Diabetes mellitus prevalence is increasing in South Asians but stable in Chinese living in Singapore and Mauritius

Diabetes prevalence in South Asians and Chinese

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Abstract

Background: Asia is experiencing a type 2 diabetes epidemic but prevalence differs by ethnicity and level of socio-economic development. Singapore and Mauritius have implemented comprehensive campaigns to address this public health problem. We compared diabetes and obesity prevalence trends among Chinese and South Asians living in Singapore and Mauritius to determine the contribution of ethnicity and economic development to diabetes.

Methods: Age-specific data from serial national population-based surveys in Singapore and Mauritius between 1987 and 2010 were used to estimate age-standardised diabetes and obesity prevalence. Modified Breslow-Cox Proportional hazard models were used to obtain rate ratios for diabetes risk factors.

Results: In Singapore, the age-standardised prevalence of diabetes remained stable for Chinese (men 14% in 1992 and 13% in 2010; women 12% in 1992 and 10% in 2010); however, increases were observed for South Asians (men 20% in 1992 and 26% in 2010; women 18% in 1992 and 20% in 2010). There were similar patterns in Mauritius. In both countries, obesity prevalence trends were stable for Chinese women, but increased for Chinese men and South Asians. Associations between obesity and diabetes were stronger in Chinese than South Asians irrespective of country.

Conclusions: Despite different socio-economic settings in Singapore and Mauritius, we observed rising diabetes prevalence among South Asians but stable prevalence in Chinese in both countries. This provides further evidence that ethnicity contributes to the development of diabetes, and that there should be an increased emphasis on future prevention strategies targeting South Asian populations in these countries.

(247 words)

This study adds:

Singapore and Mauritius are multi-ethnic island states at different stages of economic development and provide a useful model to explore the relative contribution of ethnicity and socio-economic factors to diabetes.

The significant finding(s) of the study:

Despite different socio-economic settings in Singapore and Mauritius, we observed rising diabetes prevalence among South Asians but stable prevalence in Chinese in both countries. This provides further evidence that ethnicity may contribute to the development of diabetes.

Keywords

Diabetes mellitus, obesity, prevalence

Introduction

Diabetes mellitus is a major public health problem worldwide estimated to affect 8.4% of the world's population.¹ Diabetes in Asia, particularly in India and China, has been of particular concern as prevalence is markedly high and rates are expected to increase further in the next decade.¹ Asia is a diverse continent, with countries having multi-ethnic populations.

Moreover, similar ethnic populations in different Asian countries may share genetic heritage but experience different environmental conditions.² This heterogeneity may account for variable diabetes rates amongst different ethnicities and countries across Asia.² One study showed that South Asians in India and Singapore have higher age-specific prevalence of diabetes at a younger age than do Chinese in China and Singapore.³

Singapore and Mauritius are multi-ethnic island states at different stages of economic development and provide a model to explore the relative contribution of ethnicity and socio-economic factors to diabetes. In this study, we compared (i) trends in the prevalence of diabetes and obesity over a period between 1987 and 2010, and (ii) the strength of relationships for diabetes risk factors, among Chinese and South Asians in high income Singapore and upper middle income Mauritius, to explore the relative contribution of ethnicity and environmental factors to diabetes in these countries.

Methods

Study Populations

Data from serial national population-based surveys conducted in Singapore and Mauritius were used.

Four independent national cross-sectional health surveys, recruiting 16,796 Singapore residents aged 18 to 79 years, were conducted at 6-yearly intervals from 1992 to 2010. The respective response rates were 73%, 65%, 57% and 58%.⁴ In Singapore, 74% of the resident population are Chinese and 9% are South Asians. Analyses were restricted to Chinese (originating from southeastern provinces of China, i.e. Fujian, Guangdong and Hainan, mostly of Han Chinese ancestry) or South Asian (originating from the Southern part of Indian, mostly of Tamil ancestry) participants aged 25 to 75 years at the time of the survey (n=11,034). For the diabetes prevalence analysis, participants with missing diabetes information were excluded (n=215). For the diabetes risk factor analysis, participants with missing information on anthropometric measurements, smoking, alcohol use or educational status (n=1,258) were also excluded. A total of 9,561 participants from Singapore were included in the risk factor analysis (1992: n=2,400; 1998: n=3,291; 2004: n=2,467; 2010: n=1,403).

Mauritius has a population of 1.3 million people, which comprises 68% of South Asian origin (including Bihar, Tamil Nadu, Andhra Pradesh, Telangana and Maharashtra in Indian), 3% of Chinese (mainly originating from Guangdong area, Mainland China), 27% of African (Creole), and 2% of Franco-Mauritian. The Mauritius population-based surveys invited men and women aged 25 to 75 years, and were conducted in 1987, 1992, 1998, 2004 and 2009

using similar protocols. Recruitment methods have been published.^{5,6} Sixty percent of participants contributed observations to more than one survey in 1987, 1992 and 1998, with 27% contributing data to all three 1987, 1992 & 1998 surveys.⁵ In 2004, participants were recruited from seven existing clusters used in earlier surveys and seven new clusters were randomly selected. In 2009, nine index clusters were chosen: one randomly selected from each of nine districts and two additional clusters adjacent to the index clusters.⁶ Response rates were over 85%.^{5,6} The Mauritian analyses were restricted to participants who reported being Chinese or South Asian. For the diabetes prevalence analysis, observations were excluded if (i) information about diabetes status was missing (n=616), (ii) the study site information was missing (n=2), and (iii) the woman was pregnant (n=86). For the diabetes risk factor analysis, observations were also excluded if (i) information on anthropometric measurements was missing (n=135), and (ii) data on smoking, alcohol use or education was missing (n=358). This analysis included 20,071 observations from Mauritius (1987: n=3,584; 1992: n=4,627; 1998: n=3,878; 2004: n=3,605; 2009: n=4,377).

Measurements

Venepuncture was used to collect blood for fasting plasma glucose (after an overnight fast of at least eight hours) in all participants, and 2-hour plasma glucose following a 75g oral glucose tolerance test in participants without diabetes, or those with diabetes but not taking medications for diabetes. For the Singapore surveys, all blood specimens for plasma glucose measurement were collected in fluoride / oxalate tubes and dispatched daily to a central laboratory for centrifugation and analysis on the same day⁴. Plasma glucose levels were measured using the Roche Modular DP analyser with the enzymatic colorimetric method⁴. The same method was used for the four surveys. For the Mauritian surveys, specimens for

glucose were also collected in fluoride / oxalate tubes, and glucose was assayed onsite using a YSI glucose analyser (YSI, Yellow Springs, OH) instrument using a glucose oxidase method in 1987, 1992, 2004 and 2009. In 1998, glucose was assayed within four months at a central laboratory using the same technology, and results were adjusted according to quality control measures taken during 1987 and 1992 from on-site results.

Glucose tolerance status was determined according to World Health Organisation (WHO) 2006 diagnostic criteria.⁷ Diabetes was classified if participants had fasting plasma glucose ≥ 7.0 mmol/l or 2-hour plasma glucose ≥ 11.1 mmol/l, or reported a history of diabetes and were using blood glucose lowering medication.

All participants underwent anthropometric measurements (weight, height, waist and hip circumference). Body mass index (BMI) was classified according to the WHO criteria for Asian populations — underweight: <20.0 kg/m² (rather than <18.5 kg/m² as there were too few diabetes cases with a very low BMI), normal: 20.0 – 23.0 kg/m², overweight: 23.0 – 27.5 kg/m² and obese: ≥ 27.5 kg/m². Analyses were repeated using European BMI classifications.⁸ Furthermore, waist-hip ratio European categories: ≤ 0.90 and >0.90 for men and ≤ 0.85 and >0.85 for women, waist-hip ratio Asian categories: ≤ 0.90 and >0.90 for men and ≤ 0.80 and >0.80 for women,⁹ waist circumference European categories: <95 cm, 95 – 102 cm and >102 cm for men and <80 cm, 80 – 88 cm and >88 cm for women, waist circumference Asian categories: <90 cm and ≥ 90 cm for men and <80 cm and ≥ 80 cm for women,⁹ and waist-height ratio ≤ 0.5 and >0.5 were assessed.

Alcohol consumption was classified as none, less than weekly and weekly or more frequent.

Smoking status was categorised as never, ever and current smoker.

Ethics

The Mauritius survey protocols were approved by the International Diabetes Institute Ethics Committee (Melbourne, Australia), the Ministry of Health, Mauritius and the University of Mauritius Research Ethics Committee. The Singapore surveys were approved by the Singapore Health Promotion Board Medical Dental Board Ethics Committee. All participants provided informed and written consent.

Statistical Analysis

Analyses included participants aged 25 to 74 years, except for the 1992 and 1998 Singapore surveys which had participants aged 25 to 69 years only. Age-specific prevalence estimates for diabetes and obesity were calculated using survey commands to account for the sampling design of the surveys. Age-specific prevalence estimates were directly standardised to the WHO 2000 standard population¹⁰ to obtain overall and strata (ethnicity and gender) -specific estimates for each survey year independently. There was no Chinese men aged 25 to 34 years in the 1998 Mauritius survey, so age-specific prevalence estimate for this stratum was based on the group aged 35 to 44 years. We also plotted diabetes prevalence according to 10-year age groups and 10-year birth cohorts from 1920 to 1980 stratified by ethnicity for each country to determine whether there were any observed birth cohort effects on diabetes prevalence.

Modified Breslow-Cox Proportional Hazard Model with robust variance¹¹ was used to obtain rate ratios for smoking, alcohol consumption and measures of obesity. Rate ratios were obtained by pooling data from different survey years for each country. Repeated visits were treated as separate events.

Adjustment variables were age (continuous), gender and educational status. Self-reported educational status was categorised as d6 years, 7–10 years and e 10 years in Singapore, and as d3 years, 4–6 years, 7–9 years, 10–12 years and e 12 years in Mauritius.

R version 3.0.0¹² and Stata version 12.1¹³ were used for Singapore and Mauritius analyses, respectively.

Results

The magnitude and trend of diabetes prevalence in Chinese and South Asian men was similar in the two countries over the study period. Diabetes prevalence in Chinese men of both countries (Figure 1a) showed a decreasing trend in the 1990s before increasing in 2004 [Singapore: 14% (1992), 10% (2004) and 13% (2010); Mauritius: 19% (1992), 11% (2004) and 19% (2009)]. Diabetes prevalence increased for South Asian men in both countries (Figure 1c), with similar magnitude [Singapore: 20% (1992) and 26% (2010); Mauritius: 19% (1992) and 26% (2009)]. Prevalence in Chinese women in both countries was stable (Figure 1b). Prevalence in South Asian women slightly increased, with similar magnitudes in both countries (Figure 1d) [Singapore: 18% (1992) and 20% (2010); Mauritius: 18% (1992) and 23% (2009)].

Obesity prevalence ($\text{BMI} \geq 27.5 \text{ kg/m}^2$) among Chinese women (Figure 1b) was similar in Singapore and Mauritius, with minimal increase during the observation period. Obesity prevalence increased for South Asian women (Figure 1d) [Singapore: 25% (1992) and 42% (2010); Mauritius: 22% (1987) and 34% (2009)]. Similar increasing obesity prevalence were observed for South Asian men (Figure 1c) [Singapore: 25% (1992) and 29% (2010); Mauritius: 10% (1987) and 23% (2009)], and for Chinese men (Figure 1a) [Singapore: 10% (1992) and 21% (2010); Mauritius: 15% (1987) and 18% (2009)]. Prevalence of obesity was lower, but trends were similar when using European BMI categories (data not shown).

Figure 2 shows the age group-specific diabetes prevalence by birth cohorts in Singapore and Mauritius according to ethnicity. Our data revealed that among South Asian males in both Singapore and Mauritius aged over 65 years at the survey examination, those born later (i.e.

1940s) had higher diabetes prevalence compared to those born earlier (i.e. 1920s) (75% versus 38% in Singapore and 61% versus 34% in Mauritius). Similarly this was observed for those aged 55 to 64 years (50% versus 36% in Singapore and 42% versus 30% in Mauritius). In contrast, among those in younger age groups at the survey examination, diabetes prevalence was either similar across different birth cohorts, or showed a decline in later birth cohorts. This trend was also observed in South Asian women in Singapore, but not in Mauritius. Later Singaporean Chinese male and female cohorts experienced lower age group-specific diabetes prevalence compared to earlier birth cohorts, particularly among those aged over 55 years at survey examination. The same trend of lower age group-specific prevalence in later compared to earlier birth cohorts was also observed in Mauritian Chinese women (19% versus 29% for those aged 55 to 64 years at survey), but the latest Mauritian and Singaporean Chinese male birth cohorts appeared to have higher rates of diabetes, resulting in U-shaped birth cohort age group-specific curves for those aged 35 to 44 years (Figure 2).

Measures of obesity exhibited the strongest associations with diabetes amongst risk factors evaluated in both Chinese and South Asians (Table 1). Obesity measures tended to show stronger associations with diabetes in Chinese compared to South Asians in both countries (although wide confidence intervals precluded a conclusion on significant differences between the ethnic groups) (Table 1). Alcohol and smoking showed weak or null associations with diabetes in Chinese and South Asian men and women in both countries (Table 1).

Discussion

Our study shows that diabetes and obesity prevalence trends increased for South Asians but remained stable in Chinese in both countries, despite differing socio-economic settings. In both countries, the age-specific prevalence of diabetes remained stable between 1987 and 2010 for Chinese populations, whereas we observed increasing prevalence for South Asian populations. Older South Asian men in both countries had higher diabetes prevalence in later birth cohorts compared to earlier birth cohorts, and middle-aged Chinese men in both countries showed U-shaped diabetes prevalence whereby diabetes prevalence increased in recent birth cohorts. Women were observed to have little change in diabetes prevalence across birth cohorts in both countries, except for older South Asian women in Mauritius where trends were similar to the South Asian men. In Singapore, obesity prevalence remained stable for Chinese women, but increases were observed for Chinese men and South Asian men and women. In Mauritius, similar patterns were observed. Measures of obesity were more strongly associated with diabetes compared to alcohol consumption and smoking, irrespective of ethnicity or country. Furthermore, measures of obesity were stronger predictors of diabetes in Chinese compared to South Asians in both countries.

Although an upwards trend in diabetes prevalence over the past two decades was observed in other predominant Chinese populations, such as mainland China¹⁴ and Taiwan¹⁵, we did not observe the same dramatic increases in diabetes prevalence for Chinese in either Singapore or Mauritius. Consistent with our study, increasing diabetes prevalence has also been reported in South Asian predominant populations in India¹⁶.

Adverse environmental influences early in fetal development may contribute to changes in physiology and metabolism, which consequently increase metabolic disease risk in adulthood¹⁷. Analysis of our birth cohort data shows higher diabetes prevalence in later birth cohorts (i.e. 1940s) compared to those born earlier (i.e. 1920s) for older aged South Asian men in both countries and South Asian women in Singapore. Our observations could be consistent with the nutritional deprivations caused by World War II in the 1940s. We did not observe the same birth cohort trends in older Chinese, which may indicate that the epigenetic influences may have been somewhat tempered by national diabetes prevention programs. Nevertheless, an upward trend in diabetes prevalence for middle-aged Chinese men from both countries born in more recent decades indicates that ongoing diabetes prevention initiatives need to be maintained.

Over the last decade, both Singapore^{18,19} and Mauritius²⁰ have implemented national strategies to improve diabetes screening and to raise the public awareness of diabetes and obesity. Our study, which shows diabetes prevalence increasing for South Asian populations, but not for Chinese populations in Singapore or Mauritius, demonstrates that national strategies for diabetes prevention may have had a stronger impact on Chinese populations compared with South Asian populations. This indicates that future initiatives in these countries may need a greater focus on South Asian populations.

Economic development and urbanisation in Asia is associated with a reduction in physical activity and adoption of a diet high in refined and processed foods, and hence a greater prevalence of diabetes². Thus, we hypothesised that diabetes trends would increase at a greater level in Singapore compared to Mauritius reflecting the greater economic

development and urbanisation in Singapore (Table 2). Instead, our data show similar trends in both countries. The reasons for this are not clear. One possibility could be that the effects of modernisation and urbanisation on diabetes incidence occur early in a country's development, and further modernisation has lower incremental effect on diabetes prevalence. It is also possible that, as we measured prevalence trends rather than incidence, higher diabetes mortality rates may have resulted in a greater lowering of the diabetes prevalence in Mauritius compared to Singapore. However, age-specific prevalence trends of diabetes were similar in both countries (data not shown). Finally, it is also possible that the health promotion strategies implemented in Singapore have had a greater impact on diabetes prevalence compared with Mauritius, but we could not test this.

In both countries, the well-known associations between general and abdominal obesity and diabetes prevalence²¹ were confirming. Our data suggest that the effects of general and central obesity are stronger in Chinese compared to South Asians. A finding reported by others^{22,23}, and suggests that obesity-related pathways for diabetes are more important in Chinese compared to South Asians.

Our study provides a useful model for exploring the relative contribution of ethnicity and risk factors associated with socio-economic development to diabetes prevalence. However, there are limitations. Firstly, recruitment methodology differences between Singapore and Mauritius surveys may impede direct comparisons. In particular, the call-back of older participants in Mauritius surveys might have meant that the later datasets were not representative of the population at that time and there is potential survival bias. Secondly, the lower response rates in later Singaporean surveys may have affected the representativeness of

the obesity and diabetes prevalence estimates. Since diabetes and obesity can be associated with co-morbidities, it is possible that some people with these conditions were too unwell to attend the surveys and this may have led to underestimation of our obesity and diabetes prevalence estimates. However, a sensitivity analysis of data from a non-responder follow-up survey that was conducted after the 2010 National Health Survey in Singapore showed there was little difference in prevalence of self-reported diabetes between the main survey and non-responder follow-up survey⁴. Thirdly, possible misclassification of glucose and anthropometric measures could have resulted in non-differential bias, which may have led to an attenuation of study findings. Steps were undertaken to minimise measurement errors through the standardisation of survey protocols^{4,6}. Fourthly, we may have overestimated the relative associations of obesity with diabetes as we were not able to adjust for other potential known and unknown confounders across both countries. Fifthly, the weaker associations observed for smoking and alcohol with diabetes prevalence may have been partly attributed to inaccuracies associated with these self-reported measures. Lastly, there was relatively lower numbers of Chinese participants in the Mauritius surveys, reflecting the country's population distribution (Table 2). This resulted in less precision of prevalence estimates and wider confidence intervals for Mauritius Chinese compared to their South Asian counterparts.

Conclusion

Here we show that diabetes and obesity prevalence trends increased for South Asians but remained stable for Chinese in both in Singapore and Mauritius, which implies that environmental factors important to diabetes risk are relatively similar in the two countries despite their differences in socio-economic development. Although diabetes prevalence remained stable for Chinese populations in both countries, we observed increasing prevalence

for South Asian populations. Therefore, future initiatives in Singapore and Mauritius may need to tailor preventive strategies for South Asian populations.

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Disclosure

The author(s) declare that they have no competing interests.

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Figure Legends

Figure 1: Age-standardised prevalence (%) of diabetes (solid lines) and obesity (BMI ≥ 27.5 kg/m²) (dotted lines) of (a) Chinese men, (b) Chinese women, (c) South Asian men and (d) South Asian women in Singapore and Mauritius, from 1987 to 2010.

Figure 2: Age group-specific prevalence (%) of diabetes of (a) Singapore Chinese men, (b) Mauritius Chinese men, (c) Singapore Chinese women, (d) Mauritius Chinese women, (e) Singapore South Asian men, (f) Mauritius South Asian men, (g) Singapore South Asian women and (h) Mauritius South Asian women, by birth cohort (calendar year of birth).

Table 1: Ethnic- and gender-specific rate ratios (95% confidence intervals) of potential risk factors for diabetes mellitus in Singapore and Mauritius.

Singapore					Mauritius			
	Chinese men	Chinese women	South Asian men	South Asian women	Chinese men	Chinese women	South Asian men	South Asian women
BMI (European)								
<20 kg/m ²	0.90 (0.21–3.79)	0.00 (0.00–0.01)	0.01 (0.00–0.04)	1.07 (0.24–4.87)	0.58 (0.28–1.20)	0.59 (0.26–1.34)	0.55 (0.47–0.65)	0.54 (0.44–0.66)
20–25 kg/m ²	1.00 (referent)				1.00 (referent)			
25–30 kg/m ²	1.71 (0.84–3.48)	1.18 (0.60–2.34)	1.32 (0.79–2.20)	1.23 (0.68–2.24)	1.69 (1.27–2.27)	1.97 (1.41–2.76)	1.33 (1.23–1.44)	1.55 (1.42–1.71)
≥30 kg/m ²	3.98 (1.89–8.41)	8.90 (4.89–16.22)	1.48 (0.74–3.00)	2.21 (1.13–4.33)	3.15 (2.15–4.62)	3.50 (2.20–5.55)	1.39 (1.22–1.59)	1.89 (1.71–2.09)
BMI (Asian)								
<20 kg/m ²	0.93 (0.20–4.30)	0.01 (0.00–0.02)	0.01 (0.00–0.04)	1.15 (0.24–5.49)	1.13 (0.48–2.62)	0.76 (0.32–1.81)	0.61 (0.51–0.72)	0.62 (0.50–0.77)
20–23 kg/m ²	1.00 (referent)				1.00 (referent)			
23–27.5 kg/m ²	1.30 (0.54–3.15)	2.40 (0.98–5.89)	1.09 (0.57–2.11)	1.22 (0.55–2.70)	2.76 (1.63–4.69)	2.18 (1.40–3.38)	1.31 (1.19–1.45)	1.52 (1.34–1.73)
≥27.5 kg/m ²	3.11 (1.28–7.58)	5.79 (2.11–15.91)	1.12 (0.56–2.24)	1.92 (0.94–3.94)	4.51 (2.63–7.72)	2.87 (1.77–4.65)	1.59 (1.42–1.78)	2.08 (1.84–2.36)
Waist-hip ratio (European)								
d0.90 (M)	1.00 (referent)				1.00 (referent)			
d0.85 (F)								
>0.90 (M)	2.69 (1.33–5.42)	3.03 (1.22–7.55)	1.40 (0.79–2.49)	1.96 (1.06–3.60)	2.95 (2.11–4.14)	3.12 (2.21–4.41)	1.83 (1.67–2.00)	1.70 (1.57–1.83)
>0.85 (F)								
Waist-hip ratio (Asian)								
d0.90 (M)	1.00 (referent)				1.00 (referent)			
d0.80 (F)								
>0.90 (M)	2.69 (1.33–5.42)	8.66 (2.05–36.67)	1.40 (0.79–2.49)	1.54 (0.70–3.38)	2.95 (2.11–4.14)	2.15 (1.31–3.52)	1.83 (1.67–2.00)	1.80 (1.63–2.00)
>0.80 (F)								
Waist circumference (European)								
<95 cm (M)	1.00 (referent)				1.00 (referent)			
<80 cm (F)								
95–102 cm (M)	3.19 (1.66–6.15)	1.42 (0.57–3.54)	1.12 (0.67–1.88)	2.14 (0.75–6.13)	2.29 (1.72–3.05)	2.51 (1.72–3.68)	1.43 (1.30–1.58)	1.91 (1.73–2.11)
80–88 cm (F)								
>102 cm (M)	2.70 (1.03–7.08)	5.65 (2.12–15.04)	1.47 (0.79–2.74)	3.78 (1.40–10.19)	2.51 (1.55–4.07)	3.48 (2.31–5.23)	1.54 (1.35–1.75)	2.46 (2.23–2.71)
>88 cm (F)								
Waist circumference (Asian)								
<90 cm (M)	1.00 (referent)				1.00 (referent)			
<80 cm (F)								
≥90 cm (M)	2.35 (1.28–4.33)	3.24 (1.31–8.01)	1.28 (0.79–2.06)	3.09 (1.16–8.19)	2.27 (1.75–2.95)	2.82 (1.98–4.03)	1.50 (1.39–1.62)	2.16 (1.98–2.37)
≥80 cm (F)								
Waist-height ratio								
d0.5	1.00 (referent)				1.00 (referent)			
>0.5	2.08 (1.02–4.23)	3.64 (1.33–9.97)	1.09 (0.61–1.94)	2.52 (1.04–6.06)	3.64 (2.44–5.44)	3.28 (2.12–5.08)	1.74 (1.58–1.90)	2.51 (2.25–2.81)
Alcohol consumption								
None	1.00 (referent)				1.00 (referent)			
Less than weekly	0.61 (0.31–1.20)	0.41 (0.17–0.99)	0.92 (0.54–1.57)	0.65 (0.35–1.23)	0.81 (0.60–1.07)	0.76 (0.55–1.06)	1.19 (1.09–1.30)	0.82 (0.74–0.90)
Weekly or more frequent	0.65 (0.27–1.57)	0.08 (0.01–0.60)	1.07 (0.60–1.94)	1.14 (0.14–9.10)	0.73 (0.46–1.16)	1.50 (0.65–3.44)	1.17 (1.07–1.29)	0.64 (0.39–1.05)
Smoking								
Never smoker	1.00 (referent)				1.00 (referent)			
Ex-smoker	2.08 (1.06–4.08)	0.01 (0.00–0.03)	1.35 (0.69–2.64)	0.03 (0.00–0.51)	1.47 (1.04–2.08)	1.23 (0.52–2.91)	1.12 (0.99–1.25)	1.13 (0.77–1.66)
Current smoker	1.70 (0.72–4.00)	1.97 (0.60–6.51)	0.87 (0.49–1.53)	3.24 (0.97–10.84)	0.81 (0.57–1.16)	1.50 (0.59–3.80)	0.90 (0.83–0.98)	0.92 (0.65–1.31)

Rate ratios were obtained by pooling data from different survey years for each country. Estimates shown were adjusted for age and education status.

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Table 2: Socio-economic differences between Singapore and Mauritius

	Singapore	Mauritius
Population size^a	5.1 millions	1.3 millions
Ethnic composition^b	74.2% Chinese 13.3% Malay 9.2% South Asian 3.3% Others	68% South Asian (Indo-Mauritian) 27% African (Creole) 3% Chinese (Sino-Mauritian) 2% Franco-Mauritian
Gross Domestic Product per capita^a	US\$40,941	US\$7,462
Adult literacy rate^c	95%	88%
Life expectancy at birth^a	82 years	73 years
Infant mortality rate^a	2 per 1,000 live births	13 per 1,000 live births
Neonatal mortality rate^a	1 per 1,000 live births	9 per 1,000 live births
Maternal mortality ratio^d	9 per 100,000 live births	36 per 100,000 live births
Urban population^a	100%	43%
Working population^e	65.6%	59.2%
Estimated calorie intake per capita per day^{f,g}	2,624 kcal	2,930 kcal
Common causes of mortality^h	1. Cancer 2. Ischemic heart disease 3. Pneumonia 4. Cerebrovascular disease (including stroke) 5. Accidents, poisoning & violence	1. Diabetes mellitus 2. Acute myocardial infarction and other ischemic heart diseases 3. Cerebrovascular disease 4. Hypertensive disease 5. Heart failure

^a 2010 estimates from World Development Indicators²⁴

^b Estimates from The World Factbook²⁵

^c 2005–2010 estimates from World Development Indicators²⁴

^d 2008 modeled estimates from World Development Indicators²⁴

^e Economically active population in 2008 from Labour Force Survey²⁶

^f Mean daily energy intake among adult Singapore residents in 2010 from National Nutrition Survey 2010²⁷

^g Daily dietary energy supply per person in Mauritius in 2006–2008 from FAO Statistical Yearbook 2012²⁸

^h Top 5 principle causes of deaths in 2010^{29,30}

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