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National Prevalence of Obesity

Prevalence of overweight in the Seychelles: 15 year trends and association with socio-economic status

P. Bovet[1,2], A. Chiolero[2], C. Shamlaye[1] and F. Paccaud[2]

[1]Ministry of Health and Social Development, Victoria, Republic of Seychelles; [2]University Institute of Social and Preventive Medicine (IUMSP), University Hospital Center and University of Lausanne, Lausanne, Switzerland

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Address for correspondence: Dr Pascal Bovet, Ministry of Health and Social Development, PO Box 52, Victoria, Republic of Seychelles. E-mail: pbovet@seychelles.net or pascal.bovet@chuv.ch

Summary

We assessed the 15-year trends in the distribution of body mass index (BMI) and the prevalence of overweight in the Seychelles (Indian Ocean, African Region) and the relationship with socio-economic status (SES). Three population-based examination surveys were conducted in 1989, 1994 and 2004. Occupation was categorized as 'labourer', 'intermediate' or 'professional'. Education was also assessed in 1994 and 2004. Between 1989 and 2004, mean BMI increased markedly in all sex and age categories (overall: 0.16 kg m^{-2} per calendar year, which corresponds to 0.46 kg per calendar year). The prevalence of overweight (including obesity, BMI $\geq$ 25 kg m^{-2}) increased from 29% to 52% in men and from 50% to 67% in women. The prevalence of obesity (BMI $\geq$ 30 kg m^{-2}) increased from 4% to 15% in men and from 23% to 34% in women. Overweight was associated inversely with occupation in women and directly in men in all surveys. In multivariate analysis, overweight was associated similarly (direction and magnitude) to occupation and education. In conclusion, the increasing prevalence of overweight and obesity over time in all age, sex and SES categories suggests large-scale changes in societal obesogenic factors. The sex-specific association of SES with overweight suggests that prevention measures should be tailored accordingly.

Keywords: Africa, obesity, socio-economic status, trends.

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Introduction

The epidemic of obesity extends to developing countries (1–3) and obesity ranks fifth in the list of leading risk factors underlying the total burden of disease in low-mortality developing countries (4). Furthermore, the rate of increase of the prevalence of obesity may be steeper in developing than developed countries, likely related to rapid changes in environmental obesogenic factors and individuals' lifestyles(5). High quality population-based trend studies are needed to better document the obesity epidemic in developing countries.

The association between socio-economic status (SES) and obesity varies between populations (6–8). In developed countries, obesity has been associated with lower SES in both genders, at least during the last 30 years (7,8). In developing countries obesity is first associated with high SES but then shifts to the groups of lower SES as the country's GNP increases (7). This transition tends to occur earlier in women than in men (6,9).

The associations between SES and obesity may differ according to SES indicators, e.g. income, material possession, education or occupation (7,10,11). During the past few decades, the number of years of education has often increased more in developing than developed countries so that education tends to strongly correlate with a person's age in developing countries. Unless a substantial proportion of the population is unemployed, occupation may therefore be a better indicator to assess SES in developing countries (10).

A precise insight in the gender and socio-economic patterning of weight is essential to inform appropriate health policy. Using data from three population-based surveys in the Seychelles, a rapidly developing island state in the Indian Ocean (African region), we examined the trends in the prevalence of overweight and obesity between 1989 and 2004 and their association according to sex, age and occupation.

Subjects and methods

The Republic of Seychelles is a small island state situated approximately 1800 km east of Kenya, and 90% of the population lives on the main island (Mahé). A large majority of the population is of African descent. The national gross domestic product per capita grew, in real terms, from US$ 2927 in 1980 to US$5239 in 2004, driven by booming tourism, industrial fishing and services. The Seychelles can be considered as urbanized or semi-urbanized in view of a high population density related to small size of the islands and a large proportion of the population regularly commute to town for work or services.

Three population-based surveys of cardiovascular risk factors were conducted in 1989, 1994 and 2004 (12–14). All surveys were approved by the Ministry of Health after technical and ethical reviews. Participants were free to participate and gave informed consent.

The sampling frame, methods and main results of the three surveys have been described previously (12–14). Briefly, the sampling frame of each survey consisted of a sex- and age-stratified random sample of the total population aged 25–64 years (main island in 1989 and 1994, all islands in 2004). Eligible participants were selected from computerized databases derived from population censuses, thereafter regularly updated by civil status authorities. All eligible participants were invited to attend a study centre on selected dates. The surveys were attended by 1081 persons in 1989 (86.4% participation rate), 1067 in 1994 (87.0%) and 1255 in 2004 (80.2%).

Height and body weight were measured using precision electronic scales (Seca™, Hamburg, Germany) and fixed stadiometres (Seca™) and these instruments were regularly checked for accuracy. Categories of body mass index (BMI; kg m^{-2}) were defined as follows (15): underweight: <18.5, normal weight: 18.5–24.9, overweight: 25.0–29.9, obesity: ≥30 and very severe obesity ≥40. In this paper, 'overweight' refers to BMI ≥ 25 kg m^{-2} (i.e. also includes obesity).

In the three surveys, participants were asked, using the same questions, about their current occupation or, if not currently employed, about their occupation when they were last employed. Three categories were considered in this study: 'labourer' (manual occupation with no formal training), 'professional' (which included non-manual occupations with formal training such as teachers, nurses, etc) and 'intermediate' (all other categories). Education was categorized as attendance to 'up to primary school', 'some or full secondary school' and 'some or full post secondary education' (data available only in the 1994 and 2004 surveys). Personal income was available in the 2004 survey, along with six pre-defined categories. Smoking habits were assessed by an administered structured questionnaire.

All estimates were weighted to the distribution of the population of Seychelles in 2002 (year of the last available national census). Trends over calendar years were quantified using linear regression. The association between weight categories and explanatory variables was analysed with multivariate logistic regression. P values <0.05 were considered significant. Analyses were performed with Stata 8.2 (Stata Corporation®, College Station, TX, USA).

Results

Mean BMI and the prevalence of each excess weight category were larger in men than women and increased markedly between 1989 and 2004 (Table 1). Of note, age and sex-specific mean BMI was virtually identical in the main island vs. the other islands (2004). The prevalence of 'professional' tended to be larger in women than in men in the three surveys. The distribution of education categories was similar in men and women, particularly in 2004, and around 70% of adults had attended secondary education. The prevalence of smokers was much larger in men than women and decreased over time.

Not shown in the table, 89% of men and 82% of women had been working during the past 12 months in 2004, underlying a high employment rate in both men and women. In 2004, 86% of persons aged 25–34 years had attended secondary school or a higher level as compared with only 11% of persons aged 55–64 years, suggesting a large increase in the mean number of years of education over the past decades. There was a high correlation between education and occupation categories (r: 0.56 in men, 0.65 in women), education and income categories (0.44 and 0.49) and occupation and income categories (0.57 and 0.58).

Figure 1 shows the distribution of BMI in the general population in 1989, 1994 and 2004 (standardized to the 2002 population). The mode of the BMI distribution shifted from 21.2 kg m^{-2} in 1989 to 23.2 kg m^{-2} in 1994 and 26.3 kg m^{-2} in 2004.

Mean BMI increased markedly over time in all age categories (standard error [SE] ranged between 0.3–0.5 kg m^{-2} for all estimates) (Fig. 2). The linear increase of mean BMI was 0.14 (SE: 0.2) kg m^{-2} per calendar year in men, 0.19 (0.4) kg m^{-2} per calendar year in women (both sexes: 0.16 [0.2] kg m^{-2} per calendar year). This corresponds to a

Table 1 Distribution of selected variables according to sex and survey year

Year (*n*)		Men						Women					
		1989	(513)	1994	(504)	2004	(508)	1989	(568)	1994	(563)	2004	(687)
Occupation													
Labourer	%	33.9	(2.1)	27.6	(2.9)	25.6	(1.8)	48.0	(2.1)	33.1	(2.0)	42.8	(1.9)
Intermediate	%	55.5	(2.2)	54.8	(2.2)	58.6	(2.1)	37.3	(2.0)	46.2	(2.1)	38.5	(1.9)
Professional	%	10.6	(1.4)	17.6	(1.7)	15.8	(1.5)	14.7	(1.5)	20.7	(1.7)	18.7	(1.5)
Education													
Up to primary school				31.9	(0.2)	31.4	(0.2)			30.5	(0.2)	29.3	(0.2)
Secondary school				46.1	(0.2)	43.3	(0.2)			54.7	(0.2)	45.8	(0.3)
Post secondary school				21.0	(0.2)	25.3	(0.2)			14.5	(0.2)	24.9	(0.2)
Body mass index (BMI)													
BMI (kg m^{-2})	mean	23.3	(0.2)	24.1	(0.2)	25.5	(0.2)	25.6	(0.2)	26.7	(0.3)	28.1	(0.2)
BMI $\geq$ 25 kg m^{-2}	%	28.4	(2.0)	36.8	(2.2)	51.5	(2.1)	49.1	(2.1)	56.7	(2.1)	66.4	(1.8)
BMI $\geq$ 30 kg m^{-2}	%	4.3	(0.9)	8.1	(1.2)	14.6	(1.5)	21.6	(1.7)	26.1	(1.9)	33.8	(1.8)
Smoking status													
Never smoker	%	32.6	(2.1)	34.3	(2.1)	47.4	(2.1)	81.3	(1.6)	86.6	(1.4)	89.8	(1.2)
Ex-smoker	%	17.2	(1.7)	30.6	(2.1)	21.7	(1.7)	8.8	(1.2)	7.1	(1.1)	6.3	(0.9)
Smoker	%	50.1	(2.2)	35.1	(2.1)	30.9	(1.9)	9.9	(1.3)	6.3	(1.0)	3.9	(0.7)

Results are presented as mean or percentage with standard error between brackets.

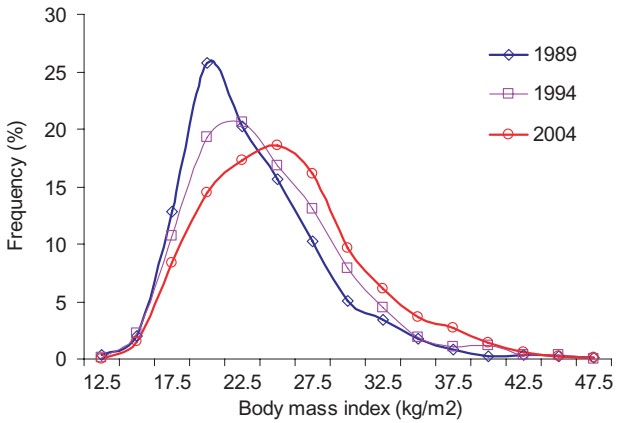

Figure 1 Age-standardized distribution of body mass index in the population aged 25–64 according to survey year.

linear increase in mean weight of 0.48 kg (0.05) per year in men and 0.45 (0.06) kg per year in women (both sexes: 0.46 kg [0.04]).

The prevalence of overweight (BMI $\geq$ 25 kg m^{-2}) increased markedly across the three surveys (Fig. 3). The prevalence of very severe obesity (BMI $\geq$ 40 kg m^{-2}) increased approximately threefold, from 0.2% to 0.7% in men and from 1.5% to 4.2% in women. The prevalence of underweight (BMI < 18.5 kg m^{-2}) was low (<6%) and tended to decrease over time.

Mean BMI increased over time in all SES categories in both men and women (Fig. 4). Mean BMI was similar in men and women with a professional occupation in all three surveys. However, mean BMI was larger in professionals than in labourers among men and lower in labourers than in professionals among women in all three surveys.

Figure 5 shows the prevalence of categories of BMI by sex, survey year and occupation. First, the prevalence of excess weight increased in all occupation categories across survey years. Second, the prevalence of overweight (BMI $\geq$ 25 kg m^{-2}) in the 'professional' category was fairly similar in men and in women in all surveys (this prevalence increased from approximately 30% in 1989 to approximately 60% in 2004). Third, among men, more professionals than labourers were overweight, while among women, more labourers than professionals were overweight.

Multivariate logistic regression showed that overweight was associated with both occupation and education (data in 2004 only), and the associations were of similar strength. The association was direct in men and inverse in women (Table 2). Overweight was also associated directly with past smoking and inversely with current smoking. Associations were similar when considering obesity instead of overweight (data not shown).

Discussion

The prevalence of overweight (including obesity) increased markedly between 1989 and 2004 in the population of the Seychelles in all sex, age and SES categories, suggesting common environmental obesogenic factors. The prevalence of overweight was larger in women than in men. In all surveys, the prevalence of overweight was similar in male and female professionals but the association between overweight and SES was inverse in women and direct in men.

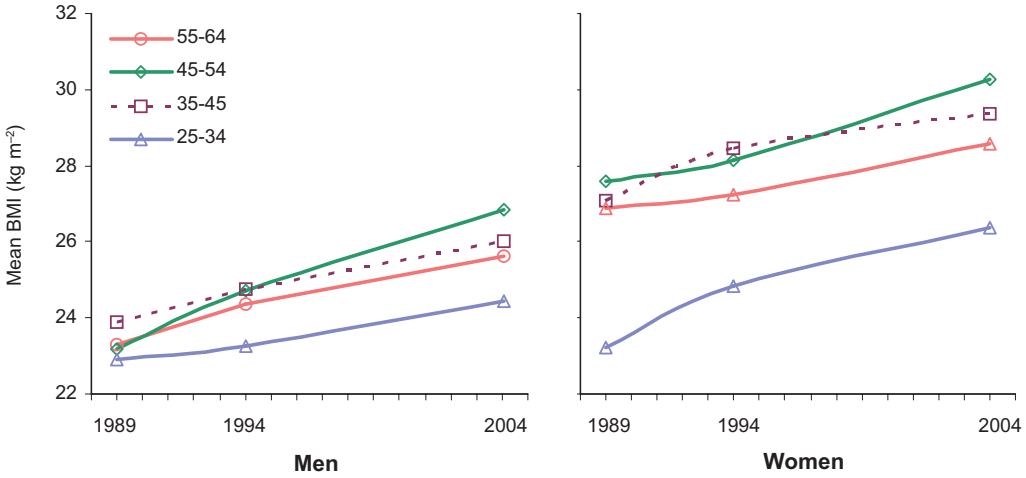

Figure 2 Mean body mass index (BMI) according to sex, survey year and age.

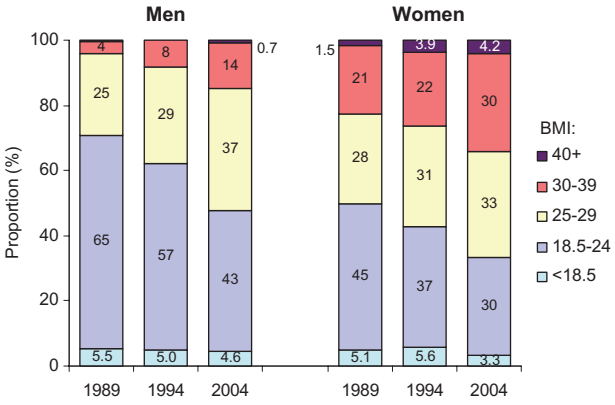

Figure 3 Prevalence of categories of body mass index (BMI) according to sex and survey year.

The prevalence of overweight in the Seychelles (in 2004) was high by international standards, e.g. similar to the USA (where approximately one-third of adults are obese and two-thirds are overweight or obese (16)). While the prevalence of overweight may still be low in some low-income or rural populations, a prevalence of overweight (including obesity) exceeding 50% has been found in several developing countries, particularly in urban settings (16,17). Most strikingly, the rate of increase in population mean weight was almost two times steeper in the Seychelles between 1989 and 2004 (0.46 kg per year) than in the USA between 1960 and 2002 (0.26 kg per year) (18). This is consistent with a rapid rate of increase of the obesity epidemic in some developing countries (5). Of note, a large and rapidly increasing prevalence of overweight was also found among children in Seychelles (19).

The higher prevalence of overweight in women than in men in Seychelles is consistent with findings in most developing countries (6), including all countries in Africa for which data are available (20,21), and also among African- and Mexican-Americans (16). It contrasts with the higher prevalence of overweight in men than women in many Western countries (17). The observed pattern in Seychelles may reflect the fact that men have been traditionally engaged in more physically strenuous occupations than women. A common observation in developing countries, particularly in Africa, is that excess weight occurs, first, more often in women but that men eventually reach similar prevalence (9).

The association of overweight with SES was positive in men and inverse in women, and this socioeconomic patterning did not change over the considered 15 year span. In comparison, the association between obesity and SES in women was positive in most developing countries some years ago (8), but an inverse relationship has been noted in several middle-income developing countries recently (6,7). An inverse association is consistently found in developed countries (7,8). In men, the obesity–SES association is less consistent in developing countries, but a positive relation is not uncommon, particularly when SES is based on income (7).

A few factors may be mentioned to contextualize our findings. The high employment rate among both men and women makes it unlikely that food scarcity protects persons of low SES from obesity. Western values are broadly adopted in Seychelles and this might influence attitudes towards thinness, particularly among women with high SES. Other cultural and social factors may also play a role. For example, a large body size can be valued by men as a sign of physical dominance and prowess (7).

The obesity epidemic in Seychelles has spread while the current staple diet in Seychelles is still largely based on rice and fish (consumed on a daily basis by the large majority of

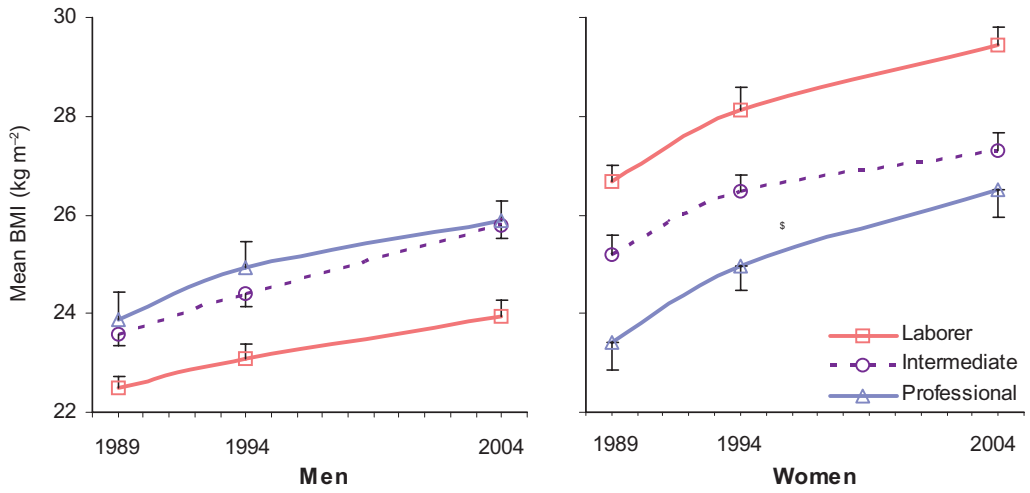

Figure 4 Mean body mass index (and standard error) according to sex, survey year and occupation.

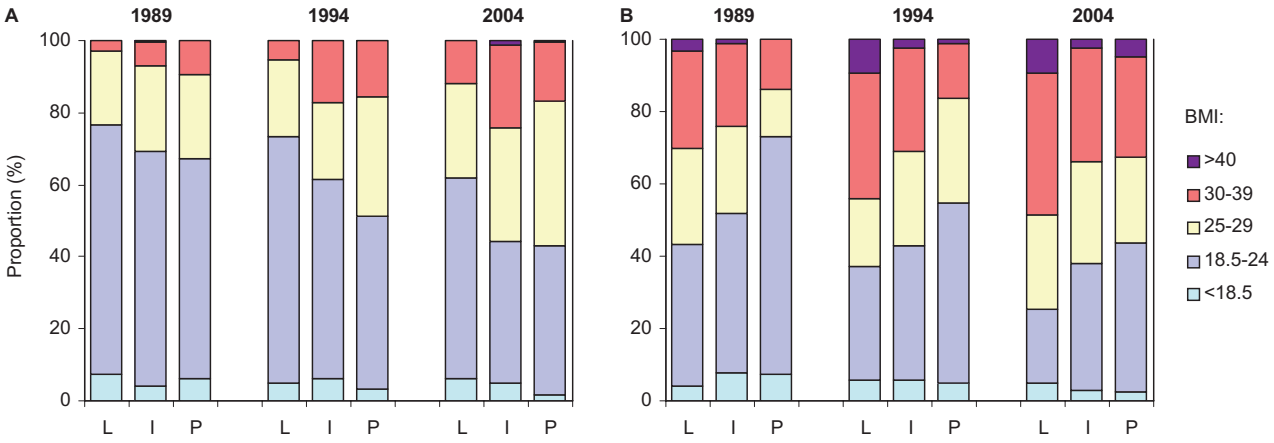

Figure 5 Prevalence of categories of body mass index (BMI) according to sex, survey year and occupation. Panel A, men; Panel B, women; L, laborer; I, intermediate category; P, professional.

people). However, the total energy intake has increased substantially: per capita calorie availability has increased in Seychelles from 1800 kcal in 1965 to 2300 kcal in the late 1980s, and above 2400 kcal in the early 2000s and the proportion of fats has increased from 16% in 1965 to 32% in 2000 (21). Increasing energy intake may relate to several factors: large availability of inexpensive fried snacks in all shop outlets, increasing consumption of 'take away' served in large one-sized boxes and common practice of frying foods at home (e.g. fish, chutneys). Also, the local production of soft drinks has tripled in the past 25 years (figures from Seychelles Breweries Ltd., Le Rocher, Mahé, Seychelles). Furthermore, from an energy expenditure perspective, many people have adopted an increasingly sedentary lifestyle with the rapid shift towards a services-based economy. The capacity of public transports has largely increased and the number of licensed vehicles has more than doubled during the study period.

Strengths of this report include the population-based design and high participation rates in all three surveys. One limitation is our predominant reliance on a single SES indicator (occupation) over the three surveys (10). However, this indicator seems robust as it was assessed identically in all surveys and considering the high occupation rate in Seychelles (>90% in 2004). In addition we also found that overweight was associated with education in the same directions and strength than occupation.

The impact on health of the rising prevalence of overweight in the Seychelles is already evident. The prevalence increased markedly between 1989 and 2004 and overweight was found to account for 49% of all diabetes cases in the population (22). We previously also described strong

Table 2 Multivariate association between overweight (BMI ≥ 25 kg m^{-2}) and smoking, occupation and education (data in 2004)

	Men						Women					
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Smoking												
Never	1		1		1		1		1		1	
Ex-smoker	1.62	1.50–1.75	1.50	1.38–1.62	1.65	1.52–1.78	1.28	1.11–1.46	1.21	1.06–1.39	1.23	1.07–1.41
Current smoker	0.70	0.66–0.75	0.65	0.61–0.70	0.71	0.66–0.76	0.50	0.43–0.57	0.53	0.45–0.61	0.50	0.43–0.58
Occupation												
Labourer	1		1		1		1				1	
Intermediate	2.11	1.97–2.27			2.01	1.87–2.16	0.65	0.61–0.70			0.76	0.70–0.81
Professional	2.19	1.99–2.42			1.91	1.71–2.14	0.48	0.44–0.52			0.63	0.57–0.70
Education												
Up to primary			1		1				1		1	
Secondary			1.72	1.57–1.89	1.48	1.35–1.63			0.63	0.56–0.70	0.73	0.65–0.83
Post-secondary			1.92	1.73–2.13	1.54	1.37–1.73			0.39	0.34–0.43	0.55	0.47–0.63

Multivariate logistic regression: models include all variables included in the table and age. All associations were statistically significant (<0.001).
BMI, body mass index; 95% CI, 95% confidence interval; OR, odds ratio.

relationships in the population of Seychelles between overweight and high blood pressure (23) and dyslipidemia (24).

Conclusions

This paper shows a marked increase in the prevalence of excess weight in a middle-income country in all sex, age and SES categories, suggesting large-scale societal obesogenic factors. The different associations of overweight and obesity with gender and SES emphasize the need to better understand the underlying cultural, social and other determinants (25,26). The marked socio-economic patterning of weight also points to a cause of health inequity (27). More generally, the data further stress the need to design and implement the physical, economic and socio-cultural environment that makes healthier choices concerning diet and physical activity feasible for all (6,28).

Conflict of Interest Statement

No conflict of interest was declared.

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References

1. James PT, Leach R, Kalamara E, Shayeghi M. The worldwide obesity epidemic. *Obes Res* 2001; **9**(Suppl. 4): 228S–233S.
2. Hossain P, Kawar B, El Nahas M. Obesity and diabetes in the developing world – a growing challenge. *N Engl J Med* 2007; **356**: 213–215.
3. Ezzati M, Vander Hoorn S, Lawes CM, Leach R, James WP, Lopez AD, Rodgers A, Murray CJ. Rethinking the 'diseases of affluence' paradigm: global patterns of nutritional risks in relation to economic development. *PLoS Med* 2005; **2**: e133.
4. The World Health Report 2002 *Reducing Risk, Promoting Healthy Life*. WHO: Geneva, 2002.
5. Popkin BM. The nutrition transition: an overview of world patterns of change. *Nutr Rev* 2004; **62**: S140–S143.
6. Monteiro CA, Moura EC, Conde WL, Popkin BM. Socioeconomic status and obesity in adult populations of developing countries: a review. *Bull World Health Organ* 2004; **82**: 940–946.
7. McLaren L. Socioeconomic status and obesity. *Epidemiol Rev* 2007; **29**: 29–48.
8. Sobal J, Stunkard AJ. Socioeconomic status and obesity: a review of the literature. *Psychol Bull* 1989; **105**: 260–275.
9. Mendez MA, Monteiro CA, Popkin BM. Overweight exceeds underweight among women in most developing countries. *Am J Clin Nutr* 2005; **81**: 714–721.
10. Galobardes B, Shaw M, Lawlor DA, Lynch JW, Davey Smith G. Indicators of socioeconomic position (part 1). *J Epidemiol Community Health* 2006; **60**: 7–12.
11. Ball K, Crawford D. Socioeconomic status and weight change in adults: a review. *Soc Sci Med* 2005; **60**: 1987–2010.
12. Bovet P, Shamlaye C, Kitua A, Riesen WF, Paccaud F, Darioli R. High prevalence of cardiovascular risk factors in the Seychelles (Indian Ocean). *Arterioscler Thromb* 1991; **11**: 1730–1736.

13. Bovet P, Perret F, Shamlaye C, Darioli R, Paccaud F. The Seychelles Heart Study II. Methods and selected basic findings. *Seychelles Med Dent J* 1997; **5**: 8–24. [http://www.smdj.sc].
14. Bovet P, Shamlaye C, Gabriel A, Riesen W, Paccaud F. Prevalence of cardiovascular risk factors in a middle-income country and estimated cost of a treatment strategy. *BMC Public Health* 2006; **6**: 9.
15. National Institutes of Health. Clinical Guidelines on the identification, evaluation, and treatment of overweight and obesity in adults – the Evidence Report. *Obes Res* 1998; **6**(Suppl. 2): 51S–209S.
16. Wang Y, Beydoun MA. The obesity epidemic in the United States – gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. *Epidemiol Rev* 2007; **29**: 6–28.
17. International Obesity Task force (IOTF) *Prevalence of obesity*. [WWW document]. URL http://www.iotf.org/database/GlobalPrevalenceofAdultObesityAugust07Web.htm (accessed 15 May 2008).
18. Ogden CL, Fryar CD, Carroll MD, Flegal KM. QuickStats: mean weight and height among adults aged 20–74 years, by sex and survey period – United States, 1960–2002. *MMWR* 2005; **54**: 771.
19. Bovet P, Chiolero A, Madeleine G, Gedeon A, Stettler N. Marked increase in the prevalence of obesity in children of the Seychelles (Indian Ocean), 1998–2004. *Int J Ped Obes* 2006; **2**: 120–128.
20. Abubakari R, Lauder W, Agyemang C, Jones M, Kirk A, Bhopal RS Prevalence and time trends in obesity among adult West African populations: a meta-analysis. *Obes Rev* 2008; **9**: 297–311. (in press).
21. Food and Agricultural Organization of the United Nations (FAO) *Food balance sheets (data archives)*. [WWW document]. URL http://faostat.fao.org/site/502/DesktopDefault.aspx?PageID=50231 (accessed 29 October 2007).
22. Faeh D, William J, Tappy L, Ravussin E, Bovet P. Prevalence, awareness and control of diabetes in the Seychelles and relationship with excess body weight. *BMC Public Health* 2007; **7**: 163.
23. Danon-Hersch N, Chiolero A, Shamlaye C, Paccaud F, Bovet P. Decreasing association between body mass index and blood pressure over time. *Epidemiology* 2007; **18**: 493–500.
24. Paccaud F, Schlüter-Fasmeyer V, Wietlisbach V, Bovet P. Dyslipidemia and abdominal obesity: an assessment in three general populations. *J Clin Epidemiol* 2000; **53**: 393–400.
25. Kumanyika SK, Morssink C, Agurs T. Models for dietary and weight change in African-American women: identifying cultural components. *Ethn Dis* 1992; **2**: 166–174.
26. Bennett GG, Wolin KY. Satisfied or unaware? Racial differences in perceived weight status. *Int J Behav Nutr Phys Act* 2006; **3**: 40e.
27. Friel S, Chopra M, Satcher D. Unequal weight: equity oriented policy responses to the global obesity epidemic. *BMJ* 2007; **335**: 1241–1243.
28. Resolution WHA57.17. Global strategy on diet, physical activity and health. Fifty-seventh Health Assembly, 22 May 2004. Geneva; 2004.

