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Health in early adulthood: the contribution of the 1978/79 Ribeirão Preto birth cohort

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Abstract

The increase in non-communicable chronic diseases of adults is due to demographic changes and changes in the risk factors related to physical activity, smoking habits and nutrition. We describe the methodology for the evaluation of persons at 23/25 years of age of a cohort of individuals born in Ribeirão Preto in 1978/79. We present their socioeconomic characteristics and the profile of some risk factors for chronic diseases. A total of 2063 participants were evaluated by means of blood collection, standardized questionnaires, anthropometric and blood pressure measurements, and methacholine bronchoprovocation tests. The sexes were compared by the chi-square test, with $\alpha = 0.05$. Obesity was similar among men and women (12.8 and 11.1%); overweight was almost double in men (30.3 *vs* 17.7%). Weight deficit was higher among women than among men (8.6 and 2.6%). Women were more sedentary and consumed less alcohol and tobacco. Dietary fat consumption was similar between sexes, with 63% consuming large amounts (30 to 39.9 g/day). Metabolic syndrome was twice more frequent among men than women (10.7 *vs* 4.8%), hypertension was six times more frequent (40.9 *vs* 6.4%); altered triglyceride (16.1 *vs* 9.8%) and LDL proportions (5.4 *vs* 2.7%) were also higher in men, while women had a higher percentage of low HDL (44.7 *vs* 39.5%). Asthma and bronchial hyper-responsiveness were 1.7 and 1.5 times more frequent, respectively, among women. The high prevalence of some risk factors for chronic diseases among young adults supports the need for investments in their prevention.

Key words
- Non-communicable chronic diseases of adults
- Metabolic syndrome
- Obesity
- Arterial hypertension
  Asthma
- Dyslipidemia

Introduction

A change in the health problems and health/disease profiles of the populations is being observed in most Latin American countries. Infant mortality, infections and malnutrition have shown a marked decrease, while non-communicable chronic diseases (NCCD) have increased among adults (1). Most of the information regarding the etiology of NCCD is limited to measurable risk factors that might be operating during adult life, as indicated by the findings of classical studies on government employees, transport workers,

British physicians, and Framingham residents. These investigations are among those who first demonstrated an association between coronary disease and levels of cholesterol, blood pressure, physical activity, and smoking habits measured in middle age. This emphasis on the measurement of risk factors during adult life is partly a consequence of the difficulty in obtaining valid information about exposure during pre-adult life to risk factors for diseases typically diagnosed during middle or old age (2). This kind of approach is also employed in studies carried out in developing countries such as Brazil (3).

Recent studies have indicated that factors operating during childhood are related to adult health. Longitudinal studies with information about subsequent phases of life may be the key to the understanding of late consequences for health. Evidence is emerging which indicates that from birth cumulative exposures and experiences affect the health status of an individual at some point in life (4). Studies in which information is obtained about early life characteristics, ideally in a prospective manner, are needed in order to examine the influence that circumstances *in utero*, such as fetal nutrition, may have on the risk of disease in adult life. The studies by Barker (5) are a classical example of this approach, with a historical cohort at the beginning of the 20th century having its birth weight linked to consequent mortality due to cardiovascular diseases and cancer. Other similar examples are the cohorts of Sheffield, Uppsala, Helsinki, Reykjavik, and Copenhagen (2). Thus, longitudinal studies initiated decades ago with prospectively collected data about living conditions are of great interest.

On this basis, the thematic project "From perinatal health to the health of young adults: study of a cohort born in 1978/79 in the hospitals of Ribeirão Preto, SP", a study initiated in Brazil in the seventies, is particularly valuable because it provides information about the socioeconomic and educational trajectory of this cohort through life, as well as information about biological parameters including perinatal and childhood growth factors in a developing country. The objective of the present paper is to describe the methodological design employed in the evaluation of the follow-up of the 1978/79 livebirths, with emphasis on the most recent survey at 23 to 25 years of age, and to present the prevalence of risk factors for NCCD in this young adult population according to gender.

Subjects and Methods

This is the fourth phase of a longitudinal prospective cohort study involving subjects born in the municipality of Ribeirão Preto during the period from June 1, 1978 to May 31, 1979. The objective of the initial investigation was to analyze the behavior of some indicators of perinatal health and their associations with the social and biological variables of mothers and newborns, to measure the utilization of health services for prenatal, delivery and newborn care and to relate these data to mortality during the first year of life (6).

In the second phase, the growth (weight and height) of these children was determined at school age, between 1987 and 1989 (7) as a function of social and biological conditions at birth. In 1996/97, a third phase involved the study of the living and health conditions of the cohort at 18 years of age, including growth, as a function of the variables studied at birth (8). Since this part of the study was carried out at the time of recruitment for military service, the conclusions were limited to males.

The objective of the fourth phase of the study was to determine the relative importance of events from the prenatal period to the beginning of adult life for physical growth and for the determination of the risk profile for NCCD, with emphasis on cardiovascular

disease, asthma and allergy (5,6). Data were collected from April 2, 2002 to May 12, 2004. The effects of some intervening factors such as cigarette smoking, sedentariness and alcohol and drug consumption on the association with the risk factors mentioned above were also considered (6).

Study population

Ribeirão Preto, a city located 320 km Northeast of São Paulo, the capital city of the State of São Paulo, in the Southeast region of Brazil, had a population of 543,885 in 2005 (9) and an area of 642 km^2. There are no data about emigration rates, but emigration is estimated to be small since the city is a center of attraction of commercial activities and services, in addition to being one of the main biomedical research centers in the state and in the country. In view of these characteristics, we felt that, even if a possible participant in the study had left the city, his parents or other close relatives would be accessible and would permit us to contact the individual in question. Since more than 99% of the population lives in the urban area (9), the search was performed only in the urban zone.

Origin of the sample

During the period from June 1, 1978 to May 31, 1979, 9067 liveborn infants delivered at Ribeirão Preto hospitals (98% of the total number of liveborns for the same period) participated in the study. For the follow-up of the cohort, babies whose mothers were not from Ribeirão Preto and did not reside in this city at the time of delivery were excluded from the study. Thus, 6973 liveborns remained in the study (Figure 1), 6827 of them being singletons and 146 corresponding to twin deliveries. Of the 6827 singletons, 246 died during the first year of life and 97 died by 20 years of age, for a total of 343 deaths (10).

Calculation of the sample for the fourth phase

The calculation of the sample size was made in an attempt to permit the estimate of prevalences that are within the 50% range with a relative precision of 1.8%, and the prevalences that are about 10% with a relative precision of 1.1%, with a confidence level of 95%. Considering a 50% prevalence of the effect, the sample size should be able to detect differences between proportions of 12%, with a prevalence of exposure of 10%, and difference of 10% with a prevalence of exposure of about 20%, working with a probability of type I error of 5% and with the power of the study fixed at 80%. If the prevalence of the effect is 10%, the sample size should detect differences of 6% between proportions for a 10% prevalence of exposure and of 5% for a prevalence of exposure of 20%, with a 5% probability of type I error and a power of the study of 80%.

The sample size should also permit, in most cases, the detection of small differences between means even for variables with a high standard deviation, with a 5% probability of type I error and with a power of more than 90%. To satisfy all these assumptions the final sample size corresponded to about 30% of the eligible population (6484 at 20 years, Figure 1), corresponding to 1946 individuals. The sample size reached was 2063, which permitted, for example, in the test carried out to evaluate differences in mean body mass index (BMI) between men and women, by studying 992 men with a mean BMI of 25 and a standard deviation of 4.4, and 1064 women with a mean BMI of 23.6 and a standard deviation of 5.1, to reach a power of 99.9% for a 1% probability of type I error.

With this final sample size it was also possible to detect correlations of 0.065 or more at the 0.05 level of significance and with a power of 80%. With 1084 cases, it is possible to detect correlation coefficients of

more than 0.085 (which correspond to regression coefficients of 0.624) at the 0.05 level of significance and with 80% power, a fact that permits separate analysis by sex.

Operational procedure for obtaining the sample

On the basis of the charts of the liveborns of the original cohort, which contained the name and address of the mother and the data of birth of the child, the potential participants in this evaluation were identified. At that time, the contact and field teams were set up and trained, with a period of 6 months being reserved for subject identification and a period of 24 months for data collection, with a capacity of 4-7 daily evaluations by the service.

For the location of the participants, the following sources were used in view of the need to search for an updated address: the Hygia system of electronic scheduling of visits for users of the medical services of SUS (Unified Health System) in Ribeirão Preto, lists of users of private health plans, charts of evaluation of schoolchildren of the cohort performed in 1987-89 (7), and charts of evaluation of the military recruits belonging to the original cohort (8).

A total of 5665 individuals were located (Figure 1), with the initial contact being made with those who had a fixed or mobile phone, in view of the high distribution of telephones per inhabitant in the municipality. In addition, letters containing explanations about the objectives of the study and a telephone number reserved for the project were mailed. Other means of dissemination of the information were used, such as television, radio and newspapers, as well as the distribution of explanatory posters to public health services. Based on the geo-economic characterization of the city which is composed of four geographic regions defined by the income of the head of the family and classified as "poor", "middle-poor", "middle-rich", and "rich" (11), 1 of each 3 individuals belonging to the same geographic area was contacted. In case of a refusal or of the impossibility to participate (e.g., imprisonment, death or serious disease) or the inability to locate an individual, contact was made with the next name on the list.

In this process, 705 individuals had to be replaced because of refusal (209 cases), imprisonment (31 cases), death after 20 years of age (34 cases), and failure to appear for the interview (431 cases). Thus, 2063 young adults effectively participated in the study (Figure 1), corresponding to 31.8% of the original sample.

The project was approved by the Ethics Committee of the University Hospital, Fac-

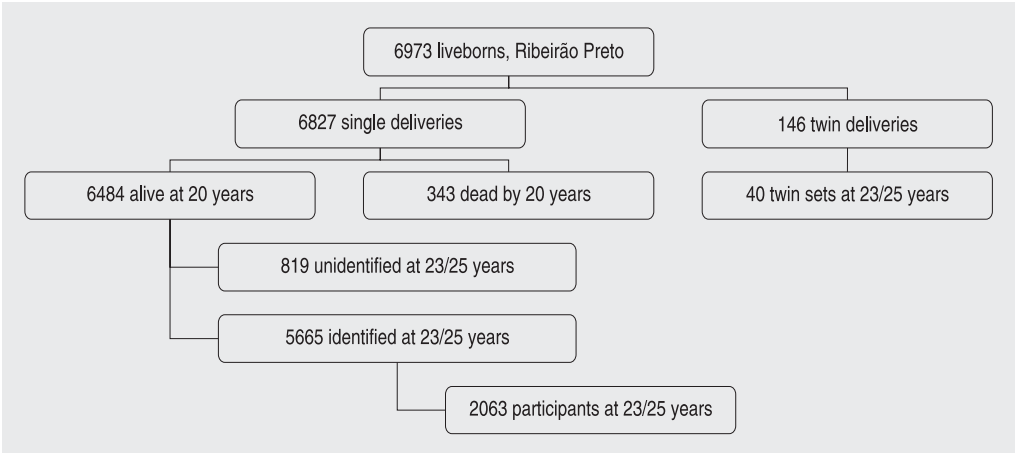

Figure 1. Some of the characteristics of liveborn individuals of the 1978/79 cohort evaluated in the fourth stage of the study at the age of 23/25 years.

ulty of Medicine of Ribeirão Preto, University of São Paulo (HCFMRP-USP). The term of consent for the participants was structured for the three phases: consent for all evaluations including blood collection, bronchial hyper-responsiveness test and allergic sensitization test; consent only for an evaluation that would not include tests, or consent to submit to at least one test. This strategy permitted us to obtain information from a larger proportion of the population since some refusals to submit to invasive procedures were assumed to occur.

Instruments used

Blood collection. A 40-mL blood sample was collected aseptically by a doctor or nursing technician after a fast of at least 12 h. Blood was collected from the cubital vein using a No. 21 scalpel, with the patient in the resting position. The sample was identified and centrifuged to obtain plasma, which was frozen and stored for analysis. All exams were processed in the laboratories of the HCFMRP-USP.

Questionnaires. Four structured questionnaires were applied according to standardized and internationally recommended techniques. The general questionnaire, to which the participants responded without interference by the team, was used to obtain information about the socioeconomic characteristics (occupation, income) (12), educational level, family history of chronic NCCD, smoking habits, and other family and environmental antecedents. Questions about the level of physical activity were asked (13). After the individual responded to this questionnaire, the responses were reviewed to identify questions not answered. The food frequency questionnaire, validated for the Brazilian population (14) and applied by a nutritionist, contained questions about alcohol consumption and the frequency of food consumption.

Symptoms of asthma, atopy, eczema, and rhinitis and environmental characteristics were obtained by means of a questionnaire containing questions of the European Community Respiratory Health Survey (15) applied by a physiotherapist. The validity and reproducibility of this questionnaire were previously tested (Vianna E, Caldeira R, unpublished data).

Physical examination. A trained doctor and a nurse technician performed anthropometric measurements - weight, height, sitting (trunk-cephalic) height, abdominal and hip circumference, and tricipital and subscapular skinfold - according to standardized techniques, with the persons barefoot and wearing light clothing (16). The instruments used were a precision scale periodically calibrated, anthropometers for standing and sitting measurements, a non-extensible metric tape and a caliper.

Blood pressure was measured three times, as reported in other epidemiological studies (17), using a digital sphygmomanometer with a cuff of the same size which was adjusted to the arm circumference. The measurements were made by the same person at 15-min intervals, with the participant resting in the sitting position with the left arm at the height of the heart. The mean of the last two measurements was then calculated.

Bronchoprovocation with methacholine and sensitization tests. The bronchoprovocation test with methacholine was applied using methacholine chloride (Sigma, St. Louis, MO, USA) diluted in phosphate-buffered saline according to international criteria (18). The procedure was carried out in the laboratory of the Pneumology Service of the HCFMRP by a trained and experienced technician, a physiotherapist, and a doctor.

Organization of the database

The questionnaires were coded and typed into a computer by trained persons according to standardized procedures. The codification was checked by the field supervisor

by sampling (10% of all the charts) to detect systematic errors during this phase of the process. Sporadic errors (<1%) within the range expected for this type of study were observed. All the information typed into the computer was checked. The questionnaire of alimentary consumption was first typed in the Diet Sys software and then the new variables generated were incorporated into the database.

The current database of the project was created in Microsoft-Access 2000. This database has 822 variables interconnected by a primary key denoted general code. All the variables included in the database were analyzed for consistency using tests ranging from simple validation rules to combination boxes with lists of predetermined possibilities for a given variable.

Variables studied

In addition to the variables related to the general characteristics of birth (sex, birth weight and length, preterm birth) and to the socioeconomic aspects of young adults (occupation and income in multiples of the Brazilian official definition of a minimum wage per month), we considered those that are relevant to the detection of cardiovascular disease (19), i.e., BMI categorized as underweight (≤18.5 kg/m^2), adequate (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obese (≥30 kg/m^2) (20); short stature, defined as values below the 3rd percentile of the reference value of the National Center for Health Statistics, with <163.3 cm as the cut-off point for males and <151.1 cm as the cut-off point for females (16,21); high blood pressure levels, corresponding to values ≥130 mmHg for systolic blood pressure and/or ≥85 mmHg for diastolic blood pressure (19); abdominal obesity, defined as abdominal circumference >102 cm for men and >88 cm for women (19).

Racial measurement of the young adults was made according to the criteria used in the Brazilian census, which always refers to self-reported skin color, denoting perceived phenotype (physical appearance) and not origin (ancestry). The official term for the admixed population is "Pardo", literally meaning "Mulatto" ("Brown" or "Gray"), and the other categories are "White", "Black", "Yellow", and "Indigenous" (22).

Physical activity was classified as active, sufficiently active and sedentary after calculating the metabolic energy turnover (MET)-min/week and this classification was based on the International Physical Activity Questionnaire scoring protocol (13). METs are multiples of the resting metabolic rate and a MET-minute is computed by multiplying the MET score of an activity by the minutes performed. Alcohol consumption in g/day was considered to be high when it was >31 g/day and low when ≤31 g/day. Tobacco consumption during the last month was evaluated. The percentage of ingested dietary fat was measured and categorized as <30, 30 to 39.9, and ≥40%; total calorie consumption was considered to be excessive when it exceeded 2900 cal/day for men and 2200 cal/day for women (23).

Fasting glycemia was determined by the GOD/PAP human diagnostic colorimetric enzymatic method (Chronolab AG, Zug, Switzerland) and was considered to be high when it was ≥110 mg/dL, with the presence of diabetes mellitus being considered when it was ≥126 mg/dL (24). Total cholesterol, HDL cholesterol and triglycerides were determined by an enzymatic colorimetric method using the Dade Behring XPand apparatus (Dade Behring, Liederbach, Germany) and reagents of Dade Behring Dimension clinical chemistry. The following values were considered to be high: ≥240 mg/dL for total cholesterol, ≥160 mg/dL for LDL cholesterol, and ≥150 mg/dL for triglycerides; HDL cholesterol was considered to be low when it was <40 mg/dL for males and <50 mg/dL for females (19).

Metabolic syndrome was considered to

be present when an individual presented at least three of the following: high blood pressure, abdominal obesity (measured on the basis of the abdominal circumference), high triglyceride levels, low HDL cholesterol, and high fasting glycemia, according to the cut-off points specified earlier (19).

Asthma was defined on the basis of two characteristics of the disease: bronchial hyper-responsiveness and symptoms. Bronchial hyper-responsiveness was identified by the methacholine challenge test and was reported as the methacholine concentration capable of provoking a 20% fall (PC20) in forced expiratory volume in 1 s. A PC20 ≤4 mg/mL was considered to be bronchial hyper-responsiveness (18). Regarding symptoms, a positive response to at least one of the following questions was required: presence of wheezing, chest tightness, and shortness of breath at rest during the day or night in the last 12 months.

Statistical analysis

The characteristics of the population at birth and at 23/25 years of age and prevalences among men and women were compared by the chi-square test, with the level of significance set at 5%.

Results

Table 1 shows a brief overview of the four phases of the 1978/79 birth cohort. In the first survey 9067 liveborns were delivered at the eight maternity hospitals in Ribeirão Preto, 6973 of them from mothers residing in the city. Excluding 146 twins, 6827 singleton births were studied. In the second phase, an attempt was made to find about 50% of the children from the original cohort frequenting first to fourth grade of the primary schools in the city. A sample of 43.5% of the initial cohort was located in the 76 schools from September 1987 to November 1989. The third phase included only men at the time of compulsory military enlistment at 18 years; since about 70% of the male population eligible for enlistment report to the draft board (8), a sample of 62% of the original male cohort was reached. Those born in 1978 were contacted in the second semester of 1996, and those born in 1979 in the second semester of 1997.

The sample studied at birth and at 23/25 years was comparable to the population studied only at birth regarding birth weight ($P = 0.618$) and length ($P = 0.507$), small for gestational age birth ($P = 0.513$), and maternal age at delivery ($P = 0.065$). There was a predominance of women ($P = 0.004$), of participants born preterm ($P = 0.037$), of participants from families with more qualified occupations ($P < 0.001$), of mothers with 5 years or more of schooling ($P < 0.001$), married ($P < 0.001$), and who did not smoke at the time of delivery ($P < 0.001$) (Table 2).

The male/female ratio was close to 1 (1.07); approximately one third of the participants were married (32%) and slightly more than one quarter had children (27.2%). Slightly more than one third belonged to the categories of skilled and semi-skilled manual workers and 23.8% were outside the economically active population. More than half the sample (53%) had a family income of 3 to 10 minimum wages. Income extremes (low: <3 minimum wages; high: >20 minimum wages) had approximately similar representations. Nearly two thirds were white and nearly half the sample had an intermediate level of schooling (9 to 11 years) (Table 3).

Men and women showed significant differences regarding anthropometric characteristics, physical activity, life habits, and percent dietary fat consumption (Table 4). The percentage of women with a weight deficit was higher than the percentage of men (8.6 *vs* 2.6%). Conversely, the number of overweight men was almost double that of women (30.3 *vs* 17.7%). The distribution of obesity was similar for the two groups

(12.8 and 11.1%). The proportion of short stature (stature below the 3rd percentile of the NCHS reference curve) (20) was half that expected among men (1.5%) and very close to that expected among women (3.8%). Women were more sedentary than men (57.3 *vs* 41.6%), consumed less alcohol (little or no consumption: 91.4 *vs* 67.2%) and smoked less (13.9 *vs* 20.8%). Men engaged in more physical activity than women (58.4 *vs* 42.7%). The consumption of dietary fat did not differ between sexes, with most of the participants (about 60%) consuming 30 to 39.9 g/day. However, about one quarter of both men and women consumed 40 g of fat or more per day.

On average, men were 13.4 cm taller than women. The mean height was 176 cm

Table 1. Chronology of the cohort study conducted on singletons born in 1978/1979 in Ribeirão Preto, SP, Brazil.

Phase of the project	Year	N	Study population	Representativity of the sample in relation to the initial N	Variables studied
First	1978 1979	6973	Liveborns delivered at the 8 public and private Ribeirão Preto maternity hospitals from June 1, 1978 to May 31, 1979 (6827 singleton, 146 twins)	98% of the universe of Ribeirão Preto liveborns	Maternal and paternal age, No. of pregnancies, No. of liveborns, No. of abortions and low weight newborns, No. of siblings and No. of household persons, maternal and paternal schooling, *per capita* and family income, mother working outside the home, occupation of the head of the family, parental smoking. Prenatal care, No. of visits, health insurance, category of prenatal care, duration of pregnancy, prenatal diseases. Type of delivery, No. of fetuses, category of hospital care and, in case of maternal death, date and causes. Newborn sex, whether liveborn or stillborn, date of birth, disease of the newborn and, in case of fetal or neonatal death, date and time of death, causes of death, weight, length and head and chest circumference.
Second	1987 1989	2861	Search for 50% of the children in the cohort aged 8-11 years who attended 1st to 4th grade in Ribeirão Preto elementary schools	43% of singletons, excluding 246 deaths in the 1st year	Data about the mother (marital status, occupation, schooling, smoking habit, No. of children, and obstetrical history). Data about the father or head of the family (occupation, smoking habit), family income. Data about the child (school, grade, weight, height, head circumference).
Third	1996 1997	2048	Boys of the cohort aged 18 years at the time of military recruitment in Ribeirão Preto	62% of male newborns, excluding 134 deaths in the 1st year	Data about the mother (occupation and schooling). Data about the father or head of the family (occupation and schooling). Data about the conscript (address, schooling, grade he was attending or had concluded, smoking habit, occupation, age at the beginning of work, monthly income, type of medical assistance, whether he was still living with his parents, No. of persons in the household, weight and height).
Fourth	2002 2004	2063	About 1 in 3 young adults of the cohort aged 23 to 25 years residing in Ribeirão Preto	31.8% of all singletons, excluding 343 deaths up to 20 years of age	Sociodemographic aspects of the young adults such as color, schooling, occupation and income, No. of siblings, order of birth, marital status, presence of children and domestic animals, practice of physical activity, tobacco and alcohol consumption, frequency of food consumption, personal and family history of non-communicable chronic diseases, use of medications. Measurements of weight, height, sitting height, abdominal and hip circumference, tricipital and subscapular skinfolds, and arterial pressure. Determination of glycemia, lipoprotein profile, clotting factors, insulin, pro-insulin, anti-glutamic acid decarboxylase and anti-insulin A2 antibodies, skin sensitivity to allergens, evaluation of pulmonary function, and bone densitometry examination.

Table 2. Comparison of the characteristics of the cohort at birth (1978/1979) with those of the participants in the fourth phase of the study (2002/2004).

Variables	N (%) of the initial population 1978/79 (N = 6484 excluding 343 deaths)	N (%) of individuals not interviewed in 2002/2004 (N = 4421)	N (%) of individuals interviewed in 2002/2004 (N = 2063)	P value
Sex				0.004
Female	3185 (49.1)	2117 (47.9)	1068 (51.8)	
Male	3299 (50.9)	2304 (52.1)	995 (48.2)	
Birth weight (g)				NS
<2500	380 (5.9)	252 (5.7)	128 (6.2)	
2500-2999	1349 (20.8)	935 (21.1)	414 (20.1)	
3000-3499	2644 (40.8)	1796 (40.6)	848 (41.1)	
3500-3999	1673 (25.8)	1149 (26.0)	524 (25.4)	
≥4000	438 (6.7)	289 (6.6)	149 (7.2)	
Birth length (cm)				NS
<47	723 (11.1)	498 (11.3)	225 (10.9)	
47-49	1612 (24.9)	1109 (25.1)	503 (24.4)	
49-51	2664 (41.1)	1830 (41.4)	834 (40.4)	
51-53	1170 (18.0)	775 (17.5)	395 (19.2)	
≥53	281 (4.3)	186 (4.2)	95 (4.6)	
Unknown	34 (0.6)	23 (0.5)	11 (0.5)	
Preterm birth				0.037
Yes	388 (6.0)	246 (5.6)	142 (6.9)	
No	6096 (94.0)	4175 (94.4)	1921 (93.1)	
Small for gestational age				NS
Yes	655 (10.1)	454 (10.3)	201 (9.7)	
No	5829 (89.9)	3967 (89.7)	1862 (90.3)	
Occupation of the head of the family				<0.0001
Non-manual	1079 (16.6)	740 (16.7)	339 (16.4)	
Skilled and semi-skilled manual	3685 (56.9)	2420 (54.8)	1265 (61.3)	
Unskilled manual or unemployed	1514 (23.3)	1115 (25.2)	399 (19.3)	
Unknown	206 (3.2)	146 (3.3)	60 (3.0)	
Maternal schooling (years)				<0.0001
≥12	655 (10.1)	440 (10.0)	215 (10.4)	
5 to 11	2483 (38.3)	1595 (36.1)	888 (43.0)	
0 to 4	3186 (49.1)	2266 (51.2)	920 (44.6)	
Unknown	160 (2.5)	120 (2.7)	40 (2.0)	
Maternal age (years)				NS
20-35	4998 (77.1)	3372 (76.3)	1626 (78.8)	
≥35	537 (8.3)	366 (8.3)	171 (8.3)	
<20	889 (13.7)	635 (14.4)	254 (12.3)	
Unknown	60 (0.9)	48 (1.0)	12 (0.6)	
Maternal marital status				<0.0001
Married	5375 (82.9)	3565 (80.6)	1810 (87.7)	
Cohabiting	613 (9.5)	481 (10.9)	132 (6.4)	
Non-cohabiting	422 (6.5)	317 (7.2)	105 (5.1)	
Unknown	74 (1.1)	58 (1.3)	16 (0.8)	
Maternal smoking ever				0.003
No	4494 (69.3)	2983 (67.5)	1511 (73.2)	
Yes	1810 (27.9)	1298 (29.3)	512 (24.8)	
Unknown	180 (2.8)	140 (3.2)	40 (2.0)	

The chi-square calculation was performed comparing the individuals not interviwed with those who were interviewed in 2002/2004. The “unknown” categories of each variable were not included in the chi-square calculation. NS = not significant (P > 0.05).

(SD 6.5) for men and 162.6 cm (SD 6.5) for women (P < 0.0001).

Metabolic syndrome prevalence was twice higher among men compared to women (10.7 *vs* 4.8%) and altered blood pressure level was six times higher (40.9 *vs* 6.4%). Men had higher proportions of high triglyceride levels (16.1 *vs* 9.8%) and of high LDL (5.4 *vs* 2.7%), while women had a higher percentage of low HDL (44.7 *vs* 39.5%). High fasting glycemia levels were infrequent and did not differ between sexes, as also observed for high total cholesterol levels and abdominal obesity (11.3% for men and 14% for women, P = 0.066). Excessive ingestion of total calories was higher among women (24.6%) than men (18.1%; P < 0.0001). Asthma and bronchial hyper-responsiveness were more frequent among women than men (1.7 and 1.5 times, respectively; Table 5).

Table 3. Sociodemographic characteristics of young adults aged 23 to 25 years (Ribeirão Preto, 2002/2004).

Variables	N	%
Sex		
Male	995	48.2
Female	1068	51.8
Skin color[a]		
White	1367	66.3
Mulatto ("pardo")	666	32.3
Yellow	30	1.5
Years of schooling		
Up to 8	320	15.5
From 9 to 11	1039	50.4
12 or more	704	34.1
Occupation		
Non-manual	434	21.0
Skilled manual	342	16.6
Semi-skilled manual	366	17.7
Unskilled manual	429	20.8
Outside the EAP[b]	490	23.8
Unknown	2	0.1
Family income (minimum wages)[c]		
Up to 3	220	10.7
3 to 5	461	22.4
5 to 10	631	30.6
10 to 20	404	19.6
20 or more	196	9.5
Unknown	151	7.3
Marital status[d]		
Cohabiting	661	32.0
Non-cohabiting	1402	68.0
Children		
Has children	562	27.2
Has no children	1501	72.8
Total	2063	100

[a]According to racial measurement in the Brazilian census, which considers self-reported skin color (22). [b]EAP = economically active population. [c]In multiples of the Brazilian official definition of a minimum wage per month. [d]Cohabiting includes married and living with a companion but not married.

Discussion

Epidemiological transition represents a specific set of more encompassing changes in the morbidity-mortality profile which expresses more general modifications in collective life in specific sectors such as habitation, sanitation, eating habits, levels of occupation and income, access to and use of information, schooling, utilization of health services, and acquisition of new life styles (25). In Brazil, even within a varied context of problems based on its geographic extension and its different socioeconomic realities, the epidemiological transition is a concrete fact (26). From this viewpoint, the study of the Ribeirão Preto cohort of 1978/1979, the oldest one being followed up in Brazil, in its fourth phase provides the opportunity to evaluate different relevant topics of importance within the current public health context. These include an investigation of the prevalence of risk factors for chronic-degenerative diseases among young adults living in a rich city in a developing country, a large urban center whose economy is based on services and commerce and having a high per capita income (8). The results presented here reveal some situations as potential public health problems, such as high prevalences of overweight, obesity, hypertension, metabolic syndrome, and asthma.

It is possible that some associations due to

health or social disadvantage could not be detected because more persons with a disadvantaged socioeconomic background or a low educational background, from one-parent families, with low birth weight and short gestation did not participate in the study. Selective attrition was also observed in the third phase of the cohort, the conscripts' study (8). Socioeconomic position seemed to be a main determinant of drop out in a prospective cohort study on risk factors for cardiovascular diseases in Northern Ireland, and drop out may be of concern for researchers when it is selective, because it can threaten the validity of the results (27). Other reasons for not participating possibly were migration, death, prison, registration errors, change of name, not having a telephone, or errors in address preventing the delivery of mailed letters. We believe that migration was low, since Ribeirão Preto is an attractive wealthy area in Brazil.

Since the population studied consists of young individuals aged 23/25 years, the prevalence of metabolic syndrome was considered to be high among men (10.7%) compared to other populations such as those from Korea (6.7% for men and 4.5% for women aged 20 to 29 years) (28) and the United States, with a general prevalence of 6.7% for the same age range (29). No studies were found on the prevalence of metabolic syndrome with data representative of the Brazilian population. However, studies conducted on different populations have revealed high prevalences of metabolic syndrome depending on the criterion used and on the

Table 4. Gender distribution of anthropometric characteristics, physical activity and alcohol, tobacco and fat consumption in the population studied at 23 to 25 years of age (Ribeirão Preto, 2002/2004).

Variables	Males	Females	P value*
Body mass index (kg/m^2)			
Underweight (<18.5)	26 (2.6%)	92 (8.6%)	<0.0001
Adequate (18.5 to 24.9)	537 (54.0%)	664 (62.2%)	
Overweight (25 to 29.9)	302 (30.3%)	189 (17.7%)	
Obese (≥30)	127 (12.8%)	119 (11.1%)	
Not determined	3 (0.3%)	4 (0.4%)	
Short stature[a]			
Yes	15 (1.5%)	41 (3.8%)	0.0010
No	978 (98.3%)	1024 (95.9%)	
Not determined	2 (0.2%)	3 (0.3%)	
Physical activity[b]			
Active	418 (42.0%)	222 (20.9%)	<0.0001
Sufficient	163 (16.4%)	232 (21.8%)	
Sedentary	413 (41.6%)	609 (57.3%)	
Smoking habit in the last month			
Yes	207 (20.8%)	148 (13.9%)	<0.0001
No	788 (79.2%)	920 (86.1%)	
Alcohol consumption			
None	194 (19.6%)	370 (34.9%)	<0.0001
Low (≤31 g/day)	470 (47.6%)	599 (56.5%)	
High (>31 g/day)	324 (32.8%)	92 (8.7%)	
% Fat			
<30	122 (12.3%)	134 (12.6%)	NS
30 to 39.9	630 (63.3%)	669 (62.6%)	
≥40	243 (24.4%)	265 (24.8%)	

[a]Stature below the 3rd percentile of the NCHS reference (14,20). [b]Classification was based on the International Physical Activity Questionnaire scoring protocol. *Chi-square test. NS = not significant (P > 0.05).

characteristics of the population studied, with rates ranging from 12.4 to 28.5% among men and from 10.7 to 40.5% among women in broader age ranges (30,31).

The presence of 41% of young individuals with elevated blood pressure levels is another factor that requires more attention and investigation due to the risk for cardiovascular diseases (19). This rate is much higher than those observed in studies of the Brazilian adult urban population, ranging from 25 to 30%, and of persons aged 25 to 39 years in 15 state capitals and the Federal District, ranging from 7.4 to 15.7% (3). It should be pointed out that this high prevalence was observed in a population of young adults from a high income city in a developing country, a fact that might facilitate the search for solutions by means of preventive public policies in similar populations in the country without losing sight of the marked socioeconomic regional differences.

The prevalence of overweight and obesity was high among both men and women. Lower rates of obesity in men (5.7%) and higher rates in women (14.7%) were detected in Belo Horizonte compared to the present study (32). In the study of state capitals and the Federal District, the prevalence of obesity was not significantly different between men and women, with a tendency to a higher prevalence among men. Since the calculation of BMI in that study was based on self-reported weight and height, it is likely that women underreport their weight, as shown in other studies (3). In our study the prevalence of overweight among men (30.3%) was almost double that observed among women (17.7%); the number of slim women was more than triple the number of slim men, a fact that may indicate greater adhesion by the women to the appeal

Table 5. Frequency distribution of metabolic syndrome and its components and of the respiratory parameters according to sex in the study population examined between 23 and 25 years of age (Ribeirão Preto, 2002/2004).

	Males		Females		P value*
	Total number	Frequency	Total number	Frequency	
Metabolic syndrome	987	106 (10.7%)	1052	50 (4.8%)	<0.0001
High blood pressure levels	994	407 (40.9%)	1066	68 (6.4%)	<0.0001
Abdominal obesity	994	112 (11.3%)	1067	149 (14.0%)	NS
High triglyceride levels	987	159 (16.1%)	1050	103 (9.8%)	<0.0001
Low HDL cholesterol	987	390 (39.5%)	1050	469 (44.7%)	0.0190
High fasting glycemia	991	12 (1.2%)	1052	10 (1.0%)	NS
High LDL cholesterol	980	53 (5.4%)	1049	28 (2.7%)	0.0020
High total cholesterol	987	36 (3.6%)	1050	35 (3.3%)	NS
Excessive ingestion of total calories	995	180 (18.1%)	1068	263 (24.6%)	<0.0001
Asthma	942	97 (10.3%)	980	169 (17.2%)	<0.0001
Bronchial hyper-responsiveness	942	164 (17.4%)	980	263 (26.8%)	<0.0001

Metabolic syndrome is defined as the presence of at least three of the following components: high blood pressure, abdominal obesity, high triglyceride levels, low HDL cholesterol, and high fasting glycemia, according to specified cut-off points (18). High blood pressure levels are ≥130 mmHg for systolic blood pressure and/or ≥85 mmHg for diastolic blood pressure (18). Abdominal obesity is abdominal circumference >102 cm for men and >88 cm for women (18). High triglyceride levels are ≥150 mg/dL (18). Low HDL cholesterol is <40 mg/dL for males and <50 mg/dL for females (18). High fasting glycemia is 110 to 125 mg/dL and diabetes mellitus ≥126 mg/dL (23). High LDL cholesterol is ≥160 mg/dL (18). Excessive ingestion of total calories is >2900 cal/day for men and >2200 cal/day for women (22). Asthma is bronchial hyper-responsiveness and symptoms (16). Bronchial hyper-responsiveness is PC20 ≤4 mg/mL (16). *Chi-square test. NS = not significant (P > 0.05).

of the slimness model currently in vogue, or a greater preoccupation with their appearance compared to men.

Eating habits and the practice of physical activity have a powerful influence on the energy balance and are considered to be the main modifiable factors that determine obesity and cardiovascular diseases (33). Diets with a high energy density associated with a sedentary life style are pointed out as the main etiologic factors for the increased prevalence of obesity in the world (34). The high proportion of sedentary individuals, more than one third of the men and more than half the women evaluated, may represent the changes in the profile of physical activity for the population and the dissemination of sedentary activities due to the modernization of the productive processes (35). Similar low levels of physical activity were also reported for both men and women in the study of capitals and the Federal District (3). In the present study, the mean calorie consumption by both men and women was above the mean daily value of 1811.18 kcal determined for Brazil in 2002-2003 (34), with women ingesting more excess calories than men, and with mean percentages of dietary fat above recommended values (36). This apparent inconsistency between a higher calorie consumption, a higher level of sedentariness and a lower proportion of excess weight presented by the women needs further investigation. The high alcohol consumption reported by one third of the men is worrisome since this is considered to be a risk factor for cardiac failure (37).

Another important fact was the percentage of cohabiting young subjects (32.0%) and with children (27.2%), which may indicate that this was a population that organized earlier in social and family terms, although the tendency of rich societies is to look for family organization later. The expressive number of individuals who are outside the economically active population (23.8%) may indicate various situations, such as being still in school because of the young age, being housewives or being unemployed.

The height of the population studied is similar to the mean height of the English and American populations (38), an expected fact in a population with a certain homogeneity in the relationship between genetic inheritance and environment. The difference of approximately 13 cm between sexes detected in classic auxology studies (16) was also observed in the present study (13.4 cm). The fact that the height of only 1.5% of the male population and 3.8% of the female population was below the 3rd percentile opens the discussion for the definition of a more adequate percentile to be used as a cut-off point in the detection of short stature in the city of Ribeirão Preto.

Although several epidemiological studies have used only questionnaires for the identification of asthma, in the present study the methacholine bronchoprovocation test was used in combination with the application of a questionnaire, a procedure adopted here for the first time in Brazil. The data revealed a high prevalence of asthma and bronchial hyperresponsiveness, detected in few parts of the world (15). The fact that asthma and hyperresponsiveness rates were higher among women is not surprising since this is a finding frequently reported in other studies (39).

The present results support the need for investment in the primary prevention of cardiovascular diseases and metabolic syndrome, which today may be considered to be a worldwide challenge, since, in addition to genetic predisposition, other potentially modifiable life style factors (33) play an important role in the onset of these conditions. In addition, the results also open pathways for the evaluation of the contribution of socioeconomic conditions at birth and of social mobility to the occurrence of risk factors for chronic diseases of adults in this population.

Birth cohorts for which phenotypic peculiarities and environmental information are collected make an important contribu-

tion to the understanding of the interaction of genetic and environmental determinants in the genesis of common diseases. Thus, the next logical stage of this study will be to look for new pathways involving a complementation of epidemiology with genetics for the adoption of measures aiming at prevention and promotion in the field of human health.

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