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Socioeconomic status and cardiovascular risk factors in young adults: a cross-sectional analysis of a Brazilian birth cohort

Situação socioeconômica e fatores de risco cardiovascular em jovens: uma análise transversal de uma coorte de nascimentos brasileira

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ABSTRACT: ***Introduction:*** In high-income countries, persons of high socioeconomic status (SES) have a lower cardiovascular risk. However, in middle and low-income countries, the results are controversial. ***Objective:*** To evaluate the association between family income and cardiovascular risk factors in young adults. ***Methods:*** A total of 2,063 individuals of a birth cohort initiated in 1978/79 in the city of Ribeirão Preto, Brazil, were evaluated at age of 23/25 years. Cardiovascular risk factors (hypertension, sedentary lifestyle, smoking, low high-density lipoprotein (HDL)-cholesterol, high low-density lipoprotein (LDL)-cholesterol, high fibrinogen, insulin resistance, diabetes, abdominal and total obesity, and metabolic syndrome) were evaluated according to family income. Income was assessed in multiples of the minimum wage. Simple Poisson regression models were used to estimate the prevalence ratios (PR) with robust estimation of the variance. ***Results:*** High-income women showed lower prevalences of low HDL-cholesterol (PR = 0.47), total obesity (PR = 0.22), abdominal obesity (PR = 0.28), high blood pressure (PR = 0.28), insulin resistance (PR = 0.57), sedentary lifestyle (PR = 0.47), metabolic syndrome (PR = 0.24), and high caloric intake (PR = 0.71) ($p < 0.05$). High-income men showed lower prevalences of low HDL-cholesterol (PR = 0.73) and sedentarism (PR = 0.81) ($p < 0.05$). These results may be explained by the fact that high-income women pay more attention to healthy habits and those with the lowest family income are least likely to access health services resources and treatments. ***Conclusion:*** Women were in the final phase of the epidemiologic transition, whereas men were in the middle phase.

Keywords: Risk factors. Cardiovascular diseases. Young adult. Income.

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RESUMO: ***Introdução:*** Em países de alta renda, indivíduos de situação socioeconômica elevada apresentam menor risco cardiovascular. Em países de média e baixa rendas, os resultados são controversos. ***Objetivo:*** Avaliar a associação entre renda familiar e fatores de risco cardiovascular em adultos jovens. ***Metodologia:*** Estudo seccional em que foram avaliados 2.063 indivíduos aos 23/25 anos de uma coorte de nascimento iniciada em 1978/79 na cidade de Ribeirão Preto, Brasil. Avaliaram-se fatores de risco cardiovascular (hipertensão arterial, sedentarismo, tabagismo, HDL — colesterol baixo, LDL — colesterol elevado, fibrinogênio alto, resistência insulínica, diabetes, obesidade abdominal e total e síndrome metabólica) de acordo com renda familiar. A renda foi avaliada em múltiplos do salário mínimo. As razões de prevalências (RP) foram estimadas em modelos de regressão de *Poisson* simples, com estimativa robusta da variância. ***Resultados:*** Mulheres de maior renda apresentaram menores prevalências de HDL — colesterol baixo (RP = 0,47), obesidade total (RP = 0,22) e abdominal (RP = 0,28), resistência insulínica (RP = 0,57), pressão arterial elevada (RP = 0,28), sedentarismo (RP = 0,47), síndrome metabólica (RP = 0,24) e alta ingestão calórica (RP = 0,71) ($p < 0,05$). Os homens de maior renda apresentaram menores prevalências de HDL — colesterol baixo (RP = 0,73) e sedentarismo (RP = 0,81) ($p < 0,05$). Pode ser que mulheres de alta renda prestem mais atenção aos hábitos saudáveis e aquelas com menor renda têm menor probabilidade de acessar recursos e tratamentos de serviços de saúde. ***Conclusão:*** As mulheres encontravam-se na fase final da transição epidemiológica, enquanto os homens, na fase intermediária.

Palavras-chave: Fatores de risco. Doenças cardiovasculares. Adulto jovem. Renda.

INTRODUCTION

Cardiovascular diseases currently represent a serious public health problem worldwide, being the main cause of morbidity and premature mortality. By 2025, more than 80% of all cases of cardiovascular diseases and diabetes are expected to occur in middle and low-income countries[1]. Cardiovascular risk factors (CRF) are conditions associated with early onset cardiovascular disease. Some of these risks are not amenable to change, such as sex, age and heredity; others may be changed, such as smoking, hypertension, dyslipidemia, obesity, diabetes mellitus/carbohydrate intolerance, sedentarism, psychosocial stress and some factors related to hemostasis, inflammation and thrombosis, recently considered to be CRF[2].

Socioeconomic status (SES) is defined as the position a person occupies in the society to which he/she belongs, measured according to income, occupation and/or education. Some studies have demonstrated an association between SES and CRF[3,4]. Researches conducted in high-income countries have demonstrated that high-income persons have a lower cardiovascular risk, whereas low-income ones present a higher cardiovascular risk. These differences in cardiovascular risk factors between the wealthy and the poor are attributed to the epidemiologic transition[4-6].

The epidemiologic transition that started in the past century in high-income countries seems to be characterized, in its initial phase, by a worse cardiovascular risk in the high-income groups of the population. In its intermediate phase, this difference seems to disappear due to a worsening of cardiovascular risk in poorer persons, while wealthier persons would continue to have an unchanged and unfavorable cardiovascular risk. In the final phase of this transition, there seems to be an inversion in the relation between income and cardiovascular risk that would lead to a lower cardiovascular risk in the wealthier population and a higher one in the poorer population[7,8].

Studies conducted in middle-income countries, in addition to being scarce, have reported controversial results. One research demonstrated a higher cardiovascular risk among high-income persons[9], while another concluded that the cardiovascular risk was lower among wealthier people[10]. It is still unknown whether the inversion of the association between SES and CRF observed in high-income countries has already occurred in middle-income countries[11].

The objective of the present study was to determine whether high-income persons have a lower cardiovascular risk than low-income ones from a birth cohort re-assessed at 23 to 25 years of age in Ribeirão Preto, Brazil. The question was: had the epidemiologic transition been concluded or was it still in its intermediate phase in the city of Ribeirão Preto, in 2002-04?

METHODS

STUDY DESIGN

The present investigation was a cross-sectional study based on data from a birth cohort started in Ribeirão Preto, Brazil, in 1978/79. This cohort is entitled "Perinatal Health in Ribeirão Preto, São Paulo, Brazil", and included liveborn singletons delivered at hospitals by mothers residing in the municipality, from June 1st, 1978 to May 31st, 1979. The persons who participated in the first phase of the research were evaluated at other times, i.e., at school age when they were 8 to 11 years old, at the time of the military draft, and at the age of 23 to 25 years. This study used data collected at young adult age from April 2, 2002 to May 12, 2004.

SAMPLE

A total of 9,067 mothers of liveborns were first interviewed in 1978/79, representing 98% of the total number of liveborns in Ribeirão Preto during the study period. Children whose mothers did not reside in the city (2,094) and twins (146) were excluded. Thus, 6,827 liveborns were included in the first phase. A new evaluation was performed from 2002 to 2004 when the subjects were 23 to 25 years old. The following procedures were used to locate the cohort subjects: search of the addresses in the original birth charts, enrollment in schools, inscriptions in health plans and in the Unified Health system, military service, and search in the telephone list.

The survey revealed that 343 subjects had died and 819 were not identified, with 5,665 subjects thus having been located. This group was submitted to systematic selection, with the first of each three names being selected according to birth date and geographic region of the city. If the selected subject was not available, the next name down on the list was chosen. 705 subjects were lost to follow-up, due to the following reasons: refusal to participate (209), detention (31), death after 20 years of age (34), or failure to attend the interview (431). The losses were replaced using the same systematic selection, resulting in 2,063 subjects. In addition, 151 young adults were excluded because no information was available about their family income. Thus, the final sample for the present study consisted of 1,912 young adults.

POWER ANALYSIS

For this study, the power was 86.9% to detect a 10% difference in the prevalences between the compared groups for prevalences that were around 50%. The study power was 82.8% to detect a 5% difference between the groups for prevalences around 10%, assuming a 0.05 significance level.

STUDY VARIABLES

The family income of the young adults was determined using a question about this topic during the month preceding data collection. All sources of family income were considered: salaries, investment money, property income, donations by relatives, and any others. The variable family income did not consider the number of family members. The absolute values of this income were calculated as multiples of the Brazilian minimum wage (MW) for each period (R$ 260.00 in 2004), and income groups were categorized as less than 5 MW, 5 to 9.9 MW, 10 to 19.9 MW, and 20 MW or more.

The participants were submitted to physical examination and to blood collection performed by a doctor and a trained practical nurse. A 40 mL blood sample was obtained aseptically from the cubital vein after a fast of at least 12 hours for the determination of fasting glycemia and total cholesterol and fractions. University Hospital, Faculty of Medicine of Ribeirão Preto, Universidade de São Paulo The samples were processed and analyzed in the laboratories of the HCFMRP-USP, by the enzymatic colorimetric method using a Dade Behring Xpand instrument (Dade Behring®, Liederbach, Germany) and Dade Behring Dimension (Liederbach, Germany) chemical reagents.Fasting plasma insulin and glucose were used to estimate insulin resistance (HOMA 1 — insulin resistance = fasting plasma glycemia x fasting plasma insulin/22.5, available at http://www.dtu.ox.ac.uk/index.php?maindoc=/homa/)[12].

Blood pressure was measured three times[13] using a digital sphignomanometer adjusted to arm circumference The same evaluator made the measurements at 15-minute intervals, with the subject sitting and holding his left arm at the height of the heart. The mean value of the last two measurements was considered for analysis.

For the physical examination, the participants wore light clothing and were barefoot. Weight was measured with a mechanical scale (Filizola®, Brazil) calibrated before each weighing, with 50 g precision. Height was measured with a Harpenden model wood stadiometer with 0.1 cm precision, with the subject standing up.

Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2). Waist circumference (WC) was measured with an inextensible metric tape positioned on the smallest circumference between the iliac crest and the last rib. This measurement was performed at the end of a normal expiration, with the subject standing up with a relaxed abdomen.

Total daily caloric intake (in kcal) and percent ingested fat (%) were calculated with the DietSys software, version 4.0 (National Cancer Institute, Bethesda, MD, USA), based on information obtained with a food frequency questionnaire validated for the Brazilian population[14]. Physical activity was determined using the short version of the International Physical Activity Questionnaire[15]. Smoking habit during the last 30 days was also obtained with a questionnaire.

The following variables were determined: Homeostatic Model Assessment of Insulin Resistance (HOMA IR — ≤ 2.15, normal or > 2.15, high[16]), total cholesterol (< 240 mg/dL, normal or ≥ 240 mg/dL, high), low-density lipoprotein (LDL)-cholesterol (< 160 mg/dL, normal or ≥ 160 mg/dL, high), high-density lipoprotein (HDL)-cholesterol (< 50 mg/dL, low or ≥ 50 mg/dL, normal for women, < 40 mg/dL, low or ≥ 40 mg/dL, normal for men), triglycerides (< 150 mg/dL, normal or ≥ 150 mg/dL, high), fibrinogen (≤ 3.7 mg/dL, normal or > 3,7 mg/dL, high), diabetes (fasting glycemia > 126 mg/dL or use of a glycemia-lowering drug, or medical diagnosis), high blood pressure (systolic blood pressure ≥ 130 mm Hg, or diastolic blood pressure ≥ 85 mmHg), waist circumference (high when ≥ 90 cm for men or ≥ 85 cm for women), excessive caloric intake (> 2,900 kcal for men or > 2200 kcal for women)[17], smoking (no or yes), practicing physical activity (sedentary or non-sedentary), and total obesity when BMI was ≥ 30 kg/m^2.

The criteria of the Joint Interim Statement (JIS) were used to classify the metabolic syndrome (MS)[18]. The JIS considers MS to be present when three or more of the following five factors were detected: abdominal obesity when WC is ≥ 90 cm for men and ≥ 80 cm for women, hypertriglyceridemia (≥ 150 mg/dL), low HDL-cholesterol levels (< 40 mg/dL for men and < 50 mg/dL for women), systemic arterial hypertension (blood pressure ≥ 130/85 mmHg or the use of an antihypertensive drug), and high fasting glycemia (≥ 100 mg/dL).

The Framingham score was applied in order to determine the risk of death due to coronary disease. The Framingham risk equation was computed as the probability of developing a coronary event within 10 years according to sex, based on the following parameters: age, total cholesterol, HDL-cholesterol, smoking, systolic arterial pressure, diastolic arterial pressure, and diabetes. The risk of death due to coronary disease is low when less than 10%, moderate from 10 to 20% and high when more than 20%[19]. This score was used as a continuous variable.

STATISTICAL ANALYSIS

The data were weighted because of differential sampling losses at 23 to 25 years. Inverse probability of selection weighting was estimated by logistic regression based on birth weight, parity, preterm birth, marital status, maternal smoking, maternal age, maternal schooling, family income, and maternal occupation. Groups with lower follow-up rates were given greater weights, whereas the ones with higher participation rates were given smaller weights trying to recreate the original composition of the cohort at birth.

The independent variable was family income and the dependent ones were the cardiovascular risk factors. To determine the associations between family income and the cardiovascular risk factors, the χ^2 test was applied to the categorical variables and analysis of variance (ANOVA) or the Kruskal-Wallis test was applied to the numerical variables. P value for trend was also calculated for all cardiovascular risk factors.

Simple Poisson regressions with robust estimation of standard errors were performed to determine the association between family income and cardiovascular risk factors, with the level of significance set at 0.05. No adjustment for confounding was performed, since socioeconomic factors are distal factors in the theoretical model. Because we wanted to estimate the total effect, it would not make sense to adjust for mediators. We also did not adjust for age because the subjects were in a narrow age range (23 to 25 years). All analyses were stratified by sex, giving that a previous study conducted on the same sample had indicated that the associations between family income and adiposity varied between sexes[20]. The STATA® 14.0 software (College Station, TX, USA) was used for the analyses.

ETHICAL AND LEGAL ASPECTS

The study was approved by the Research Ethics committee of HCFMRP-USP (protocol No. 7606/99, on February 7, 2000), and all subjects gave written informed consent to participate.

RESULTS

When comparing the cardiovascular risk factors according to sex, women showed higher prevalences of diabetes (2.5%), low HDL-cholesterol (45.1%), high fibrinogen (15.5%), high caloric intake (25.3%), smoking (20.9%), and sedentarism (54.3%), whereas men presented higher prevalences of high HOMA IR (22.5%), high triglycerides (16.3%), high blood pressure (40.8%), and metabolic syndrome (17.8%). In addition, the Framingham score was higher among men (1.03%) compared to women (0.53) (Table 1).

The young adult women belonging to the low family income group had higher prevalences of insulin resistance (HOMA IR index — 19.8%; p = 0.039), low HDL-cholesterol (52.6%; p < 0.001), total obesity (14.6%; p = 0.003), abdominal obesity (18.5%; p < 0.001), MS (7.7%, p = 0.021), and high caloric intake (27.4%; p = 0.023), as well as a higher prevalence of sedentarism (58.5%; p < 0.001). The median cardiovascular risk measured by the Framingham score was low (0.46%), but higher (0.47%; p = 0.002) among low-income women compared to all others (Table 2).

Low-income young adult men had a higher prevalence of low HDL-cholesterol (40.3%; p = 0.023) and sedentarism (32.6%; p = 0.044) (Table 2). The Framingham score was very low for all groups (median: 0.86%) (Table 3).

In the Poisson regression models, the young adult women and men belonging to the low-income group were used as reference. High-income women had lower prevalences of insulin resistance (HOMA IR, PR = 0.57; p = 0.009), low HDL-cholesterol (PR = 0.47;

Table 1. Cardiovascular risk factors according to sex in Ribeirão Preto, 2002–2004.

Cardiovascular risk factors	Men	Women	p-value
	% (n)	% (n)	
High HOMA IR	22.5 (79)	17.6 (63)	0.007
Diabetes	1.3 (4)	2.5 (4)	0.048
High LDL-cholesterol	6.1 (17)	4.7 (18)	0.189
Low HDL-cholesterol	38.7 (128)	45.1 (132)	0.005
High total cholesterol	4.0 (11)	4.9 (16)	0.286
High triglycerides	16.3 (51)	11.0 (41)	0.001
High fibrinogen	5.2 (19)	15.5 (15)	0.001
High blood pressure	40.8 (30)	6.3 (16)	0.001
Total obesity	13.2 (47)	11.4 (43)	0.245
Abdominal obesity	11.5 (40)	14.2 (36)	0.090
Metabolic syndrome	17.8 (56)	5.9 (50)	0.001
High caloric intake	18.7 (62)	25.3 (43)	0.001
High fat consumption	84.9 (260)	86.3 (254)	0.460
Smoking	15.0 (63)	20.9 (52)	0.001
Sedentarism	28.9 (302)	54.3 (76)	0.001
Framingham score*	1.03(0.69)	0.53(0.34)	0.001

HOMA IR: Homeostatic Model Assessment of Insulin Resistance; LDL: low-density lipoprotein; HDL: high-density lipoprotein; *continuous variable expressed as median and interquartile range.

p < 0.001), high blood pressure (PR = 0.28; p = 0.011), total obesity (PR = 0.22; p < 0.001), abdominal obesity (PR = 0.28; p < 0.001 MS (PR = 0.24; p = 0.001), high caloric intake (PR = 0.71; p = 0.008), and sedentarism (PR = 0.47; p < 0.001) (Table 4).

High-income young adult men had lower prevalences of low HDL-cholesterol (PR = .73; p = 0.026) and sedentarism (PR = 0.81; p = 0.029) (Table 5).

DISCUSSION

The present study investigated the associations between family income and cardiovascular risk factors among young adults participating in a cohort study in the city of Ribeirão

Table 2. Cardiovascular risk factors according to family income level in minimum wages among women from Ribeirão Preto, in 2002–2004.

Cardiovascular risk factors	Family income (minimum wages)				p-value
	< 5 n = 379	≥ 5 and ≤ 9.9 n = 343	> 10 and ≤ 19.9 n = 177	≥ 20 n = 79	
	% (n)	% (n)	% (n)	% (n)	
High HOMA IR	19.8 (81)	16.5 (60)	11.6 (22)	11.4 (9)	0.039
Diabetes	2.4 (9)	1.6 (7)	2.7 (5)	3.0 (2)	0.787
High LDL-cholesterol	5.8 (22)	2.9 (9)	4.6 (8)	3.2 (2)	0. 250
Low HDL-cholesterol	52.6 (198)	44.5 (151)	30.8 (54)	24.7 (22)	< 0.001
High total cholesterol	4.2 (16)	3.8 (14)	7.2 (12)	5.8 (4)	0.333
High triglycerides	10.5 (42)	10.7 (36)	12.0 (22)	16.5 (13)	0.499
High fibrinogen	16.1 (63)	16.7 (59)	13.9 (25)	13.4 (11)	0.798
High blood pressure	7.9 (31)	6.1 (22)	3.5 (7)	2.2 (1)	0.086
Total obesity	14.6 (61)	10.6 (36)	6.5 (12)	3.3 (3)	0.003
Abdominal obesity	18.5 (73)	14.2 (48)	6.9 (13)	5.2 (5)	< 0.001
Metabolic syndrome	7.7 (31)	7.1 (26)	1.7 (4)	1.9 (2)	0.021
High caloric intake	27.4 (106)	24.4 (80)	16.0 (29)	19.7 (17)	0.023
High fat consumption	85.5 (326)	87.1 (301)	87.9 (155)	83.3 (66)	0.734
Smoking	16.3 (54)	12.6 (40)	12.5 (22)	20.2 (16)	0.244
Sedentarism	58.5 (222)	54.0 (186)	51.8 (95)	27.6 (23)	< 0.001
Framingham score*	0.47(0.35)	0.45(0.29)	0.41(0.22)	0.45(0.24)	0.002

HOMA IR: Homeostatic Model Assessment of Insulin Resistance; LDL: low-density lipoprotein; HDL: high-density lipoprotein; *continuous variable expressed as median and interquartile range.

Preto, São Paulo, Brazil. High-income women showed a lower prevalence of insulin resistance, low HDL-cholesterol, abdominal obesity, total obesity, high blood pressure, metabolic syndrome, high caloric intake, and sedentarism. High-income men presented a lower prevalence of low HDL-cholesterol and sedentarism.

The strong points of the study were the large sample size and the use of various cardiovascular risk factors: blood pressure, lipid profile, obesity, metabolic syndrome, dietary consumption, physical activity, smoking, diabetes, and insulin resistance using the HOMA-IR model, currently accepted for the identification of insulin resistance among young people. In addition, few studies about these aspects are available in low and middle-income countries.

Among the limitations of the study is the fact that, even though this is a birth cohort study, in this analysis, only cross-sectional data were used. Another limitation was the use

Table 3. Cardiovascular risk factors according to family income level in minimum wages among men from Ribeirão Preto, in 2002–2004.

Cardiovascular risk factors	Family income (minimum wages) < 5 n = 302	≥ 5 and ≤ 9.9 n = 288	≥ 10 and ≤ 19.9 n = 227	≥ 20 n = 117	p-value
	% (n)	% (n)	% (n)	% (n)	
High HOMA IR	26.2 (79)	21.2 (63)	20.5 (47)	17.1 (21)	0.171
Diabetes	1.1 (4)	1.1 (4)	1.0 (1)	1.5 (2)	0.973
High LDL-cholesterol	4.7 (17)	5.6 (18)	5.8 (14)	10.5 (14)	0.129
Low HDL-cholesterol	40.3 (128)	44.4 (132)	33.9 (75)	29.7 (34)	0.023
High total cholesterol	3.1 (11)	4.8 (16)	3.0 (8)	4.0 (5)	0.622
High triglycerides	15.7 (51)	14.1 (41)	21.1 (48)	12.9 (16)	0.143
High fibrinogen	6.5 (19)	5.2 (15)	4.5 (10)	4.4 (6)	0.710
High blood pressure	10.1 (30)	5.5 (16)	6.2 (14)	4.3 (5)	0.233
Total obesity	15.5 (47)	14.9 (43)	10.6 (24)	8.5 (10)	0.123
Abdominal obesity	13.8 (40)	12.4 (36)	10.0 (23)	8.9 (10)	0.448
Metabolic syndrome	17.9 (56)	16.7 (50)	17.6 (41)	19.8 (23)	0.917
High caloric intake	19.4 (62)	16.4 (43)	18.0 (41)	15.0 (15)	0.684
High fat consumption	82.2 (260)	88.1 (254)	85.9 (199)	88.0 (105)	0.290
Smoking	20.9 (63)	18.4 (52)	20.0 (46)	21.4 (25)	0.863
Sedentarism	32.6 (302)	28.0 (76)	21.1 (50)	26.6 (33)	0.044
Framingham score*	0.87(0.56)	0.83(0.53)	0.85(0.62)	0.93(0.68)	0.375

HOMA IR: Homeostatic Model Assessment of Insulin Resistance; LDL: low-density lipoprotein; HDL: high-density lipoprotein; *continuous variable expressed as median and interquartile range.

of family income as the only indicator of the socioeconomic status of the subjects, without considering education. However, schooling did not have a discriminatory power since most subjects had a similar educational level (84.5% had more than 12 years of study).

Additional possible limitation could be selection bias, since subjects with a lower income at birth (25.9%) had lower participation rates ($p < 0.001$) in the follow-up than subjects with a higher income at birth (35.4%). This greater loss of data regarding income among poorer subjects may have prevented the detection of some differences or may have underestimated

Table 4. Association of cardiovascular risk factors with family income level in minimum wages among young adult women from Ribeirão Preto, in 2002–2004.

	Family income (minimum wages)				
Cardiovascular risk factors	< 5 (n = 379)	≥ 5 and ≤ 9.9 (n = 343)	≥ 10 and ≤ 19.9 (n = 177)	≥ 20 (n = 79)	p for trend
	Prevalence ratio (95% confidence interval)				
High HOMA IR	1.00	0. 83 (0.61 – 1.14)	0.58 (0.37 – 0.92)	0.57 (0.30 – 1.08)	0.009
Diabetes	1.00	0.67 (0.24 – 1.84)	1.10 (0.35 – 3.40)	1.21 (0.32 – 4.49)	0.842
High LDL-cholesterol	1.00	0.49 (0.23 – 1.05)	0.80 (0.35 – 1.83)	0.55 (0.16 – 1.85)	0.281
Low HDL-cholesterol	1.00	0.84 (0.72 – 0.99)	0.58 (0.45 – 0.75)	0.47 (0.31 – 0.69)	< 0.001
High total cholesterol	1.00	0.90 (0.43 – 1.86)	1.72 (0.80 – 3.66)	1.38 (0.50 – 3.75)	0.224
High triglycerides	1.00	1.01 (0.66 – 1.57)	1.14 (0.69 – 1.88)	1.56 (0.88 – 2.75)	0.211
High fibrinogen	1.00	1.03 (0.73 – 1.44)	0.86 (0.55 – 1.34)	0.83 (0.45 – 1.49)	0.449
High blood pressure	1.00	0.77 (0.44 – 1.32)	0.45 (0.19 – 1.01)	0.28 (0.06 – 1.19)	0.011
Total obesity	1.00	0.72 (0.48 – 1.08)	0.44 (0.24 – 0.83)	0.22 (0.07 – 0.71)	< 0.001
Abdominal obesity	1.00	0.76 (0.54 – 1.08)	0.37 (0.21 – 0.66)	0.28 (0.11 – 0.68)	< 0.001
Metabolic syndrome	1.00	0.91 (0.54 – 1.53)	0.22 (0.07 – 0.64)	0.24 (0.05 – 1.02)	0.001
High caloric intake	1.00	0.89 (0.68 – 1.15)	0.58 (0.40 – 0.85)	0.71 (0.45 – 1.13)	0.008
High fat consumption	1.00	1.01 (0.95 – 1.08)	1.02 (0.95 – 1.10)	0.97 (0.87 – 1.08)	0.875
Smoking	1.00	0.77 (0.52 – 1.14)	0.76 (0.47 – 1.23)	1.23 (0.74 – 2.05)	0.817
Sedentarism	1.00	0.92 (0.80 – 1.05)	0.88 (0.74 – 1.05)	0.47 (0.32 – 0.68)	< 0.001

HOMA IR: Homeostatic Model Assessment of Insulin Resistance; LDL: low-density lipoprotein; HDL: high-density lipoprotein.

the associations presented here. In addition, some data about family income were missing (151 observations). In the statistical analysis, inverse probability of selection weighting was performed trying to mitigate selection bias.

The present results showed that low-income women had a worse cardiovascular profile than high-income women. Seven of the 15 cardiovascular risk factors investigated were more prevalent among low-income women, who also had a worse Framingham cardiovascular

Table 5. Association of cardiovascular risk factors with family income level in minimum wages among young adult men from Ribeirão Preto, in 2002–2004.

	Family income (minimum wages)				
Cardiovascular risk factors	< 5 (n = 302)	≥ 5 and ≤ 9.9 (n = 288)	≥ 10 and ≤ 19.9 (n = 227)	≥ 20 (n = 117)	p-value for trend
Prevalence ratio (95% confidence interval)					
High HOMA IR	1.00	0.80 (0.59-1.09)	0.78 (0.56–1.08)	0.65 (0.41–1.02)	0.123
Diabetes	1.00	0.98 (0.23–4.01)	0.84 (0.15–4.60)	1.33 (0.24–7.28)	0.882
High LDL-cholesterol	1.00	1.20 (0.61–2.33)	1.24 (0.62–2.49)	2.23 (1.11–4.48)	0.054
Low HDL-cholesterol	1.00	1.10 (0.90–1.34)	0.84 (0.66–1.06)	0.73 (0.53–1.01)	0.026
High total cholesterol	1.00	1.54 (0.71–3.33)	0.96 (0.38–2.39)	1.27 (0.43–3.75)	0.845
High triglycerides	1.00	0.90 (0.60–1.34)	1.34 (0.92–1.95)	0.82 (0.47–1.41)	0.692
High fibrinogen	1.00	0.79 (0.39–1.59)	0.69 (0.32–1.46)	0.67 (0.26–1.70)	0.294
High blood pressure	1.00	1.17 (0.94–1.46)	1.16 (0.92–1.46)	1.26 (0.97–1.64)	0.071
Total obesity	1.00	0.95 (0.64–1.41)	0.68 (0.42–1.10)	0.57 (0.29- 1.12)	0.130
Abdominal obesity	1.00	0.89 (0.57–1.39)	0.72 (0.43–1.20)	0.64 (0.32–1.28)	0.120
Metabolic syndrome	1.00	0.93 (0.64–1.34)	0.98 (0.67–1.44)	1.10 (0.70–1.72)	0.754
High caloric intake	1.00	0.84 (0.58–1.21)	0.92 (0.64–1.33)	0.77 (0.46–1.28)	0.383
High fat consumption	1.00	1.07 (0.97–1.17)	1.04 (0.94–1.15)	1.07 (0.96–1.19)	0.251
Smoking	1.00	0.88 (0.62– 1.24)	0.95 (0.67–1.35)	1.02(0.67– 1.56)	0.989
Sedentarism	1.00	0.86 (0.66–1.11)	0.64 (0.47–0.88)	0.81(0.57– 1.15)	0.029

HOMA IR: Homeostatic Model Assessment of Insulin Resistance; LDL: low-density lipoprotein; HDL: high-density lipoprotein.

risk score. For men, only two of the 15 factors investigated were more prevalent among low-income subjects. In addition, there was no difference in the Framingham cardiovascular risk score among men.

Thus, it can be seen that the epidemiologic transition observed in Ribeirão Preto, a city in a middle-income country, occurred in a different manner according to sex: for women, the socioeconomic gradient of cardiovascular risk had already become inverted for almost the greatest part of the risk factors studied, suggesting that these women are already in the final phase of the epidemiologic transition. And for men, the socioeconomic gradient of cardiovascular risk became inverted only regarding two of the risk factors studied, suggesting that men are in the intermediate phase of the epidemiologic transition.

In this transition, the cardiovascular risk factors are first concentrated among high-income persons in high-income countries since these persons come in earlier contact with the "modern lifestyle". Later, some factors such as behavioral, nutritional and educational changes, access to health services and a greater practice of physical exercise lead to a reduction of these cardiovascular risk factors in the high-income population, and finally start to affect low-income persons by leading them to a worsening of their cardiovascular risk factors[7,8,21,22].

In middle-income countries, the process of epidemiologic transition started at a later time than in high-income countries. In addition, there is the fact that this transition may occur in a different manner at each location in middle-income countries, as observed in the present study in which the transition was faster and the association between income and worse cardiovascular risk was inverted only among women[9,23]. An Indian study on a population of an age similar to that of the present one detected a worsening of risk factors among their high-income subjects[9], whereas a study conducted in the United States on a Hispanic population revealed that, despite the older age of the sample, high-income was associated with a reduction of risk factors[24]. The same has been found among elderly residents in São Paulo, Brazil, where low-income groups had higher CVD risk[25].

The high-income women studied here showed a lower cardiovascular risk and completed the epidemiologic transition process before the men did. This fact may have been due to the greater concern of these women about consuming less caloric foods. Thus, their greater access to information and better financial conditions favor a healthy and balanced diet[25]. On the other hand, low-income women showed a higher caloric intake and were more sedentary, a fact that may have contributed to their higher prevalences of total obesity and abdominal obesity and of other cardiovascular risk factors[26].

The greater practice of physical activity by high-income young adult women may be explained by their greater concern about having a "pleasant and healthy body". Thus, due to their greater health awareness, they adhere better to the practice of physical activity. This may have contributed to the fact that their BMI values are lower, with consequent lower prevalences of obesity and higher HDL-cholesterol[27].

In agreement with another study, high-income women also showed lower prevalence of insulin resistance[28]. Although the prevalence of diabetes is low among young adults, the lower presence of insulin resistance favors lower odds of developing diabetes. The high-income women in the present study also showed lower prevalence of MS, which placed them in a situation similar to that encountered in higher income countries[29].

Higher income women exhibited a better cardiovascular risk profile than men belonging to the same income class, a result in agreement with a study conducted in the United States[30]. This may be explained by the fact that high-income women pay more attention to a healthy diet, to weight reduction and to physical activity, with their education possibly having positive effects of an economic and psychosocial order and protecting against adverse situations.

Kandasamy and Anand[31] pointed out that, because of the genetic and hormonal characteristics and contraceptive use, women have higher risk of increased cardiovascular risk factors and cardiovascular diseases when compared to men. In addition to these risks, these authors affirm that being a woman and having low family income induce more problems and risks, often due to an array of social and structural circumstances, such as fragmented health care, social isolation, language difficulties, violence, caregiving burden, stress at home and early childhood adversity. Besides that, those with the lowest family income are least likely to access health services resources and treatments.

CONCLUSION

Low-income women had a worse cardiovascular risk than high-income women, in agreement with the epidemiologic transition that has occurred in high-income countries. In contrast, among men, there was no difference in cardiovascular risk according to family income, suggesting that men are still in the intermediate phase of the epidemiologic transition. Although the present sample consisted of a young population, the prevalence of some cardiovascular risk factors was already high.

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