International Journal of Cardiology 168 (2013) 1201–1206

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

The social transition of risk factors for cardiovascular disease in the African region: Evidence from three cross-sectional surveys in the Seychelles ☆

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ARTICLE INFO

Article history:
Received 26 July 2012
Received in revised form 1 November 2012
Accepted 11 November 2012
Available online 30 November 2012

Keywords:
Social determinants
Cardiovascular risk factors
Trends
Africa
Low and middle income countries
Survey

ABSTRACT

Objectives: To examine the association between socioeconomic status (SES) and several cardiovascular disease risk factors (CVRFs) and to assess whether this association has changed over a 15-year observation period.
Methods: Three independent population-based surveys of CVRFs were conducted in representative samples of all adults aged 25–64 years in the Seychelles, a small island state located east to Kenya, in 1989 (N = 1081), 1994 (N = 1067) and 2004 (N = 1255).
Results: Among men, current smoking and heavy drinking were more prevalent in the low versus the high SES group, and obesity was less prevalent. The socioeconomic gradient in diabetes reversed over the study period from lower prevalence in the low versus the high SES group to higher prevalence in the low SES group. Hypercholesterolemia was less prevalent in the low versus the high SES group in 1989 but the prevalence was similar in the two groups in 2004. Hypertension showed no consistent socioeconomic pattern. Among women, the SES gradient in smoking tended to reverse over time from lower prevalence in the low SES group to lower prevalence in the high SES group. Obesity and diabetes were more common in the low versus the high SES group over the study period. Heavy drinking, hypertension and hypercholesterolemia were not socially patterned among women.
Conclusion: The prevalence of several CVRFs was higher in low versus high SES groups in a rapidly developing country in the African region, and an increase of the burden of these CVRFs in the most disadvantaged groups of the population was observed over the 15 years study period.

1. Introduction

In low and middle income countries (LMICs), the global burden of cardiovascular disease (CVD) is projected to increase over the next decades due to epidemiologic and demographic transitions [1,2]. In particular, it is expected that the population prevalence of several risk factors for cardiovascular diseases (CVRFs), mainly unhealthy behaviours (tobacco use, lack of physical activity, unhealthy diet) and physiological risk factors (blood pressure, blood lipid levels and diabetes), will rise as a consequence of lifestyle changes associated with globalisation and urbanisation and related nutritional transition [3–5].

Research in high income countries has consistently shown that socioeconomic status (SES) is among the strongest determinants of the population distribution of CVRFs and CVD [6]. However, the association between SES and CVRFs has reversed over time from higher prevalence in the higher socioeconomic groups to higher prevalence in the most disadvantaged sections of the population [7,8]. Fewer studies have examined the social distribution of CVRFs in LMICs, but cigarette smoking, obesity and diabetes have generally been found to be directly associated with SES (i.e. higher prevalence in the higher SES groups) [9–12]. However, recent studies suggest that a "social transition" similar to that observed in high income countries might be taking place in LMICs [10,13–17]. The general lack of reliable time series data on the socioeconomic distribution of CVRFs in LMICs, in particular in the African region, has made it difficult to assess this hypothesis by examining time trends in single countries.

In Seychelles, a small island state located east to Kenya, repeated cross-sectional surveys conducted between 1989 and 2004 make it possible to examine changes in the social patterning of CVRFs over time. This study examines the association between SES and several CVRF (current smoking, heavy drinking, obesity, diabetes, hypertension and

☆ Funding: The surveys were funded by the Ministry of Health, Republic of Seychelles (all surveys), the Department of Cooperation, Jura Canton, Switzerland (1989), the Swiss National Foundation for Science (1994; Prosper 3233-038792), the Hospital Services of Vaud Canton, Switzerland (1994, 2004), the World Health Organization (2004), and the Lausanne University Institute of Social and Preventive Medicine (all surveys). Silvia Stringhini is supported by a post-doctoral fellowship from the Swiss School of Public Health (SSPH+).
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http://dx.doi.org/10.1016/j.ijcard.2012.11.064

high cholesterol) and assesses whether this association has changed over the 15-year observation period.

2. Data and methods

2.1. Study population

The Republic of Seychelles is a rapidly developing small island state in the Indian Ocean (African region), east of Kenya and north of Mauritius. The population size was 67,000 in 1989 (44% aged ≥25 years) and 84,000 in 2004 (57% aged ≥25 years). The majority of the population is of African descent. Life expectancy at birth increased from 63 to 69 years in men and from 73 to 76 years in women between 1989 and 2004. The gross domestic product (GDP) per capita rose, in real terms, from $2927 in 1980 to US$ 5239 in 2004, driven by booming tourism, industrial fishing and services. Health care, including access to major medications for hypertension, cholesterol and diabetes at primary health care level, has been available with no fee to all inhabitants through a national health system during the whole study period. Previous studies have shown that the prevalence of several CVRFs was high in Seychelles with plateauing or decreasing levels for traditional CVRFs over time (particularly smoking) and increasing levels of cardio-metabolic CVRFs (mainly obesity and diabetes) [18–21]. CVD is a major cause of mortality in Seychelles but age-adjusted rates have decreased substantially between 1989 and 2010 [22].

Three independent population-based examination surveys of CVRFs were conducted in representative samples of all adults aged 25–64 years in the Seychelles in 1989, 1994 and 2004. 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 [23–25]. Briefly, each survey consisted of an age- and sex-stratified random sample of the total population aged 25–64 years. Inclusion criteria were unchanged in the three surveys. Eligible participants were selected from an electronic database derived from population censuses, regularly updated by civil status authorities. Of note, the study design of the three surveys (i.e. age-stratified sample) allows to account for changes in the age-structure of the population over time. The surveys were attended by 1081 persons in 1989 (86.4% participation rate), 1067 in 1994 (87%), and 1255 in 2004 (80.2%). A total of 1585 men and 1818 women participated to the three surveys. In all surveys, trained officers administered a structured questionnaire on demographic and lifestyle factors to the participants using same or similar questions with regard to the variables considered in this study.

2.2. Measures

2.2.1. Measurement of cardiovascular risk factors (CVRF)

Current smoking was defined as smoking at least one cigarette every day. Alcohol intake was assessed from a set of questions on drinking frequency and volume for the six main alcoholic beverages (beer, wine/liquor, spirits and locally made homebrews), taking advantage of the fact that only a limited number of brands and contents were available in the country up to 2004. Mean daily ethanol intake per week was calculated. *Heavy drinking* was defined as consuming more than 75 g of ethanol per week.

Weight was measured with calibrated medical electronic scales (Seca) and height was measured using fixed stadiometers. Body mass index (BMI) was calculated as weight divided by squared height (kg/m^2). *Obesity* was defined as BMI≥30. Blood pressure (BP) was measured with a mercury sphygmomanometer using a cuff adapted to the arm circumference and was based on the last two of three readings taken at intervals of at least 2 min, after the participants had been quiet in the study centre for at least 30 min and seated for >10 min. *Hypertension* was defined as BP≥140/90 mm Hg or taking treatment.

Fasting blood was collected in the early morning after an overnight fast, blood was spun at the study centres, and serum was immediately frozen to −20 °C, and all analyses, except for capillary glucose, were performed at university laboratories in Switzerland. In 1989 and 1994, total cholesterol was measured enzymatically (CHOD-PAP method) using reagents from Boehringer (Manheim, Germany). In 2004, blood lipids were measured using a Hitachi 917 instrument and Roche reagents. *High total cholesterol* was defined as total cholesterol ≥6.2 mmol/l (240 mg/dl) [26]. Fasting blood glucose (FBG) was determined immediately after blood drawing using point-of-care instruments in 1989 and 2004. In 1989, venous blood was measured using a reflectance metre (Reflomat with Hemoglucotest reagent strips, Boerhinger), a validated and frequently used glucometer at the time. In 1994, presence of sugar in the urine was tested in all participants using dipsticks (Glukotest, Boehringer, Mannheim, Germany). In 2004, glucose was measured on venous blood using a Cholestec LDX analyzer (Cholestec, Hayward, USA), a reliable alternative to conventional laboratory devices. Diabetes was defined as FBG ≥7.0 mmol/l (126 mg/dl) (1989, 2004) or positive glucosuria or history of diabetes (1994) [27].

2.2.2. Socioeconomic status (SES)

In all three surveys, the same question classified occupation in six categories, based on the participant's current occupation or his/her past occupation if a participant was not currently employed. The classification of occupations along six classes ranked from higher to lower prestige or social standing and it is consistent with the British Registrar's general classification of occupations [28]. In this paper, we grouped the 6 categories into three categories. The highest category includes "professionals" and "skilled non manuals", the intermediate category includes "semi-skilled non-manuals", "skilled manuals", and "semi-skilled manuals" and the lowest category includes "unskilled workers" [21].

The authors of this manuscript have certified that they comply with the Principles of Ethical Publishing in the International Journal of Cardiology.

2.3. Statistical analysis

Analyses were conducted separately for men and women. We used least squares regression to calculate age-adjusted prevalence rates of CVRFs for each SES group and calendar year. Differences in CVRFs prevalence between the lowest and the highest SES categories, with their 95% confidence intervals (CI), were also calculated. For each CVRFs, changes in absolute inequalities over time were assessed using the significance level of an interaction term between SES and year of survey which was added to the regression models described above. Relative inequalities in CVRFs were assessed using age-adjusted log-binomial regressions. As tes (Wald test and likelihood ratio test) did not suggest significant departure from a linear trend ($p>0.05$), we used the measure of SES as a continuous 3-level variable. The prevalence ratio associated with a unit change in SES was squared to yield the prevalence ratio in the lowest versus the highest SES group (a two unit change). Changes in relative inequalities over time were assessed by additionally including in the log-binomial regressions described above an interaction term between SES and year of survey. Statistical analysis was conducted using Stata v.12 (Stata corp, College Station, TX, USA).

3. Results

A total of 104 participants had to be excluded from the analyses because of missing values on some of the CVRFs considered. The analyses were based on 1053 participants in 1989, 1002 participants in 1994 and 1193 participants in 2004. Women were more common than men in the lower SES category. Among men, the proportion of participants with low SES decreased over the study period (39.0% in 1989 vs. 27.6% in 2004); among women no consistent pattern was observed. The overall prevalence of current smoking and heavy drinking decreased steadily in men and women between 1989 and 2004, while the prevalence of obesity and diabetes greatly increased ($p<0.001$). The prevalence of hypercholesterolemia increased in men only ($p<0.001$) and the prevalence of hypertension remained stable (Table 1).

Absolute SES inequalities in age-adjusted prevalence of CVRFs are shown in Table 2 and Fig. 1. Among men, there were large absolute inequalities in current smoking and heavy drinking in the three time periods, the prevalence being higher by 20%–30% (absolute difference) in men of low vs. high SES. The prevalence of obesity was lower by ~10% in men of low vs. high SES, and this difference remained stable over the study period. The prevalence of diabetes was 8.6% lower in men of low vs. high SES in 1989 but 7.7% higher in 2004 (p for interaction between SES and year of survey = 0.004). There was a tendency for a convergence of absolute inequalities in hypercholesterolemia over the study period, with the prevalence being lower by 12.5% in men of low vs. high SES in 1989 but similar in the three SES groups in 2004.

The second part of Table 2 shows the pattern of absolute inequalities among women. SES differences in current smoking, heavy drinking and high cholesterol were small compared to men, but large absolute inequalities were observed for obesity, the prevalence being between 10 and 17% higher in women of low vs. high SES in all surveys. There was also evidence for an increase in absolute social inequalities in diabetes ($p = 0.045$).

Relative socioeconomic inequalities in CVRFs are shown in Table 3. Smoking was about 2 times more prevalent in men of low vs. high SES and relative inequalities in smoking remained stable over the study period. Relative inequalities tended to increase for heavy drinking and to decrease for obesity. In 2004, the association between high SES and obesity was no longer significant (PR = 0.58, 95%CI = 0.33; 1.02 for lowest vs. highest SES group). The SES gradient in diabetes reversed over the study period with a prevalence ratio (comparing participants of low vs. high SES) of 0.41 in 1989 and 1.87 in 2004 (p for interaction between SES and year of survey = 0.026). In 1989, hypercholesterolemia was found more often in men of low vs. high SES but a SES gradient was no longer present in 2004.

Among women (second part of Table 3), the socioeconomic gradient (comparing low vs. high SES) in smoking reversed from 0.74 in 1989 to