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THE ASSOCIATION BETWEEN SOCIOECONOMIC INDICATORS AND CARDIOVASCULAR DISEASE RISK FACTORS IN RIO DE JANEIRO, BRAZIL

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Summary. The objective of this study was to analyse the association between socioeconomic indicators and cardiovascular disease risk factors in adult residents of Rio de Janeiro city, Brazil. Data were obtained by direct interview and physical examination in a population-based cross-sectional study in the city of Rio de Janeiro, 1995–96. Subjects were selected by two-stage random sampling and information was collected on socioeconomic, anthropometric and demographic characteristics, as well as on existing risk factors for cardiovascular disease. An index to express the risk of cardiovascular disease (CVD) was built, based on the presence of two or more of the following risk factors: overweight (measured by the body mass index, BMI), fat location (measured by the waist–hip ratio index, WHR), smoking, hypertension, sedentary lifestyle and alcohol consumption. The association between this risk index and the socioeconomic variables level of schooling, *per capita* income and residence location (slum vs non-slum) was evaluated through logistic regression models that controlled for the age of the subjects. Two separate models were built, according to the gender of the subjects. Complete data were collected for 1413 males and 1866 females over the age of 20 years (82% of the intended sample). In the studied population, a considerable prevalence of risk for CVD was found: 42·2% among males and 65·4% among females. For males, the socioeconomic and demographic indicators retained in the logistic model were age (OR 1·01, 95% CI 1·00–1·01), level of schooling (1·77, 95% CI 1·39–2·26) and *per capita* income (OR 0·77, 95% CI 0·61–0·97). For females, the indicators retained were age (OR 1·02, 95% CI 1·01–1·02) and level of schooling (OR 2·26, 95% CI 1·84–2·77). The findings indicate that cardiovascular disease risk is already an alarming problem in the urban populations of developing countries, and that educational level is the most important socioeconomic factor associated with its presence.

Introduction

Cardiovascular diseases (CVD) are among the worst causes of morbidity and mortality both in developed countries and in the large urban centres of the developing world. Their prevalence showed a sharp increase from the second half of the last century on, with an alarming growth in the proportion of deaths caused by acute myocardial infarction and stroke (World Bank, 1993; Van Der Sande, 2001).

In Brazil, mortality data indicate that CVD are an important cause of mortality both in rural and in urban areas of the country. Between 1930 and 1994, the proportion of deaths due to CVD increased from 11·8% to 33·3%, representing now the third most important cause of hospital admissions in the country (WHO, 2005). The high prevalence of these diseases generates a growing demand for adequate health services, complicated by the fact that these are chronic health problems requiring high-cost technology, causing incapacity for work, demanding early retirement and imposing a loss of life quality for the patients. Their prevention, therefore, is certainly an important public health task, both in developed and developing countries (World Bank, 1993; Terris, 1999).

Although the main risk factors for CVD are well known (smoking, diabetes, sedentary lifestyle, hypertension, overweight and alcohol consumption), the association between these factors and socioeconomic determinants is still not well understood. The study of this association is, thus, essential for the definition of public health strategies for dealing with CVD. The present work investigated the relationship between CVD risk factors and socioeconomic characteristics using information collected from an adult population random sample.

Methods

The study analysed information from a population-based survey carried out in 1995–97 in the city of Rio de Janeiro, Brazil. Data were obtained by interview and physical examination on subjects selected by a two-stage sampling process. At the first stage, 60 census sectors were randomly selected, with probability proportional to their population size, and at the second, 34 residences were sampled from each primary sampling unit, providing 2040 households. Once a household was selected, all of its residents above 20 years of age were interviewed. Data quality was verified by means of telephone interviews that randomly re-checked answers on 5% of the questionnaires. More information on the data collection procedures can be found in Marins *et al*. (2001).

Lifestyle variables

Smoking was dichotomized into ‘smokers’ and ‘non-smokers’. Type and quantity of smoking were not considered, and ex-smokers were grouped into the ‘non-smokers’ category. *Sedentary lifestyle* considered the practice of leisure activities such as jogging and sports during the preceding month, and received the label ‘no’ if the subject reported at least one regular physical leisure activity during the preceding month, and 'yes' otherwise. *Alcohol consumption* was classified as 'lower consumption' for the subjects who reported abstinence or consumption of fourteen or fewer doses per week (two daily doses) and 'higher consumption' otherwise.

Measurement of arterial hypertension

For hypertension measurements, subjects were oriented to have an empty bladder, to rest for at least five minutes before the first measurement and not to smoke or drink coffee for the 30 minutes preceding the examination. Two measurements were performed in each subject, with an interval of at least two minutes. Measurements were made with a calibrated electronic device, with a cuff covering at least 80% of the upper-arm area. The cuff was evenly inflated to about 20 mmHg above the arterial pressure supposed for the pulse and deflated at the speed of 2–3 mm/s. The first audible sound defined the systolic arterial pressure, and its disappearance the arterial diastolic pressure. If a difference of more than 5 mmHg between the two systolic and diastolic measurements was detected, two new measurements were taken. The cut-off points for hypertension were defined as 140 mmHg for systolic pressure and/or 90 mmHg for diastolic pressure (Chobanian *et al.*, 2003).

Anthropometric variables

Anthropometric measurements were performed at the households of the subjects, and the measurement procedures, based on Lohman *et al.* (1988), were standardized during a training period. All anthropometric measurements were taken with subjects wearing light clothes. Weight measurements were made with digital scales with 100 g variation and 150 kg maximum capacity. Height was measured in centimetres with a metric tape fixed to a wall with no baseboard, while subjects stood erect with bare feet and arms along the body. Two height measurements were obtained and their mean recorded, unless a difference of 1 cm or more was identified. In this case, both measurements were repeated. Waist girth was measured at the minimum circumference between the iliac crest and the rib cage, and hip girth was measured considering the maximum width over the greater trochanters. Both were obtained twice and the measurement was repeated if the difference between the first two measurements was bigger than 1 cm (Chobanian *et al.*, 2003).

The body mass index (BMI), defined as weight (kg) divided by the height (m) squared, was calculated, and overweight was defined by the cut-off point of 25 kg/m^2. Central body fat distribution was evaluated by the waist-to-hip ratio (WHR), with cut-off points of 0·95 (males) and 0·80 (females).

Socioeconomic determinants

Subjects were classified as either slum dwellers or non-slum dwellers, according to their *residence location. Per capita income* was calculated as the total monthly income of a family divided by the number of persons in the family. This variable was dichotomized using the sample median (approximately US$200/month) as a cut-off point, with subjects receiving the value '0' when below the cut-off point, and '1' otherwise. *Level of schooling* was measured by the number of years of schooling of the subjects, and dichotomized as 'lower schooling' (no more than eight years of schooling – dichotomized as '1' for the analysis) and 'higher schooling' (more than eight years – dichotomized as '0').

Cardiovascular disease risk index (CVDRI)

An index to assess 'risk of CVD' was developed, taking into account the number of CVD risk factors identified in each subject. The CVD risk factors considered were 'high WHR', 'overweight', 'hypertension', 'sedentary lifestyle', 'smoking' and 'higher alcohol consumption'. In order to allow for the development of logistic regression models from the data, this variable was dichotomized. Thus, subjects who had two or more of these factors were considered 'in risk' and had the value '1' assigned to their cardiovascular disease risk index. Conversely, subjects who had zero or one of the factors were defined as 'low risk' and were assigned the value '0'.

Data analysis

The association between the CVDRI and the independent variables age (in years), residence location, level of schooling and *per capita* income was analysed through multiple logistic regression models built separately for males and females (Hosmer & Lemeshow, 2000). At first, all independent variables were included in a model. Secondly, final models were obtained by retaining only the variables with p values below 0·25 in the first stage. The SPSS software version 10 was used for data manipulation and model estimation.

Results

From the 2040 residences at first selected, 1668 agreed to participate in the study, with a non-response rate of 18·2% (323 subjects refused to participate and 49 residences were closed or otherwise inaccessible). The original sample consisted of 3997 adults over 20 years of age; of these 3279 (82%) had complete data on anthropometric and blood pressure measurements.

Table 1 describes the sample distribution of the variables. In the studied population, 42·2% of the males and 65·4% of the females were classified in the 'risk of CVD' category. The prevalence of high WHR was 21·4% among males and 49·4% among females, and the prevalence of overweight 43·9% in males and 43·2% in females.

Table 2 presents the results of the logistic regression models, with the model-adjusted OR and their respective 95% confidence intervals. For males, the variables retained as predictors of CVDRI were age (OR 1·01, 95% CI 1·00–1·01), level of schooling (OR 1·77, 95% CI 1·39–2·26) and *per capita* income (OR 0·77, 95% CI 0·61–0·97). For females, these were age (OR 1·02, 95% CI 1·01–1·02) and level of schooling (OR 2·26, 95% CI 1·84–2·77).

Table 1. Sample distribution of study variables, city of Rio de Janeiro, 1995–97

Variable	Males		Females	
	n	(%)	*n*	(%)
Total number of subjects	1413		1866	
Body mass index				
>25	621	(43·9)	807	(43·2)
Waist–hip ratio				
Elevated	303	(21·4)	921	(49·4)
Age				
≥45 years	579	(41·0)	891	(43·9)
Level of schooling				
Lower (≤8 years)	530	(37·5)	809	(43·4)
Residence area				
Slum	368	(26·0)	501	(26·8)
Per capita monthly income				
<US$200	673	(47·6)	921	(49·4)
Smoking				
Smoker	434	(30·7)	439	(23·5)
Alcohol consumption				
≥14 weekly doses	93	(6·6)	115	(6·2)
Hypertension				
Yes	145	(10·3)	224	(12·0)
Sedentary lifestyle				
Yes	963	(68·2)	1347	(72·2)
Risk score distribution				
0	235	(16·6)	205	(11·0)
1	652	(46·1)	700	(37·5)
2	401	(28·4)	676	(36·2)
3	109	(7·7)	261	(14·0)
4	16	(1·1)	24	(1·3)
Subjects at risk (>1 risk factor)	596	(42·2)	1220	(65·4)

Discussion

Risk factors associated with CVD are usually classified as ‘constitutional’, such as age and gender; ‘behavioural’, such as smoking, alcohol use, sedentary lifestyle and diet, and ‘metabolic’ (for example, overweight, which results from an interaction of constitutional and behavioural factors) (Aubert *et al*., 1998). Public health interventions, of course, should be concerned with the factors pertaining to the second of these groups.

This work analysed the relation among socioeconomic status indicators and a risk index for cardiovascular disease. With this aim, a global indicator of cardiovascular risk was built, taking into account information on well known risk factors (smoking, hypertension, higher alcohol consumption, sedentary lifestyle, central body fat and

Table 2. Risk predictors of CVD according to logistic regression models for males and females: adjusted odds ratios and 95% confidence intervals, city of Rio de Janeiro, 1996. All models with χ^2 p values<0·001 (p values rounded to three decimal places)

Retained variables	Beta	p values	OR (95% CI)
Males			
Age	0·007	0·050	1·01 (1·00–1·01)
≥45 years			
Level of schooling			
Lower (≤8 years)	0·576	0·000	1·77 (1·39–2·26)
Per capita monthly income			
<US$200/month	− 0·253	0·031	0·77 (0·61–0·97)
Females			
Age			
≥45 years	0·017	0·000	1·02 (1·01–1·02)
Level of schooling			
Lower (≤8 years)	0·816	0·000	2·26 (1·84–2·77)

overweight). The socioeconomic factors residence location, level of schooling and *per capita* income were used as independent variables and controlled by two already well accepted constitutional factors: age and gender (Helmert *et al.*, 1990; Wing *et al.*, 1992; Aubert *et al.*, 1998; Cicera *et al.*, 1998; Lloyd-Jones *et al.*, 1999; Narváez *et al.*, 2001).

Sedentarism was used as one of the components of the CVD risk index. Although the degree of physical exercise actually present in a group of subjects is usually difficult to ascertain, many studies have identified exercise as an important and independent predictor of CVD, demanding specific medical attention (USDHHS, 1996; Grundy, 1999; Grundy *et al.*, 1999). The cut-off point for alcohol consumption was defined as two drinks per day, as consumption above this level has been associated with an increased risk of stroke (Mukamal, 2005).

It is accepted that, over the course of a lifetime, even the presence of one single risk factor for CVD should already be considered a health concern (Greenlund *et al.*, 1998; Wilson *et al.*, 1998). However, the present work chose to define 'risk of CVD' as the presence of at least two risk factors, since its aim was not to predict mortality, but, rather, to select population groups that are potential targets of feasible primary prevention strategies. A large fraction of the studied population was considered to be at 'risk' by the indicator used. This is an extremely serious concern, since, as said, subjects were only considered to be in this category when they had at least two of the previously discussed risk factors. In fact, close to 90% of the studied population had at least one of those factors.

In the present study, the BMI was used for the assessment of the subjects' overweight and the WHR was used in the estimation of central body fat, since a large number of studies point to a direct relation between central body fat and cardiovascular disease (Must *et al.*, 1999). The widely used cut-off point of 25 was used to define BMI overweight (WHO, 1995). The fraction of subjects classified as overweight was found to be very high (43·9% for males and 43·2% for females), which is similar to the findings of surveys in other countries, for instance the United States and countries in Europe (Hill & Peters, 1998; Flegal *et al*., 1998; Bonow & Eckel, 2003).

The present study found that 11% of the sample subjects were hypertensive, 27% were smokers, 70% were sedentary and 43% were (BMI) overweight. Few population-based studies in developing countries have tried to ascertain these proportions with comparable methods, but, in Mexico, a sample survey-based study found that 30·1% of the population were hypertensive, 36·6% smoked and 24·4% were overweight (Velázquez-Monroy *et al*., 2003). In the largest city of Pakistan, a recent study detected that 22% of the subjects were hypertensive, 20% smoked and that 65% were sedentary (Dodani *et al*., 2004).

The most interesting finding of the present study was the strong and inverse connection between educational levels and the CVD risk index. This association has already been found in other studies, e.g. in Germany, Spain, Finland, England, Sweden and the USA (Helmert *et al*., 1990; Cicera *et al*., 1990; Myllykangas *et al*., 1995; Morris *et al.*, 1996; Wamala *et al*., 1999; Diez-Roux *et al*., 1999). However, although many studies have addressed this subject in developed countries, few have detected this effect in metropolitan populations of less developed countries. This finding has a very positive characteristic, since it may be supposed that it is easier to change the educational level of a population than its income levels. Similarly, diet and other behavioural characteristics surely are amenable to change through educational programmes or by changes in the educational status of a subject.

It was also found that, for males, an inverse association existed between *per capita* income and the CVDRI, while, for females, this relationship was apparently absent. The association between income and cardiovascular risk is still not clear, although some reports also show an inverse association between income and cardiovascular risk factors (Kaplan & Keil, 1988). A possible explanation for the inverse association is that lower income groups consume a more traditional diet, which has been shown to have an important association with BMI (Sichieri, 2002).

In conclusion, the present work found a high prevalence of cardiovascular disease risk factors in the studied population, highlighting the importance of examining socioeconomic determinants of cardiovascular risk in developing countries. The findings indicate that cardiovascular disease risk is already an alarming problem in the urban populations of developing countries, and that educational levels are the clearest factor associated with its presence.

References

Aubert, L., Bovet, P., Gervasoni, J., Rwebogora, A., Waeber, B. & Paccaud, F. (1998) Knowledge attitudes and practices on hypertension in a country in epidemiological transition. *Hypertension* **31**, 1136–1145.

Bonow, R. O. & Eckel, R. H. (2003) Diet, obesity, and cardiovascular risk. *New England Journal of Medicine* **348**, 21.

Chobanian, A. V., Barkis, G. L., Black, H. R., Cushmam, W. C., Green, L. A., Izzo, J. I. *et al.* (2003) The seventh report of the joint national committee on prevention, detection, evaluation and treatment of high blood pressure. *Journal of the American Medical Association* **289**, 2560–2571.

Cicera, L., Torno, T., Chirlaque, M. D. & Navarro, C. (1998) Cardiovascular risk factors and educational attainment in Southern Spain: A study of a random sample of 3091 adults. *European Journal of Epidemiology* **14**, 755–765.

Diez-Roux, A., Horthridge, M. E., Morabia, A., Basset, M. & Shea, S. (1999) Prevalence and social correlates of cardiovascular disease risk factors in Harlem. *American Journal of Public Health* **89**, 302–307.

Dodani, S., Mistry, R., Farooqi, M., Khwaja, A., Qureshi, R. & Kasmi, K. (2004) Prevalence and awareness of risk factors and behaviors of coronary heart disease in a urban population of Karachi, the largest city of Pakistan: a community survey. *Journal of Public Health* **26**(3), 245–249.

Flegal, K. M., Carrol, M. D., Kuczmarski, R. J. & Johnson, C. L. (1998) Overweight and obesity in the United States: prevalence and trends 1960–1994. *International Journal of Obesity* **22**, 39–47.

Greenlund, K., Kiefe, C. I., Gidding, S. S., Lewis, C. E., Srinivasan, S. R., Williams, D. & Berenson G. S. (1998) Differences in cardiovascular disease risk factors in black and white young adults: comparison among five communities of the CARDIA and Bogalusa Heart Studies. *Annals of Epidemiology* **8**(1), 22–30.

Grundy, S. M. (1999) Primary prevention of coronary heart disease: integrating risk assessment with intervention. *Circulation* **100**(9), 988–998.

Grundy, S. M., Pasternak, R., Greenland, P., Smith Jr, S. & Fuster, V. (1999) Assessment of cardiovascular risk by use of multiple-risk-factor assessment equations: a statement for healthcare professionals from the American Heart Association and the American College of Cardiology. *Circulation* **100**(13), 1481–1492.

Helmert, U., Shea, S., Herman, B. & Greiser, E. (1990) Relationship of social class characteristics and risk factors for coronary heart disease in West Germany. *Public Health* **104**, 399–416.

Hill, J. O. & Peters, J. C. (1998) Environmental contributions to the obesity epidemic. *Science* **280**, 1371–1374.

Hosmer, D. W. & Lemeshow, S. (2000) *Applied Logistic Regression – Second Edition.* New York John Wiley & Sons.

Kaplan, G. & Keil, J. E. (1993) Social factors and cardiovascular disease: review of the literature. *Circulation* **88**, 1973–1988.

Lloyd-Jones, D. M., Evans, J. C., Larson, M. G., O'Donnell, C. J. & Levy, D. (1999) Differential impact of systolic and diastolic blood pressure level on JNC-VI staging. *Hypertension* **34**, 381–385.

Lohman, T. G., Roche, F. & Martorell, R. (1988) *Anthropometric Standardization Reference Manual.* Human Kinetics Books, Illinois, USA.

Marins, V. M. R., Almeida, R. M. R., Pereira, R. A. & Barros, M. B. A. (2001) Factors associated with overweight and central body fat in the city of Rio de Janeiro: results of a two-stage random sampling survey. *Public Health* **115**, 236–242.

Morris, J. N., Blane, D. B. & White, I. R. (1996) Levels of mortality, education and social conditions in the local education authority areas of England. *Journal of Epidemiology and Community Health* **50**, 15–17.

Mukamal, K. J., Ascherio, A., Mittleman, M. A., Conigrave, K. M., Canergo, C. A., Kawachi, I. *et al.* (2005) Alcohol and risk for ischemic stroke in men: the role of drinking patterns and usual beverage. *Annals of Internal Medicine* **142**(1), 11–19.

Must, A., Spadano, J. & Coakley, E. H. (1999) The disease burden associated with overweight and obesity. *Journal of the American Medical Association* **282**(16), 1523–1529.

Myllykangas, M., Pekkanen, J., Rasi, V., Haukkala, A. A., Vahtera, E. & Salomaa, V. (1995) Haemostatic and other cardiovascular risk factors and socioeconomic status among middle-age Finnish men and women. *International Journal of Epidemiology* **24**(6), 1110–1116.

Narváez, I., Lafuente, J. S., Saéz, Y., Lafuente, J. & Iriarte, J. A. (2001) Arterial hypertension as a cardiovascular risk factor in an elderly community of low social condition. *Journal of Clinical and Basic Cardiology* **4**, 225–227.

Sichieri, R. (2002) Dietary patterns and their associations with obesity in Brazilian city of Rio de Janeiro. *Obesity Research* **10**, 42–49.

Terris, M. (1999) The development and prevention of cardiovascular disease risk factors: socio environmental influences. *Preventive Medicine* **29**, S11–17.

USDHHS (US Department of Health and Human Services) (1996) *Physical Activity and Health: A Report of the Surgeon General*. Department of Health and Human Services – CDC – National Center for Chronic Disease Prevention and Health Promotion, Atlanta, GA, USA.

Van Der Sande, M. A. B., Walraven, G. E., Milligan, P. J., Banya, W. A., Ceesay, S. M., Nyan, O. A. & McAdam, K. P. (2001) Family history: an opportunity for early interventions and improved control of hypertension obesity and diabetes. *Bulletin of the World Health Organization* **79**(4), 321–328.

Velázquez-Monroy, O., Rosas-Peralta, M., Lara-Esqueda, A., Pastelín-Hernández, G., Sánchez-Castillo, C., Attie, F. & Tapia-Conyer, R. (2003) Prevalencia y interrelación de enfermedadas crónicas no transmisibles y factores de riesgo cardiovascular en Mexico. *Archivos de Cardiología de Mexico* **73**(1), 62–77.

Wamala, P., Mitleman, M. A., Schenck-Gustafsson, K. & Orth-Gomér, K. (1999) Potential explanations for educational gradient in coronary heart disease: a population-based case-control study of Swedish women. *American Journal of Public Health* **89**(3), 315–321.

WHO (1995) *Physical Status: The Use and Interpretation of Anthropometry: Report of a WHO Expert Committee.* WHO Technical Report Series 854. WHO, Geneva.

WHO (2005) *WHO Statistical Information System*. Table 1: Numbers of deaths and death rates: Brazil, 2001. URL: http://www3.who.int/whosis (accessed 15th January 2005).

Wilson, P. W. F., D'Agostino, R. B., Levy, D., Belanger, A. M., Silbeshatz, H. & Kannel, W. B. (1998) Prediction of coronary heart disease using risk factor categories. *Circulation* **97**, 1837–1847.

Wing, R., Jeffery, R. W., Burton, L. R., Thorson, C., Kuller, L. H. & Folson, A. R. (1992) Change in waist-hip ratio with weight loss and its association with change cardiovascular risk factors. *American Journal of Clinical Nutrition* **55**, 1086–1092.

World Bank (1993) *World Development Report 1993: Investing in Health.* Oxford University Press, New York.