3 days a week; No exercise: no participation in any form of sport or exercise that lasted for at least 20 minutes per occasion.

[2] Daily smoker: smokes cigarettes at least once a day; Occasional smoker: smokes cigarettes but not every day; Ex-smoker: former daily smoker but currently does not smoke at all; Non-smoker: never smoked before or smoked too little in the past to be regarded as an ex-smoker.

[3] Regular drinker: drinks alcohol ≥ 4 days a week; Frequent drinker: drinks alcohol 1– 4 days a week; Occasional drinker: drinks alcohol ≤ 3 days a month; Non-drinker: have never consumed alcohol or have not consumed alcohol within the past 12 months of the survey.

was obtained from respondents by asking them whether they had ever consumed alcohol, and if they had, they were queried on the frequency at which they had at least one drink. Alcohol consumption status was classified according to the frequency of alcohol intake. Respondents who drank alcohol more than four days a week, one to four days a week, and three days or less in a month were classified as regular, frequent and occasional drinkers, respectively. Respondents who had never consumed alcohol or had not consumed

Table II. Leisure-time physical activity behaviour among Singaporeans aged 18–69 years by educational level and gender, Singapore National Health Survey, 2004: age-standardised percentages.

Educational level	No exercise Percentage (95% CI)	Occasional exercise Percentage (95% CI)	Regular exercise Percentage (95% CI)
Men			
No / primary education	63.7 (61.5–65.7)	9.3 (8.1–10.6)	26.9 (24.9–28.8)
Secondary / GCE "O" level	46.7 (44.5–48.9)	24.2 (22.4–26.1)	29.1 (27.2–31.1)
GCE "A" level / polytechnic diploma	29.9 (28.0–32.0)	33.3 (31.2–35.3)	36.8 (34.7–39.0)
University / professional qualifications	24.1 (22.3–26.0)	41.6 (39.4–43.7)	34.3 (32.3–36.4)
Women			
No / primary education	72.6 (70.6–74.5)	12.2 (10.8–13.7)	15.2 (13.7–16.9)
Secondary / GCE "O" level	56.1 (54.0–58.3)	21.6 (19.8–23.4)	22.3 (20.5–24.2)
GCE "A" level / polytechnic diploma	45.6 (43.5–47.8)	27.9 (26.0–29.9)	26.5 (24.6–28.5)
University / professional qualifications	45.1 (42.9–47.2)	30.9 (28.9–32.9)	24.0 (22.3–26.0)
Both genders			
No / primary education	69.6 (68.1–70.9)	11.2 (10.3–12.2)	19.2 (18.0–20.4)
Secondary / GCE "O" level	51.6 (50.0–53.1)	22.7 (21.4, –24.0)	25.7 (24.4–27.1)
GCE "A" level / polytechnic diploma	38.0 (36.5–39.5)	30.5 (29.1–31.9)	31.5 (30.1–32.9)
University / professional qualifications	33.2 (31.7–34.6)	37.3 (35.8– 38.8)	29.6 (28.2–31.0)

Table III. Cigarette smoking behaviour among Singaporeans aged 18–69 years by educational level and gender, Singapore National Health Survey, 2004: age-standardised percentages.

	Daily smoker Percentage (95% CI)	Occasional smoker Percentage (95% CI)	Ex-smoker Percentage (95% CI)	Non-smoker Percentage (95% CI)
Men				
No / primary education	41.5 (39.3–43.6)	2.5 (1.9–3.2)	12.1 (10.8–13.6)	43.8 (41.5–45.9)
Secondary / GCE "O" level	28.6 (26.7–30.6)	3.4 (2.7–4.3)	12.1 (10.8–13.6)	55.9 (53.7–58.0)
GCE "A" level / polytechnic diploma	17.8 (16.2–19.5)	2.8 (2.1–3.6)	9.0 (7.9–10.4)	70.4 (68.4–72.4)
University / professional qualifications	8.3 (7.2–9.6)	2.1 (1.5–2.8)	8.2 (7.1–9.5)	81.4 (79.7–83.1)
Women				
No / primary education	11.5 (10.2–12.9)	2.2 (1.6–2.9)	0.2 (0.1–0.4)	86.1 (84.6–87.6)
Secondary / GCE "O" level	4.6 (3.8–5.6)	0.9 (0.6–1.4)	1.8 (1.3–2.5)	92.7 (91.4–93.7)
GCE "A" level / polytechnic diploma	2.3 (1.7–3.0)	0.2 (0.1–0.5)	0.5 (0.3–0.9)	97.0 (96.2–97.7)
University / professional qualifications	1.0 (0.7–1.5)	0.2 (0.1–0.5)	2.0 (1.5–2.7)	96.8 (96.0–97.5)
Both genders				
No / primary education	21.6 (20.4–22.9)	2.3 (1.9–2.8)	4.3 (3.7–4.9)	71.7 (70.3–73.1)
Secondary / GCE "O" level	15.6 (14.5–16.8)	2.0 (1.6–2.5)	6.9 (6.2–7.8)	75.5 (74.1–76.8)
GCE "A" level / polytechnic diploma	9.9 (9.0–10.8)	1.4 (1.1–1.8)	4.6 (4.0–5.3)	84.1 (82.9–85.2)
University / professional qualifications	5.0 (4.4–5.8)	1.1 (0.8–1.4)	5.7 (5.0–6.5)	88.2 (87.2–89.1)

alcohol within the past 12 months of the survey were considered as non-drinkers.

All analyses were performed using the Statistical Package for Social Science version 13.0 (SPSS Inc, Chicago, IL, USA). First, the associations between the socioeconomic variables and health-related behaviours, and gender, were assessed by Pearson chi-square statistics. Next, the prevalence of each of the three health-related behaviours by educational level and gender were computed to discern whether lower educated groups tend to be more physically inactive, smoke more or consume more alcohol, relative to higher educated groups. In order to eliminate differences in observed rates that result from age differences in sample composition across the educational strata, the prevalence percentages and its 95% confidence intervals for each health-related behaviour were age-adjusted for gender, using the direct method and the 2004 Singapore resident population as the reference population. To study the multivariate association between educational level and health-related behaviours, logistic regression models, adjusted for age, gender, ethnic group and employment status, were employed. The adjusted odds ratios for subjects at each educational level were compared to subjects with the highest educational level for each health-related behaviour for both genders.

Table IV. Alcohol consumption behaviour among Singaporeans aged 18–69 years by educational level and gender, Singapore National Health Survey, 2004: age-standardised percentages.

	Regular drinker Percentage (95% CI)	Frequent drinker Percentage (95% CI)	Occasional drinker Percentage (95% CI)	Non-drinker Percentage (95% CI)
Men				
No / primary education	4.3 (3.4–5.2)	6.1 (5.1–7.2)	31.3 (29.2–33.3)	58.2 (55.8–60.1)
Secondary / GCE "O" level	3.9 (3.2–4.9)	8.2 (7.1–9.5)	37.2 (35.1–39.4)	50.6 (48.4–52.8)
GCE "A" level / polytechnic diploma	4.1 (3.3–5.0)	9.8 (8.6–11.2)	47.3 (45.1–49.5)	38.8 (36.7–41.0)
University / professional qualifications	2.5 (1.9–3.3)	10.1 (8.8–11.4)	56.2 (54.1–58.4)	31.2 (29.2–33.3)
Women				
No / primary education	1.7 (1.2–2.4)	5.0 (4.1–6.0)	17.4 (15.8–19.1)	75.9 (74.0–77.7)
Secondary / GCE "O" level	1.4 (1.0–2.0)	3.8 (3.0–4.7)	28.8 (26.8–30.8)	66.0 (63.9–68.1)
GCE "A" level / polytechnic diploma	1.8 (1.3–2.4)	5.1 (4.2–6.1)	36.1 (34.2–38.3)	57.0 (54.8–59.1)
University / professional qualifications	1.1 (0.7–1.7)	3.0 (2.3–3.8)	41.1 (39.0–43.3)	54.8 (52.6–56.9)
Both genders				
No / primary education	2.6 (2.1–3.1)	5.3 (4.7–6.0)	22.2 (20.9–23.5)	69.8 (68.3–71.1)
Secondary / GCE "O" level	2.7 (2.2–3.2)	5.8 (5.1–6.6)	32.6 (31.1–34.0)	58.9 (57.4–60.4)
GCE "A" level / polytechnic diploma	2.9 (2.5–3.5)	7.4 (6.6–8.3)	41.5 (40.0–43.0)	48.1 (46.6–49.7)
University / professional qualifications	1.7 (1.3–2.1)	7.1 (6.4–8.0)	49.2 (47.7–50.7)	42.0 (40.5–43.5)

Table V. Multivariate associations between heath-related behaviours and educational level by gender among Singaporeans aged 18–69 years, Singapore National Health Survey, 2004.

Educational level	Health-related behaviour			
	No exercise vs. regular and occasional exercise Odds ratio (95% CI)	Daily smoker vs. occasional and non-smokers Odds ratio (95% CI)	Regular drinker vs. frequent, occasional and non-drinker Odds ratio (95% CI)	≥ 2 vs. 0–1 health-damaging behaviour Odds ratio (95% CI)
Men				
No / primary education	6.7*** (4.7–9.5)	12.6*** (7.9–20.1)	3.6*** (1.7–7.8)	23.2*** (11.7–46.0)
Secondary / GCE "O" level	3.0*** (2.3–3.9)	7.6*** (5.1–11.2)	2.2* (1.1–4.4)	12.3*** (6.5–23.4)
GCE "A" level / polytechnic diploma	1.3 (0.9–1.7)	3.2*** (2.1–5.1)	1.9 (0.8–4.3)	2.9** (1.3–6.3)
University / professional qualifications	1.00	1.00	1.00	1.00
Women				
No / primary education	4.1*** (3.0–5.8)	8.8*** (3.3–23.3)	5.4** (1.7–17.6)	14.5*** (4.4–47.7)
Secondary / GCE "O" level	2.2*** (1.7–2.8)	3.6*** (1.5–8.6)	2.5 (0.9–7.4)	5.2** (1.7–16.3)
GCE "A" level / polytechnic diploma	1.4* (1.0–1.9)	1.7 (0.6–4.8)	2.8 (0.9–8.8)	4.5* (1.3–15.2)
University / professional qualifications	1.00	1.00	1.00	1.00
Both genders				
No / primary education	5.1*** (4.0–6.5)	12.2*** (8.0–18.6)	4.2*** (2.2–8.0)	21.3*** (11.7–38.6)
Secondary / GCE "O" level	2.6*** (2.1–3.1)	7.0*** (4.9–10.0)	2.3** (1.3–4.1)	10.7*** (6.1–18.6)
GCE "A" level / polytechnic diploma	1.3** (1.1–1.7)	3.0*** (1.9–4.5)	2.2* (1.1–4.2)	3.4** (1.8–6.6)
University / professional qualifications	1.00	1.00	1.00	1.00

Odds ratio (for men and women): odds ratio adjusted for age, ethnic group and employment status;

Odds ratio (for both genders): odds ratio adjusted for age, ethnic group, gender and employment status;

* $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$.

RESULTS

The socioeconomic and health behavioural characteristics of the subjects categorised according to gender, are shown in Table I. Significant differences were observed for educational attainment, employment status and the three health-related behaviours. Men were more likely than women to be better educated and gainfully employed. Men were also more likely to smoke daily and drink alcohol regularly, but women tended to be physically inactive. The prevalence of the three health-related behaviours by educational level and gender are shown in Tables II–IV. The age-standardised prevalence of health-damaging behaviours (no exercise, daily smoking and regular alcohol consumption) was consistently highest among men and women who had primary or no education. Men and women who

Table VI. Number of health-damaging behaviours (no leisure-time physical activity, daily smoking and regular alcohol consumption) by educational level and gender among Singaporeans aged 18–69 years, Singapore National Health Survey, 2004: age-standardised percentages.

Educational level	Number of health-damaging behaviours		
	None Percentage (95% CI)	One Percentage (95% CI)	Two or more Percentage (95% CI)
Men			
No / primary education	24.8 (23.0–26.7)	43.3 (41.2–45.5)	31.9 (29.9–34.0)
Secondary / GCE "O" level	39.9 (37.8–4.20)	42.2 (40.1–44.4)	17.9 (16.3–19.7)
GCE "A" level / polytechnic diploma	55.3 (53.1–57.4)	38.8 (36.7–41.0)	5.9 (5.0–7.0)
University / professional qualifications	67.8 (65.8–69.9)	29.4 (27.5–31.4)	2.7 (2.1–3.6)
Women			
No / primary education	22.3 (20.6–24.2)	69.8 (67.7–71.7)	7.9 (6.8–9.1)
Secondary / GCE "O" level	40.7 (38.6–42.8)	56.4 (54.3–58.6)	2.9 (2.2–3.7)
GCE "A" level / polytechnic diploma	53.2 (51.0–55.4)	43.9 (41.8–46.1)	2.9 (2.2–3.7)
University / professional qualifications	53.7 (51.6–55.9)	45.3 (43.1–47.4)	1.0 (0.6–1.5)
Both genders			
No / primary education	23.2 (21.9–24.5)	60.8 (59.4–62.4)	16.0 (14.9–17.1)
Secondary / GCE "O" level	40.6 (39.1–42.1)	49.6 (48.0–51.1)	9.8 (9.0–10.8)
GCE "A" level / polytechnic diploma	54.1 (52.6–55.6)	41.5 (40.0–43.0)	4.4 (3.8–5.0)
University / professional qualifications	62.1 (60.5–63.5)	36.0 (34.6–37.5)	1.9 (1.5–2.4)

underwent university education were the least likely to display health-damaging behaviours. The gradient in prevalence from the lowest to the highest level of education varied for each behaviour.

Physical inactivity and daily smoking prevalence was indirectly related to education in both genders. Women were more likely than men to not exercise, but men were more likely to be daily smokers across all educational levels. There was no clear gradient between the prevalence of regular alcohol consumption and educational level. However, frequent and occasional alcohol drinking were more common among men with higher levels of education. Occasional drinking was also more prevalent among the more educated women. The multivariate associations between the health-related behaviours and education for both genders are shown in Table V. Inverse associations were observed for physical inactivity and smoking. Men who had primary or no education were 6.7 times (95% CI 4.7–9.5) more likely to not exercise, compared with counterparts who had university education. The corresponding odds ratio for women was 4.1 (95% CI 3.0–5.8). Least educated men and women were 12.6 times (95% CI 7.9–20.1) and 8.8 times (95% CI 3.3–23.3), respectively, more likely to smoke daily, compared to their most educated peers.

Men with the least education had a significantly increased risk (3.6-fold) of being regular alcohol drinkers, compared with their most educated counterparts. Least educated women had an even higher risk (a significant 5.4-fold) of being regular drinkers. Least educated men and women also had significantly increased risk (23.2-fold and 14.5-fold, respectively) of having two or more health-damaging behaviours. The proportion of subjects with none, one, and two or more health-damaging behaviours, categorised by education and gender, are shown in Table VI. The proportion of men and women with none of the three health-damaging behaviours increased with educational level, while the proportion of men and women with one, and two or more health-damaging behaviours all declined with increasing educational level. Overall, a higher proportion of men and women who had less education were engaged in two or more health-damaging behaviours, relative to their more well-educated peers.

DISCUSSION

This study found inverse relations between educational level and the prevalence of leisure-time physical inactivity and cigarette smoking, for both genders in Singapore's adult population. The prevalence of regular alcohol consumption was differentially graded across the educational levels for both genders with no clear association. Furthermore, a negative educational gradient was observed in men and women who had two or more health-damaging behaviours. The findings on the higher prevalence of the three health-damaging behaviours among the lower educated groups could be because education facilitates the acquisition of positive social, psychological and economic skills, and assets which include positive attitudes about health, access to preventive health services,[21] and membership into peer groups that promote the adoption or continuation of positive health behaviours.[22,23]

The inverse association between physical inactivity and education observed here is consistent with previous Western studies. Australian surveys,[24] American studies,[11,25] the Framingham Offspring Study,[26] and a European Union study[27] have demonstrated a significant trend to higher leisure-time activity in participants with higher educational levels.

Our study showed no clear association between the prevalence of alcohol consumption and education, as opposed to Northern American and European studies which have reported a negative relation in both genders.[28-30] Possible explanations for the variation may be due to the different definitions of heavy and regular alcohol consumption in the studies, and the different drinking cultures in the various countries. Nevertheless, our observations of higher prevalence of frequent and occasional alcohol consumption among the higher educated groups, and higher prevalence of alcohol abstinence (non-drinkers) in the lower educated groups in both genders were consistent with findings in the literature.[28,29,31-33] Our findings on the negative association between smoking and education concurred with the preponderance of similar evidence found in Western populations.[11,25,26,34-38] However, our results on the patterns of smoking by education and gender were not entirely consistent with those reported in some studies. Epidemiological analysis from Italy found that the educational gradient for smoking was negative in men but positive in women,[30] and a study in 12 European countries found that higher educated women in southern Europe smoked more.[16] The inconsistency with these findings could be due to differences in smoking epidemiology and tobacco control policy development, and the differing stage of the smoking epidemic in each country.[39,40] Our study also found that concurrence of health-damaging behaviours (two or more) was more common among the more lowly educated in both genders, and often higher in men. This could be because of the higher prevalence of individual health-damaging behaviours in these groups.

This study has some limitations. Our results relied on the accuracy of self-reported data, which could be subjected to recall bias and under- or over-reporting; data validity has to be considered. Studies on the validity of self-reported smoking in relation to education have shown inconsistent results,[41-43] but a review study on self-reported smoking concluded that self reports of smoking were accurate in most studies.[44] Nevertheless, we could not rule out the possibility of under- or over-reporting of smoking, physical activity level, and alcohol consumption in our study. However, we believe that the reiteration of the survey objective and the Singapore Ministry of Health's assurance of information confidentiality by trained nurses prior to the interview, greatly diminished respondents' motivation for under- or over-reporting. In addition, the use of a structured questionnaire to elicit information in a standardised manner by the same group of nurses throughout the survey, and who had undergone the same rigorous pre-fieldwork training lent credence to the validity of the self-reported data with a concomitant reduction in interviewer effect.

Another limitation was that the study had a response rate of 57.7%. Although the survey data have been weighted to the age, gender and ethnic distributions of the 2004 resident population, the study results may have been distorted if the associations between educational level and the health-damaging behaviours in non-respondents differed from that in the respondents. Based on a follow-up survey on a sample (n = 782) of the non-respondents conducted after the main survey (response rate 77.1%), we found that there were no educational differences in selective non-response, and the association between educational level and physical activity status did not differ between respondents and non-respondents. However, information on daily smoking and regular alcohol consumption status in non-respondents was not available, and hence we could not ascertain whether there were any differences in the associations between educational level, and cigarette smoking status and alcohol consumption status between respondents and non-respondents.

This study has practical implications for public health policy formulation and interventional strategies aimed at improving the uptake of healthy lifestyles and behaviours in the population. Our findings point to the need for the development of health promotion or interventional strategies focusing more on lowly educated people in order to reduce the differentials in health-related behaviours. The largely cognitive nature of conventional health promotion, and its dependence on voluntary behavioural change, which is likely to have a larger effect on higher educated people, suggests that generic one-size-fits-all health promotion campaigns need to be re-assessed. Tailored intervention programmes incorporating elements that address influences specifically salient to less educated groups might be necessary in order to achieve more satisfactory uptake of health-enhancing behaviours. For instance, community-based approaches or programmes targeting population segments with lower education could consider their normative beliefs and values, mastery experiences, literacy levels, baseline knowledge, social support and the environment in which they live.

This study found that although the population of Singapore, comprising three major ethnic groups (Chinese, Malays and Indians), is culturally different

from Western populations, the associations between education and the health-related behaviours do not seem to differ much from that observed in developed Western countries. Such a fact should stress the importance, opportunities and scope in learning from other countries' related experiences and developing comprehensive and effective strategies aimed at reducing inequalities in health-related behaviours. The health-related behaviours considered (physical activity, smoking and alcohol consumption) are behavioural risk factors of cardiovascular disease, which can lead to various morbidities and premature death. A Canadian study has estimated that 70% of premature deaths related to cardiovascular disease can be prevented by controlling these risk factors.[45] Thus, our findings also imply that efforts to reduce the disease burden, or interventional strategies, to achieve more adequate prevention of coronary heart disease, can legitimately focus on the less educated socioeconomic groups.

In conclusion, this study reports, for the first time, the association between prevalence of health-related behaviours and education, as a socioeconomic measure in the Singapore population, and corroborates the inverse education gradients for leisure-time physical activity and cigarette smoking found in Western populations. However, the inverse education gradient for alcohol consumption observed in a number of Western studies is not supported by our findings. This study also elucidates that educational inequalities in the health-related behaviours considered, should be taken into account in health promotional policies or intervention programmes aimed at encouraging healthy lifestyles in the population. In this regard, we could draw on the experience or adapt the successful policies of Western countries to reduce the local differentials in health-related behaviours.

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