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thesis entitled

CORONARY HEART DISEASE RISK FACTORS AND
HEALTH-RELATED FITNESS OF ADOLESCENTS
IN NITEROI, RIO DE JANEIRO, BRAZIL

presented by

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has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Kinesiology

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Date 17 Dec 98

CORONARY HEART DISEASE RISK FACTORS AND HEALTH-RELATED FITNESS OF ADOLESCENTS IN NITERÓI, RIO DE JANEIRO, BRAZIL

By

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Kinesiology

1998

ABSTRACT

CORONARY HEART DISEASE RISK FACTORS AND HEALTH-RELATED FITNESS OF ADOLESCENTS IN NITERÓI, RIO DE JANEIRO, BRAZIL

By

Rosane Carla Rosendo da Silva

The purpose of this study was to determine the status of selected risk factors for coronary heart disease (CHD) and components of health-related physical fitness (cardiorespiratory fitness and body fatness) among adolescents in Niterói, Rio de Janeiro, Brazil, taking into account the effects of race, socioeconomic status (SES) and sexual maturation. The CHD risk factors included in the study were smoking, overweight, elevated blood pressure, inactivity, relative fat distribution, and low fitness. The relationship of cardiorespiratory fitness (CF) and physical activity (PA) with CHD risk factors, and the clustering of risks were also investigated. A total of 329 subjects (126 males and 203 females) were included in the study. The results indicated that race had no relationship with CF, PA or the CHD risk factors. Non-Whites tended to show a higher prevalence of elevated BPs and overweight, and also more centrally distributed fat. Non-White males were more likely to be smokers, while the reverse occurred among females. SES did not explain any part of the variance in CF or in CHD risk factors, except that lower middle class status explained 3% of the variance in PA. Lower SES individuals were at higher risk for smoking, elevated BPs and inactivity. Middle class girls and lower class boys were more likely to be overweight. CF had no relationship with BPs, BMI, TER, or WHR. CF was inversely related to Σ6SF, and a positive relationship was observed with PA. Boys at risk for low fitness tended to have lower PA, higher BPs, and significantly higher Σ6SF. Significantly lower PA, higher BMI, Σ6SF and TER were characteristic of females at risk. BPs also tended to be higher among these girls. PA did not explain any part of the variance in Σ6SF, BMI, TER, WHR, or SBP. PA was inversely related to DBP. Inactive boys tended to show higher BP values, while girls tended to have lower CF and higher Σ6SF, TER, WHR, and BPs. Risk factors clustered within approximately 25% of individuals. Inactivity was present in all clusters. Few individuals clustered 3 and 4 risk variables. Non-White females tended to cluster risk factors more frequently than White females. The results demonstrated that CF and PA had no or a low relationship with the selected risk factors measured in this study. They also showed that Non-White and lower class subjects are more prone to have CHD risk factors.

DEDICATION

" Because I experienced the future,

I need to be strong in the present,

I need to be restless,

I want a better country."

Carta à República, Milton Nascimento

To Julia and all Brazilian youth.

ACKNOWLEDGEMENTS

This work is in many ways a result of the collaborative work, since we always depend on many people. I would like to express my sincere thanks to all members of this "team". The list does not follow an order of importance and names are avoided as much as possible so that I will not incur in the error of omitting names.

- To the Holy Father, for His blessings and for all the opportunities during this lifetime.
- To my parents, Fárida and Aryldo (in memorium), for their love, support and the example of hard work and dedication. A special thanks to Fárida for being always there for me and for taking care of all my business in Brazil while I am abroad, allowing me to focus on the work.
- To Regina Celia, Edmir and Julia, my sister, brother-in-law, and niece, respectively, for their love.
- To the Brazilian citizens, who allow the Government to invest in the education of scholars through their taxes;
- To Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES, Brazilian Ministry of Education, for the financial support for the program and research;
- To the Departamento de Educação Física and the Coordenação de Capacitação Docente of Pró-Reitoria de Pesquisa e Pós-Graduação of Universidade Federal Fluminense, for the four year leave to complete this program;
- To Dr. Robert M Malina, my mentor, for the wonderful learning experience;
- To Drs. Robert M Malina, James M Pivarnik, Martha E Ewing and Harry Perlstadt,

the Committee members, for the guidance in the program and suggestions to this work;

- To all teacher and professors in my academic life for providing me food for thought;
- To the State and Municipal Departments of Education in Niterói, for giving me the access to the schools;
- To the principals and physical education teachers who indirectly participated in the study;
- To all the subjects in the study, for their time and cooperation. Furthermore, for giving me the opportunity to find answers to some of my questions;
- To Mr. Ralph L. L. N. Reys and Mr. Celio L. Baptista, undergraduate students in Kinesiology, for assisting with the data collection, and doing more than the stipend could cover;
- To all friends and family in Brazil and in the United States, for their prayers, letters, e-mails, and phone calls expressing their love that helped me to be less homesick;
- To each and everybody who directly or indirectly supported me through this journey.

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CHAPTER 1

INTRODUCTION

Degenerative diseases, including coronary heart disease (CHD), are the major causes of death of adults in developed countries and in some segments of the population in developing countries, especially the more affluent. The high mortality/morbidity in the last four decades is related to increases and changes in food consumption, decrease in physical activity levels, increase in cigarette use, and also increase in stress levels. The more affluent segments of the population in developing countries also experience these changes in lifestyle, as they are more exposed to and can afford the amenities of the developed world.

Mortality rates due to infectious diseases have declined in developing countries, particularly in the second half of this century, while degenerative diseases are increasing in all segments of the population. This shift of primary causes of death is defined as the epidemiological transition (Omran, 1971). Mortality due to cardiovascular diseases in Brazil has increased from about 12% in 1930s to 33% in the 1980s (Briscoe, 1990). In the most developed areas of the country (Southeast and South), proportionate mortality is even higher, 35% and 38%.

Data on the major risk factors for CHD are presently limited for the Brazilian population, especially at young ages. Hypertension has an estimated prevalence of 15% (Ministry of Health, 1993), although studies from different parts of the country indicate that the prevalence ranges from 6.6% to 55.8% (Rosendo da Silva, 1996). Smoking prevalence is 13.9% and 10%, respectively, for males and females (Ministry of Health, 1993). The prevalence of overweight has increased in children 1 to 4 years of age as well as in adults 25 to 64 years of age from 1974 to 1989, and it is higher in females than in males (Monteiro et al., 1995b).

The prevalence of physical inactivity was estimated at 67% of the population in 1988 (Rodrigues, 1989) and recent data from the Survey on Standards of Life (IBGE on-line, 1998) showed that 81% of the participants were inactive. Data from Rio Grande do Sul showed that 47% of middle class and 25% of lower class adults exercise regularly in their leisure time (Achutti et al., 1988 as cited by Briscoe, 1990). Unfortunately, the definitions of activity level are not reported. The increase in CHD mortality in Brazil appears to be partially explained by a corresponding increase in the prevalence of risk factors in the population.

The atherosclerotic process begins in early life and manifests itself as CHD in adulthood. However, Rowland (1991, 1996) has argued that there is no study to prove that decreasing risk factors of CHD in early life will decrease disease occurrence later on. Nonetheless, risk factors tend to track from adolescence to adulthood, independently or clustered. For example, Raitakari et al. (1995) reported that the risk factors of CHD (hyperlipidemia, high blood pressure, smoking and physical inactivity) tend to cluster from adolescence to young adulthood (12 to 24 years) in a Finnish sample.

The only risk factor more or less consistently related to exercise at young ages is obesity (Rowland, 1991). Obesity is often related to physical inactivity and nutritional lifestyle, and obesity in later childhood and adolescence are good predictors of adulthood status (Vaccaro and Mahon, 1989). Obesity is thus an important risk factor in children, especially when associated with hypertension and high serum lipids.

It is well reasonably established that regular physical activity can decrease the risk of CHD in adults, thus diminishing the disease burden on society. School physical education programs have adopted the health-related fitness model as a way to improve physical fitness in childhood and adolescence and to promote an active lifestyle which presumably carries over into adulthood. This model is based to a large extent on adult morbidity and mortality, i.e., CHD (Bar-Or and Malina, 1995; Malina, 1995b; Rowland, 1996). It has been argued that regular exercise does not improve children's health per se, and no data are currently available to support or refute the concept that regular physical activity during childhood and adolescence prevents the development of risk factors during growth and maturation. The extent to which exercise can slow the atherosclerotic process is not known. Further, Després et al. (1990) noted that data relating exercise to decrease in CHD risk in children are not conclusive, especially for children with normal ranges of risk factors. Exercise may play an important role for those at higher risk; however, individual variation in the magnitude of response must be taken into account.

The debate on the role of school physical education in promoting active lifestyles to be carried over into adulthood in the U.S. and Europe has influenced Brazilian scholars to begin to discuss the role of physical education in Brazilian education in the middle of the 1980s. Several Brazilian scholars proposed a focus on health-related fitness in the physical education curriculum (Nahas and Corbin, 1992a, 1992b; Guedes and Guedes, 1993a, 1993b, 1994). However, few studies of health-related physical fitness have been done in Brazil (Barbanti, 1982; Böhme and Freitas, 1989; Guedes, 1994; Queiroz, 1992; Silva, 1992) and these are presently limited to descriptive data on children and adolescents from Itapira (São Paulo), Viçosa (Minas Gerais), Londrina (Paraná), Rio

Branco (Acre), and Manaus (Amazonas). No analyses of the data were provided on the basis of race, socioeconomic status (SES), sexual maturation, or habitual physical activity. Some authors (Guedes, 1994; Queiroz, 1992; Silva, 1992) related physical fitness and cardiovascular health, but none investigated CHD risk factors. Few studies on habits of physical activity have been carried out in Brazilian children (Andrade et al., 1996, 1998; Matsudo et al., 1996, 1998).

The purpose of this study is to investigate the prevalence of selected risk factors of CHD and components of health-related physical fitness in adolescents taking into account race, SES, habitual physical activity, and sexual maturation.

Research Questions

What is the status of selected risk factors for CHD and health-related physical fitness of adolescents in Niterói, Rio de Janeiro?

Sub-questions

1. To what extent do sociodemographic characteristics predict selected risk factors for CHD and health-related physical fitness in adolescents?
2. What is the relationship between cardiorespiratory fitness and selected risk factors for CHD in adolescents?
3. What is the relationship between level of physical activity and selected risk factors for CHD in adolescents?
4. Do risk factors for CHD cluster within individuals?

Limitations

The study is cross-sectional and permits only an indication of the status at the time of the study. The study was based on a convenience sample. It thus may not be representative of the whole school population of the same age in Niterói, and it may nor represent adolescents of the same age that are out of the school system. Another limitation is that students in the public school system are mainly from low SES families, which represent the major economic status of the Brazilian population; however, the characteristics of this group may differ from groups with higher SES background.

Significance of the study

In addition to descriptive data on growth, health-related physical fitness and selected CHD risk factors, the study also provides information about the relationships of SES and ethnicity with risk factors and health-related physical fitness. Such data may be important to integrate physical education with other health programs targeted to this age group.

CHAPTER 2

REVIEW OF LITERATURE

Socioeconomic changes that allow for improvements in living conditions, nutrition and health care in developed countries also contribute to the shift from high mortality due to infectious diseases to increased mortality due to degenerative diseases, especially CHD (Omran, 1971). Since the increase in case fatality and prevalence of these diseases were noted, studies have been conducted to identify factors that enhance the risk for CHD. Five major modifiable risk factors have been identified: hyperlipidemia, cigarette smoking, hypertension, overweight/obesity, and physical inactivity.

Physical activity is a relevant area of investigation and several agencies and organizations such as the International Federation of Sports Medicine (1990); American Heart Association (Fletcher et al., 1992), the World Health Organization/ International Society and Federation of Cardiology (Bijnen et al., 1994), the Centers for Disease Control and Prevention/American College of Sports Medicine (Pate et al., 1995), and the Surgeon General US Public Health Service (CDC, 1996) have emphasized the importance of the adoption of regular physical activity to enhance health status. Although much is known about the effects of regular physical activity on disease prevention and rehabilitation in the adult population, more research is needed on the determinants of physical activity and on the effects of physical activity on children and adolescents.

Physical fitness is defined as "a set of attributes that people have or achieve, that relates to the ability to perform physical activity" (Caspensen et al., 1985, p. 129).

Physical fitness has focused on two goals: health-related fitness and skill-related fitness (sports-related or performance-related fitness). In general, skill-related fitness shows a limited relationship to health, due to the high dependence on motor skills, cardiorespiratory power and capacity, muscular strength, power or endurance, body size, body composition, motivation, and nutritional status (Bouchard and Shephard, 1994).

Health-related fitness includes components that are related to health status and habitual physical activity, especially in adults. Recently, Bouchard and Shephard (1994) proposed several components of health-related physical fitness: morphological (body composition, fat distribution, mass for height, joint flexibility, and bone density); muscular (power, strength, and endurance); motor component (agility, balance, coordination, and speed); cardiorespiratory (oxygen transport, function of heart and lung, and blood pressure); and metabolic component (glucose tolerance, lipid and lipoprotein metabolism, and choice of metabolic substrate). Several of these components and specific factors are related to CHD.

The relationship between health-related physical fitness and CHD risk factors in Brazilian adolescents must be studied in the context of growth and nutritional status given concern for nutritional conditions in parts of Brazil. A child's current growth status reflects his/her nutritional history, and this is especially true in developing countries. Both growth status and current nutritional status may influence health-related physical fitness as well as physical activity. Sexual maturation is an additional factor that influences variation in growth, health-related physical fitness and CHD risk factors during puberty. Therefore, this review is divided into three sections: Growth and maturation, health-related physical fitness, and CHD risk factors in adolescents, respectively.

Growth and sexual maturation of adolescents

The growth status of children is an important parameter in evaluating the health and nutritional status of a population (WHO, 1995). Growth refers to an increase in body size; it is influenced by genetic and environmental factors in an interactive manner. Although the genetic factors are of predominant influence, environmental factors such as nutrition have significant effect (Bouchard et al., 1997).

The most widely used method for assessing growth status is anthropometry. Stature and body weight are the major indicators because both measures are universally applicable, inexpensive and non-invasive (WHO, 1995). Three indices are commonly used to evaluate growth status in children: height-for-age, weight-for-age, and weight-for-height. These indices are often expressed in terms of z-scores or percentiles relative to reference data to allow for classification of stunting, wasting, thinness, risk for overweight, and obesity based on specific cut-off points (WHO, 1995). The United States National Center for Health Statistics (NCHS) data are recommended as the international reference, because these data fulfill most of the criteria of sampling and analysis required for determining a reference population (WHO, 1983).

The major data set on the growth of Brazilian children is from the Santo André Study (Marcondes et al., 1982). Phase I of the study was carried out in 1968/69 on children from birth to 12 years of age. Children and adolescents from 10 to 19 years were studied in Phase II, which took place in 1978. The Santo André Study data have the limitation of non-generality to other groups within the country. At the time of the study, Santo André was one of the most industrialized cities in Brazil, with higher wages and better living conditions than most cities in the rest of the country. Therefore, the sample is from a more affluent segment of the Brazilian population. Nevertheless, the Santo André data may be used as a reference for the country in the same manner that the NCHS data are internationally used (Marcondes et al., 1982). However, when the Santo André data are compared to the NCHS reference, the Brazilian population is shorter and lighter, especially after 11 years of age (Marques et al., 1982).

Although several years have passed since the Santo André survey, the data still represent a better off sample compared to the other geographic regions of Brazil. A group of 400 students 10 to 14 years from Campina Grande (a municipality of Rio Grande do Norte, Northeast Brazil) was evaluated for stature and weight (Dinoá and Assis, 1990). Compared to the Santo André reference, the values from Campina Grande for height-for-age and weight-for-age are lower.

Nutritional status

Indices for the nutritional status among adolescents are the body mass index (BMI, weight/height^2) and height-for-age (WHO, 1995), which are also ordinarily compared to NCHS reference data. However, the use of height-for-age in an adolescent sample must be done cautiously due to the differential timing of growth spurts and the influence of sexual maturation on height and weight. Specific BMI percentiles are recommended to determine thinness (<5th percentile), risk for overweight (>85th percentile) and overweight (>95th percentile, Himes and Dietz, 1994; WHO, 1995).

Using data from the National Survey of Households, Anjos et al. (1998) developed a BMI percentile reference for the Brazilian population aged 0 to 25 years.

Comparing this reference to the NCHS reference, mean BMI values are similar until 6 years of age and lower thereafter. Comparison of the 5th and the 95th percentiles between the two populations shows that the differences increase after 5 years of age. The differences between populations are less than 5 BMI units for any age and sex.

Nutritional status is commonly evaluated using arm anthropometry, because muscle mass is an indirect indicator of protein reserve (Gurney and Jelliffe, 1973). When nutritional requirements are not met, the protein in the muscle mass is utilized to generate energy. Malnourished individuals have smaller arm muscle areas because of lower protein reserve. In many surveys, the upper arm muscle area is estimated from relaxed arm circumference and the triceps skinfold. Reference data are also derived from NCHS data (Frisancho, 1990). Wasted individuals show an upper arm muscle area < 5th percentile for sex and age, while individuals with good nutrition have an upper arm muscle area > 95th percentile. Average values range from the 15th to the 85th percentiles. Sex differences in estimated arm muscle area are significant after 12 years of age, reflecting the male adolescent spurt in muscle mass.

Malnutrition

Chronic malnutrition affects normal growth. Individuals small for gestational age are shorter in stature during childhood and also in adolescence (Frisancho et al., 1994), suggesting that malnutrition during fetal life has a long term effect. Malnutrition has its major lasting effects during early childhood, resulting in stunting that is often not reversed.

Malnutrition in fetal life also appears to predispose individuals to cardiovascular disease in adulthood (Barker and Osmond, 1992). Sawaya et al. (1995) found that stunted adolescents living in a shantytown in São Paulo were at higher risk for obesity (weight-for-age > 120% NCHS reference data) than adolescents with normal height-for-age. The prevalence of obesity was 10.8% for stunted boys and 7.8% for normal height-for-age boys, and 35% and 13% for their female counterparts, respectively.

The major determinant for malnutrition is low SES. Low SES not only restricts the amount and type of food to be prepared and served, but also influences living conditions, including sanitation, water supply, and crowding. These are all related to augmented risk for infectious diseases (Martorell, 1996). Low SES is also associated with less access to health care (PAHO, 1994b). There is an overrepresentation of Blacks and Pardos in the lower SES in Brazil; hence, it is expected the prevalence of malnutrition to be higher in these racial groups.

Malnutrition also affects learning and intellectual performance, which influences work qualification (Berg, 1973). The economic consequence of malnutrition is that the lower the qualification, the lower the income. Further, in a job that is more dependent on physical work output, output may be diminished in individuals exposed to malnutrition during childhood. A lower work output is in turn related to lower income, especially in unskilled workers. Therefore, the malnutrition cycle includes lower work output, less income generated, poor living conditions and more malnutrition (Martorell, 1996). Malnutrition also decreases the number of working years, and increases accident rates at work and absenteeism (Berg, 1973). In summary, malnutrition has negative effects on income in two ways: directly by decreasing work capacity and indirectly by lowering work qualification.

To investigate the effects of malnutrition on work output comparisons of maximal oxygen consumption ($\dot{V}O_2$ max) or physical work capacity at heart rate 170 beats per minute (PWC 170) between well-nourished and undernourished individuals have been made. Barac-Nieto et al. (1984) studied Colombian boys 6 to 16 years and found that undernourished children (either body weight or height <95th of Colombian reference data) had lower absolute $\dot{V}O_2$ max. However, when $\dot{V}O_2$ max was expressed relative to body weight, undernourished children showed higher values than the well-nourished due to the lower body weight of the former. When expressed in units of lean body mass (LBM), $\dot{V}O_2$ max was also higher in malnourished boys, which was explained by the higher relative proportion of body weight as LBM. The higher $\dot{V}O_2$ max/LBM was also accounted for by higher oxidative capacity per unit of LBM. Any task requiring a given oxygen (O_2) consumption represents higher intensity for undernourished boys in this group.

Differences in work output were also found in 12 year old boys of migrant workers, who lived in slums of São Paulo (Desai et al., 1984). These children showed a higher heart rate response and higher $\dot{V}O_2$ max for each workload (ml/kg/min), lower PWC 170, and higher serum lactic acid levels one minute post-test, showing overall a lower work capacity than higher SES boys. Lower values were also found in anthropometric dimensions, and 57% of the variation in work capacity in the migrant boys could be accounted for by weight and height. These data are consistent with previous findings of Desai et al. (1981) in low and high SES boys and girls. Spurr and Reina (1986) also reported higher percentage of $\dot{V}O_2$ max for the same workload in malnourished children.

Haas et al. (1996) found that individuals exposed to a nutritional supplement from gestation through the preschool years had a higher $\dot{V}O_2$ max at 11 to 26 years than those not exposed to the supplementation. The differences were greater in males than in females. $\dot{V}O_2$ max was inversely related to stunting (height at 3 years compared to NCHS norms), but differences disappeared when adjusted for current body weight and estimated LBM, indicating that LBM is a source of variation on later performance across all levels of stunting. Barac-Nieto et al. (1984) found that 80% of the variance of the low $\dot{V}O_2$ max of malnourished individuals is accounted for by differences in muscle mass.

Biological Maturation

Maturation refers to the tempo and timing of progress toward the mature biological state (Malina and Bouchard, 1991). Maturation varies with the biological system considered and also among individuals. Due to the variability in time and tempo among individuals of same chronological age, biological maturity status needs to be accounted for in analyses of growth, health related-fitness, and CHD risk factors of adolescents.

Maturation can be assessed by several methods. All methods assess an event in a continuous process. Skeletal maturation is the best method for assessing biological maturation because it can be used for the entire growth period. However, exposure to the x-rays is needed to determine skeletal maturation, limiting the wide use of this method.

Somatic maturation includes the determination of age at peak height velocity (PHV), which requires longitudinal data that span adolescence. The initiation of the adolescent growth spurt occurs at about 10 years in females and 12 years (Malina and

Bouchard, 1991). Before the growth spurt there are no significant differences in stature among boys and girls. Because boys enter in the growth spurt later (longer period in a relatively high growth velocity in preadolescence), and PHV is higher, sex differences in stature emerge. Leg length is the major contributor to the sex difference in height. Due to the longer period in the prepubertal stage, when leg length growth is faster than trunk length, the sitting height/stature ratio is lower for males than for females, indicating relatively longer legs.

Maturation also influences body composition. As the individual matures, the chemical composition of the fat-free mass changes. There is an increase in the protein, fat, and mineral content in the body and a decrease in water content. These changes are related to the increases in muscle mass, fat mass and bone density. Body density increases during growth due to increases in muscle mass and bone density (Malina and Bouchard, 1991). However, as fatness accumulates in later adolescence, body density declines.

Muscle mass increases during the growth spurt. Greater increases in muscle mass occur in males due to the influence of testosterone. On the other hand, fat mass increases in females throughout puberty, as an influence of the estrogens. Subcutaneous fat decreases in early puberty in males, especially in the extremities, and increases later in puberty on both the trunk and extremities (Marshall and Tanner, 1986; Malina and Bouchard, 1991). This pattern of fat distribution in males, which results in the accumulation of proportionally more fat on the trunk, may increase the risk for degenerative diseases. Puberty in males is also associated with a decrease in HDL cholesterol and an increase in LDL cholesterol and triglycerides.

The assessment of sexual maturation is based on secondary sex characteristics: breast development in females, genital development in boys, and pubic hair in both sexes. Breast, genital, and pubic hair development are continuous processes. The most commonly used criteria for assessing sexual maturation are those of Tanner (1962). Five stages for each of the secondary sex characteristics are described, where stage 1 is the infantile state and stage 5 is the adult state. Stages 2, 3 and 4 represent sexual maturation phases. Pubic hair assessment may include a stage 6, showing a hair distribution beyond the inverse triangle. This distribution was found in 80% of males and 10% of females by Tanner (1962); however, stage 6 was not included in the method because it is not usually completed until the mid-twenties.

Data from the Santo André Study included the sexual maturation of Brazilian males and females 10 to 19 years. The criteria of Tanner were applied by physicians. The frequencies of the subjects in each stage of sexual maturation are shown in Tables 1 and 2. The results are consistent with data from other countries.

Assessment of secondary sex characteristics by direct observation raises issues of privacy and consent. As a result, protocols for self-assessment have been developed. The concordance of self-assessment and physician assessment of sexual maturation was investigated in Brazilian youth (Saito, 1984; Carvalho, 1990; Matsudo and Matsudo, 1994; Guimarães and Passos, 1997).

Saito (1984) investigated the concordance of stages of sexual maturation in 78 adolescents (42 females and 36 males), aged 11 to 18 years. She found Kappa coefficients of 0.89 and 0.87 for girls and boys, respectively. Carvalho (1990) studied 104 male students aged 10 to 17 years. For genital development, 47.5% of the students agreed with the physician assessment, while for pubic hair development the agreement was 40.4%. Disagreement was found in 44.9% and 45.5% of the sample for one stage in pubic hair and genital development, respectively. Disagreements of more than one stage were low (5.6% for pubic hair and 6.9% for genital development). Disagreement was higher at younger ages (11-12 years) than for older students.

Matsudo and Matsudo (1994) also investigated the concordance of self-assessment and physician assessment of sexual maturation. A sample of public school students (174 females and 178 males) ages 6-26 years was evaluated by two physicians (one male and one female) at two different occasions. The subjects also assessed themselves twice. In both sexes, concordance for pubic hair was higher than concordance of breast and genital development. Concordance was higher at the extremes, stages 1 and 5. Correlation coefficients between these assessments are shown in Table 3, and are similar to those in the literature.

Guimarães and Passos (1997) studied the concordance between self-assessment and physician assessment of stages of sexual maturation in a sample of 445 girls aged 8 to 18 years from 2 public schools and one private school. The students self-assessed their pubertal status according to the pictures of the stages described by Tanner (1962). Their assessment was followed by the physician's. For breast development, concordance varied from 65.4% to 73.5%, while for pubic hair the values ranged from 44.4% to 48.9%. The authors also found that concordance was greater in girls from public schools (lower SES), and suggested that the difference may be explained by a greater familiarity to the changes that occurs in their bodies during puberty, allowing them to better perform the self-assessment.

Age at menarche is also used to assess sexual maturation in females, although menarche is a late event in the maturation process. Three methods are used in the determination of age at menarche. The first method is status quo, which provides a sample estimate through probits analysis. With this method, the median age at menarche in Brazilian girls is 12.6 years (Colli, 1988), which is not different from ages at menarche of other Latin and North American countries. European females tend to have a later age at menarche (Marshall and Tanner, 1986).

The second method for assessing age at menarche is the retrospective method, where the female is asked to report at what age she started to menstruate. This method is subject to bias in recall. Colli (1988) found a mean age of menarche to be 12.5 years in Brazilian girls, using the retrospective method.

The third method is the prospective method, which requires longitudinal data. This is the most accurate method of determining the age at menarche in individual girls, but representative samples are needed for a reliable estimate (Eveleth and Tanner, 1990).

Maturation is influenced by genetic and environmental factors. Age at menarche has high heritability, in the order of 0.80. Malnutrition is one of the environmental factors that contributes to later maturation and its influence is unequal in the different systems. Malnutrition delays the age of menarche, but it does not appear to influence the height gain during puberty (Marshall and Tanner, 1986). Menarche is also later in individuals who live in altitude and rural areas, and those from a high SES.

Maturity status

Maturation is a variable process among individuals. The time and tempo of the process influence aspects of health-related fitness and risk factors for CHD. Age at PHV, on average, is about 12.0 years in females and 14.0 years in males; menarche occurs, on average, a bit more than a year after PHV (Malina and Bouchard, 1991).

Individuals advanced in maturation are taller than later maturers, although the former catch-up by the end of adolescence. Advanced maturers are also heavier than later maturers, but there is no catch-up in body weight. Conversely, Beunen et al. (1994) found no difference in body weight between early and late maturing males at 30 years of age.

van Lenthe et al. (1996c) found a higher risk for obesity in early maturing males and females of the Amsterdam Growth Study. The BMI and sum of skinfolds were higher in advanced boys and girls at 13 years and at 27 years. These differences remained significant after adjusting for energy intake and physical activity level.

Early maturation in males is associated with relatively more subcutaneous fat deposition on the trunk compared to the extremities. Beunen et al. (1994) found no differences in extremity skinfolds among early and late maturers during adolescence and at age 30, but found thicker trunk skinfolds in early maturers, indicating proportionately more subcutaneous fat on the trunk.

Early maturing boys tend to have better performances than the late maturers, especially in tasks that involve strength and power. Differences in performance are also observed in girls, where later maturers more often tend to have better performances. Early maturers of both sexes have higher absolute $\dot{V}O_2$ max than late maturers; however, these differences disappear when $\dot{V}O_2$ is adjusted for body mass (Malina and

Bouchard, 1991).

Health-related physical fitness

Although there is a new classification of health-related physical fitness (Bouchard and Shephard, 1994), this section will follow the traditional classification (cardiorespiratory fitness and body composition). The components fat distribution and blood pressure are included with the CHD risk factors since they are related to obesity and hypertension.

A battery of health-related fitness tests aimed initially for children and youth has been operationalized to include cardiorespiratory endurance (walk/run test), muscular endurance and strength (modified sit-up test), body composition (sum of triceps and calf skinfolds, sum of triceps and subscapular or body mass index), and flexibility (sit-and-reach; AAHPERD, 1980). Cardiorespiratory fitness and body composition are considered the two major components of health-related fitness due to their apparent relationship to health in adults (Docherty, 1996). However, in measuring health-related items, only body composition has direct relationship with health status of children and youth. Overweight and obese children and adolescents have increased risk for respiratory disorders, orthopedic problems, stigmatization and self-image problems, and cardiovascular risk, i.e., abnormal glucose tolerance, hypertension, lipid profile abnormalities (Must, 1996), and poorer health and performance-related physical fitness (Malina et al., 1995a)

There is no scientific evidence that improving health-related physical fitness test results will improve the health status of children (Seefeldt and Vogel, 1989) and decrease risk later in life (Rowland, 1991, 1996). Although no evidence is available, there is an emphasis on health-related physical fitness in school programs to prevent cardiovascular diseases in later life, based on the establishment of an active lifestyle in childhood, which will be carried throughout the lifespan. However, evidence for the tracking of physical activity is equivocal (Malina, 1996b).

Cardiorespiratory fitness

Cardiorespiratory fitness is considered the key element of health-related fitness and is often viewed in the context of aerobic power ($\dot{V}O_2$ max) and the ability to perform prolonged submaximal exercise (submaximal cardiorespiratory capacity). Aerobic power is the most widely used assessment method of cardiorespiratory fitness.

Absolute $\dot{V}O_2$ max (l/min) increases during growth and maturation; linear increases are observed for boys, while $\dot{V}O_2$ max levels off at 12-13 years in girls. Increases of the oxygen delivery chain and muscle mass are responsible for increases in $\dot{V}O_2$ max with growth and maturation. For running activities, the increase in $\dot{V}O_2$ max is also related to a greater running economy due to an increase in stride length and a decrease in stride frequency. There is no significant sex differences in $\dot{V}O_2$ max in childhood; however, as puberty approaches sex difference become more pronounced. The differences are usually explained by higher muscle mass and physical activity levels in boys compared to girls (Krahenbuhl et al., 1985). Relative $\dot{V}O_2$ max (ml/kg/min) remains constant for boys during growth, but decreases in females. The decrease is largely associated with an increase in fat mass (Rowland, 1990).

Ethnic differences are also evident in $\dot{V}O_2$ max. African American adolescent females show lower relative $\dot{V}O_2$ max than non-Black American females (Pivarnik et al., 1995). The difference was explained by the higher body weight of the Black teenagers. The ethnic difference also persists after $\dot{V}O_2$ max is regressed on fat-free mass, indicating that a lower muscle mass and higher bone mass in African Americans may explain part of the difference in $\dot{V}O_2$ max.

Maturation status also influences $\dot{V}O_2$ max. The more mature individual is taller and heavier compared to the less mature. After controlling for chronological age, most of the variation in absolute $\dot{V}O_2$ max is explained by height and weight (Cunningham et al., 1984). Early maturing boys have higher absolute $\dot{V}O_2$ max values, largely due to greater heart and muscle mass volumes and higher hemoglobin concentrations than late maturers, the difference disappears in late adolescence. The differences remain significant after adjusting for body weight.

In girls, the difference in absolute $\dot{V}O_2$ max is smaller between early and late maturers and also disappears in late adolescence. When adjusted for body weight, no differences in $\dot{V}O_2$ max are observed in girls of contrasting maturity status (Malina et al., 1997). Relative $\dot{V}O_2$ max is higher in late maturers of both sexes due to their lower body weight (Malina and Bouchard, 1991).

Genetic effects on cardiovascular fitness are expressed by the interaction of the phenotypes associated with cardiac, vascular, and respiratory functions. Genetic influences appear to be lower for submaximal exercise capacity (< 10%) than for maximal exercise capacity (< 25%, Bouchard and Pérusse, 1994).

For testing large populations such as school children, a walk/run for either time or distance has been used to indirectly assess aerobic power. Validity correlation coefficients of the distance run compared to $\dot{V}O_2$ max vary from 0.70 to 0.82 in school age children (Docherty, 1996). Although the walk/run test has been structured to require maximal effort, it is difficult to elicit maximal effort in children (Pate and Shephard, 1989).

Brazilian studies on health-related fitness have used the walk/run for time, 9 and 12 minutes, with children and adolescents, respectively (Barbanti, 1982; Guedes, 1994; Queiroz, 1992; Silva, 1992). One exception is the longitudinal study of Nahas et al. (1992), which used a walk/run for 1000 meters.

Cardiorespiratory fitness is also affected by regular physical activity. However, it appears that most adolescents do not engage in exercise of sufficient intensity for extended periods of time to allow for significant changes in cardiovascular fitness over that expected with normal growth and maturation. Due to this low workload, or perhaps to the poor validity of physical activity instruments in this age, the relationship between habitual physical activity and cardiovascular fitness is only low to moderate. Physical activity explains about 3% of the variance in $\dot{V}O_2$ max in adolescents (Morrow and Freedson, 1994), and exercise training ordinarily results in increases in $\dot{V}O_2$ max (Krahenbuhl et al., 1985).

Low cardiorespiratory fitness is a risk factor for inactivity and mortality. Dennison et al. (1988) found that boys in the lowest quintile of the 600 yard (548.6 m) run were almost twice as likely to be physically inactive in young adulthood than individuals in the other quintiles; those in the other quintiles did not differ among themselves. Analyses of the run test results in elementary school (10-11 years) and high school (15-18 years) boys yielded the same trend.

Blair et al. (1989) related physical fitness (measured by a maximal treadmill exercise test) to risk for all-cause and cause-specific mortality in adults. Both males and females in the lowest quintile of physical fitness had a higher risk for mortality due to all causes, cardiovascular disease and cancer than those in the other four quintiles. Those in the other quintiles did not differ in risk.

Body composition

Body composition is the only component of health-related fitness that is directly related to health in youth. This component is assessed by skinfolds, stature, and weight. Skinfold values are used alone or in combination. The commonly used skinfolds are the triceps, subscapular, suprailiac, and medial calf. The sum of the triceps and calf, and the sum of the subscapular and triceps skinfolds are also used. The medial calf and triceps skinfolds are used in children age 6 to 9 years, and the subscapular and triceps skinfolds are used in children 10 to 18 years. Other skinfolds and sums of skinfolds can also be used in the assessment of body composition.

Health-related physical fitness is ordinarily estimated relative to population based percentiles or criterion-referenced standards. The best method of classification has yet to be defined. Percentile norms for skinfolds are available from the National Children and Youth Fitness Studies I and II (NCYFS, Ross et al., 1987; Safrit, 1995). Criterion-referenced standards were developed for the recent version of the AAHPERD health-related physical fitness battery, Physical Best (AAHPERD, 1989). Percentiles for skinfolds in Brazilian children are only available for non-nationally representative samples (Barbanti, 1982, 1983; Böhme and Freitas, 1989; Goldberg et al., 1986; Guedes,

1994; Silva, 1992; Queiroz, 1992). On average, skinfolds are lower in Brazilian than in American children, especially at the higher percentiles.

Height and weight are used to calculate the BMI, weight/stature^2. Age and sex-specific BMI criterion-referenced standards are recommended for the Physical Best. NHANES percentiles are also used, and cut-off points for the risk for obesity and obesity have been defined as the 85th and the 95th percentiles, respectively (Himes and Dietz, 1994). The criteria for risk for obesity and obesity can also be applied to the triceps skinfold using NHANES norms (Must et al., 1991b).

Coronary heart disease risk factors

Although hyperlipidemia, hypertension, cigarette smoking, overweight/obesity, and physical inactivity are the major cardiovascular risk factors, the present study will only assess non-invasive risk factors for CHD. Therefore, blood lipids will not be considered in this review.

Cigarette smoking

Cigarette smoking is correlated with CHD and there is a dose-response relationship between smoking and CHD. The relative risk of CHD mortality is 1.5 in smokers versus non smokers. Smoking interacts with other risk factors for CHD; other confounding variables such as obesity, dietary habits and activity level, may influence the link between smoking and CHD. The thrombogenic and atherogenic effects of smoking are the major mechanisms for CHD in smokers (Hays et al., 1996). When smoking cessation occurs there is a quick decrease in the thrombolytic effects and the progression of the atherosclerotic process is slowed.

Smoking prevalence has decreased since late 1960s for males and late 1970s for females. However, the reductions have been less significant in women, teenagers, and individuals in lower income and education groups (Townsend et al., 1994). Black individuals initiate smoking later than Whites. Although Black adults are more likely to be smokers than Whites, they are more likely to be light smokers (< 20 cigarettes, Rogers et al., 1995).

Smoking that begins in adolescence is predictive of smoking during adulthood ($r=0.83$, Elster, 1994). Data from the Youth Risk Behavior Surveillance (YRBS) in 1995 (CDC, 1996) show that 34.8% of high school students (9th to 12th grades) currently smoke (≥ 1 cigarette/day in the last 30 days). White and Hispanic individuals are more prone to be smokers than Black students in both sexes. Almost one-half of these students (16.1% of the total sample) smoked ≥ 20 cigarettes per day. Compared with data from the YRBS in 1993 (30.5% for ≥ 1 cigarette/day and 13.8% for ≥ 20 cigarettes/day), the prevalence of smoking has increased, especially for Black teenagers (Kann et al., 1995). The Bogalusa Heart Study[1] shows similar racial differences in cigarette smoking, although a decrease in cigarette use among adolescents was recently observed (Greenlund et al., 1996).

[1] Bogalusa, Louisiana, is a bi-racial community-based mixed longitudinal study of the early natural history of cardiovascular disease that started in 1976.

Blood Pressure and Hypertension

Blood pressure (BP) varies with age. As individuals grow older, BP values tend to increase. Systolic blood pressure (SBP) increases rapidly in the first week of postnatal life, and slower up to the second month of life. From 2 to 12 months it remains stable, and thereafter SBP shows a steady increase until late adolescence. The increase in SBP seems to only occur with a simultaneous increase in body weight and height (Brandão et al., 1989).

Diastolic blood pressure (DBP) shows a different pattern. It increases in the first week of postnatal life, decreases through the second or third months, and then starts to slowly increase for the rest of the first year, remaining lower than the first week values. Small changes are noticed up to 6 years and then DBP increases are parallel to SBP (Sinaiko, 1995).

Using the data from NHES Cycles II and III, Szklo (1979) showed that from 6 to 12 years SBP was higher in girls. At 12 years there was a crossover and boys presented higher values from then on. No consistent patterns were observed for DBP. A similar trend was shown in the Fels Longitudinal Study (Malina and Roche, 1983).This phenomenon suggests an effect of sexual maturation, as girls enter puberty at earlier ages.

In adulthood, increases in BP are sex-specific. There is a steeper increase in males during early adulthood which continues into middle age. In females, the steeper increase occurs in the middle-age years. The rate of increase, however, varies among individuals (Ward, 1995).

Blood pressure is also influenced by race, where Black individuals show higher values. Although the difference may not always be significant, it is observed in early childhood and continues throughout the lifespan. Alpert and Fox (1993), using meta-analysis found that significant race effects on BP were present in boys from birth to 12 years for DBP and in girls from birth to 18 years for SBP and 19-25 years for DBP. Kozinetz (1991) showed that Black girls 7 to 18 years had higher BP values (both SBP and DBP); however, only in the 10-12 years group the differences were significant. The difference persisted after controlling for body weight, height and sexual maturation.

Data from the Fels Longitudinal Study show that BP status during childhood tracks into adulthood (13 to 40 years of age), with correlation coefficients ranging from 0.39 to 0.24 for SBP and from 0.37 to 0.20 for DBP. Although the correlations are low, the tracking shows that adolescents with high normal DBP had a higher relative risk of adult hypertension, 1.9 for males and 2.6 for females (Beckett et al., 1992).

BP is affected by body weight, where heavier individuals show, on average, higher values. The rate of increase of BP during growth seems to be faster in obese individuals. Law and Shiell (1996), in a meta-analytic review, found that BP is inversely related to birth weight in pre-adolescent children and adults, positively related in neonates, and inconsistent in adolescents. They also reported that the magnitude of this relationship increases with age. Adolescent-onset adult overweight increases the prevalence of hypertension by 8.5 times compared to a lean cohort (Srinivasan et al., 1996).

Both SBP and DBP aggregate in families. Genetic and cultural transmissible effects contribute to the phenotypic variance. Familial aggregation studies show that genetic factors account for 60-70% of the variation in BP, while environmental factors explain the remaining variation (Ward, 1995). Brandão et al. (1992) studied the familial aggregation of blood pressure in a Brazilian sample of adolescents 10 to 15 years. It was estimated that 82% and 64% of the phenotypic variance of SBP and DBP, respectively, is explained by genetic factors.

BP is maintained by the integration of functions of the cardiovascular system and vasoactive hormones. Failure in the integration of these functions results in hypertension. Similarities or differences in patterns across families and populations may occur because of different pressure-maintaining mechanisms (James and Baker, 1995). In children, the common household appears to have an important influence in BP. As expected, natural siblings have higher correlation coefficients than adopted children, but coefficients are greater between siblings than between parent and natural child and parent and adopted child. In adult siblings, the correlation coefficients remain constant even when the adults were exposed to different environmental factors (Ward, 1995). It seems that once adulthood is reached, environmental factors are less influential than genetic factors.

Elevated BP or hypertension is defined as persistently high arterial BP that may have no known cause (essential, idiopathic, or primary) or may be associated with other diseases (secondary, Novak, 1995). Truly hypertensive patients tend to have high BP throughout the day (T. Pickering, 1995). Hypertension is also defined as "an upward resetting of the set point of blood pressure" (G. Pickering, 1995). These definitions imply a cut-off point between normal and high BP. However, definitions are arbitrary, especially because the data relating BP to mortality are largely from clinical settings (T. Pickering, 1995).

Readings in the clinical setting may be higher than normal due to anxiety (also known as white coat hypertension). It yields the possibility of biased interpretations.

Ambulatory measures tend to give a better estimate of the true BP than clinical measurement, and it may be also due to a greater number of readings (the phenomenon of regression toward the mean). It is important to ensure that the subject is comfortable, rested, quiet and at ease, so that the measurement is more likely to be repeatable. Hypertension is to be confirmed by multiple measures at least in 2 subsequent visits one or several weeks apart.

The measurement of BP for diagnosis of hypertension has been standardized by the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (JNC-V, 1993). During the measurement the arm should be supported and kept at the heart level, an appropriate cuff size and a recently calibrated sphygmomanometer should be used, and the two or more readings should be within 5 mm Hg, taken at least 2 minutes apart. No caffeine intake or cigarette smoking should occur at least 30 minutes before the measure, and the individual should rest for 5 minutes prior to the measure. In adults and children, DBP is recorded based on the 5th Korotkoff sound (D5, National High Blood Pressure Education Program, 1996). The average of two measures is used in classifying children. The classification of hypertension for children differs from that for adults, in which percentile values are used instead of cut-off values. High normal BP is a SBP and/or DBP > 90th percentile for age, and hypertension when BP is ≥ 95th percentile (Table 4, Task Force on Blood Pressure Control in Children, 1987).

The prevalence of hypertension increases with age, is greater for Blacks than Whites, and it is greater for less educated individuals independent of race (CDC, 1994; Sorel et al., 1991, 1992). Individuals in low SES and low education groups have a higher prevalence of hypertension than those in higher groups. In early adulthood and early middle age, hypertension is more prevalent in males than in females, but at older ages the situation is reversed.

The prevalence of hypertension in children and adolescents is low, ranging from 0.26% to 1.9%. In children, a major cause for hypertension is renal disease while in adolescents it is diagnosed as early mild hypertension (Sinaiko, 1995). Mild hypertension in adolescence provokes similar cardiac ventricular and hemodynamic changes observed in hypertensive adults (National High Blood Pressure Education Program, 1996). For Brazilian children 10 to 15 years, the prevalence of hypertension (>95th percentile) is 2.7% (Brandão et al., 1992).

Dressler et al. (1986) investigated the extent to which the effect of ethnicity on BP may be modified by the presence (or absence) of psychosocial resources. Psychological resources were measured using an index that combines measures of social support (number of extended kin in the community and perceived support available in problematic situations), and a scale of active coping (active, defensive or passive attitude in given stressful situations).

Regardless of ethnicity, individuals with high psychological resources had lower SBP and DBP than those with low resources, but the difference was more pronounced in mixed-Blacks and Blacks. In an ethnically unequal society, a person in a disadvantaged ethnic status may be at a higher psychosocial stress due to ethnicity, and those individuals with high resources cope better with this stress. Lifestyle stress, as a resultant of the individual's attempt to maintain a higher status style of life which is discordant with his/her true place in the social class hierarchy, offers a higher risk for diastolic hypertension in developing societies (Dressler et al., 1987).

Dressler et al. (in press) also investigated the effects of socioeconomic variables and skin color on blood pressure among Brazilian adults. SES was measured by cultural consonance in lifestyle, defined as the degree to which individuals adhere to a cultural model of appropriate lifestyle, and calculated by the number of the important items owned. They found that darker-skinned Brazilians have higher blood pressure only if they have low cultural consonance in lifestyle, which shows a significant interaction effect between cultural consonance and skin color in relation to blood pressure.

Overweight and obesity

Major changes in dietary patterns have occurred over the last century in the now developed countries. Popkin (1993) identified five patterns of dietary change: collecting food, famine, receding famine, degenerative disease, and behavioral change. From the collecting food pattern to the degenerative disease pattern, the main observed changes in consumption are an increase in fat content (from low to high total fat and cholesterol), decrease in fiber and polyunsaturated fatty acids, and increase in sugar and refined carbohydrates. These changes are partially responsible for the increase in overweight and obesity in the population of developed countries, a public health concern. A concomitant decrease in physical activity also contributes to the increase in overweight and obesity (Popkin, 1994).

As the underdeveloped countries become more industrialized, the changes in diet pattern and increase in the prevalence of overweight and obesity are observed. Some segments of the population are moving towards the behavioral modification pattern, where reduction in the consumption of fat and refined sugars and increase in fibers and complex sugars are emphasized. In both developed and developing countries, well educated and more affluent segments of the population are more likely to make dietary changes.

Body fat depots are dependent on the balance between energy expenditure and energy intake. An excess of energy intake, or a decrease in energy expenditure, or both, results in increase in fat depots. The response to dietary caloric content is also influenced in part by genetics. Gene-diet interaction appears to determine changes in body fat as well as the pattern of distribution of these changes (Bouchard and Pérusse, 1994). Hormonal changes during sexual maturation also contribute to the increase in fat depots, especially in females (Malina and Bouchard, 1991).

There are several methods to estimate body composition. Most of the methods are based on the two component model, where body mass is divided into fat-free mass and fat mass. The gold standard method is densitometry or underwater weighing. Anthropometric studies of body composition include lengths, body weight, breadths, circumferences, and skinfold thicknesses. Skinfold thicknesses, which measure subcutaneous adipose tissue, are the most commonly used for assessing body composition due to the high correlation with percentage body fat and to the relative simplicity of the method. Several skinfold sites are used and the values are either applied to an equation to predict body density (and percentage of body fat) or used in comparison to reference data (individual skinfolds or sum of skinfolds). The NCHS reference data for the triceps skinfold are presented in sex and age specific percentiles, allowing for classification of overweight and obesity by the 85th and 95th percentiles, respectively (Must et al., 1991b).

Overweight is also defined by the BMI. The BMI is dependent on body weight and independent of height. The correlation between the BMI and percentage body fat ranges from 0.40 to 0.60 (Roche, 1996). For adolescents, sex- and age-specific reference data have been reported and values ≥85th percentile are classified as at risk for overweight and those ≥ 95th percentiles as overweight (Himes and Dietz, 1994). The BMI should be carefully used in adolescent males due to potential risk for misclassification of muscular individuals as overweight.

Overweight not only contributes to a decrease in life expectancy, but is also a risk factor for CHD, hypertension, diabetes, cardiovascular disease and chronic respiratory disorders (PAHO, 1994b). The increase in the risk for disease occurs in young as well as in older individuals. Must (1996) reviewed the consequences of obesity in early age. Some of the short-term consequences are respiratory disorders, orthopedic problems, stigmatization and self-image problems, and cardiovascular risk (abnormal glucose tolerance, hypertension, and lipid profile abnormalities). The long term effect of obesity is that young subjects in the upper end of the normal distribution have a higher probability for maintaining their condition from childhood into adulthood (Kannel et al., 1995). Persistent obesity contributes in turn to the excess all-cause and CHD mortality, especially among males.

The Bogalusa Heart Study includes mixed-longitudinal observations of pre-school and school children, and of young adults. Data on individuals who participated in different surveys allow the study of tracking of overweight and obesity. The association between adolescent and adult overweight was investigated in 783 individuals 13 to 17 years in 1976-1977 and who were also examined in 1988-1991 (Srinivasan et al., 1996).

The individuals were classified as overweight or lean according to age-, race-, and sex-specific BMI percentiles of the Bogalusa population (BMI > 75th percentile and BMI >25th and < 50th percentiles, respectively). Fifty-eight percent of the overweight adolescents remained overweight as adults, 41% of the lean adolescents remained lean, while 10% became overweight. The predictive value of overweight was highest for Black females (62%) and lowest for Black males (52%).

Prediction of obesity in adulthood from childhood measures was studied by Rolland-Cachera et al. (1989). The BMI and four skinfolds (biceps, triceps, subscapular, and suprailiac) were collected every 6 months from 1 to 17 years. The subjects were measured again between 18 and 25 years of age. Correlation analyses compared measures for every year from 1 to 16 years and the adult measure. For all comparisons, correlation coefficients for the BMI were higher than those for skinfolds, thus leading to the conclusion that BMI in childhood is more predictive than skinfolds for the prediction of adult values.

Tracking of overweight was investigated from early adolescence to young adulthood in the Amsterdam Growth Study which longitudinally evaluated children 13 to 16 years and then at 21 and 27 years (Twisk et al., 1995). Eighty four males and 98 females were used in this analysis. Body fat was estimated by the sum of 4 skinfolds: biceps, triceps, subscapular, and suprailiac. Interperiod correlation coefficients for age 13 to subsequent ages were calculated. The coefficients ranged from 0.87 to 0.22 for males from 14 to 27 years, and from 0.89 to 0.51 for females.

The predictive value of the childhood BMI for overweight at age 35 years increases with age. The predictive value is moderate for ages < 13 years, good at 13 years, and excellent at 18 years (Guo et al., 1994). Individuals at either the 75th or 95th percentiles of the BMI have higher risk for overweight at age 35 years than those at 50th percentile. The odds ratio for overweight in individuals 8-18 years at the 75th percentile of BMI is more than double the odds ratio for individuals at the 50th percentile. There was no sex difference in this sample. The odds ratio doubles at 1 year of life for those at the 95th percentile and continues to increase during childhood and adolescence. Larger values are observed in females (Guo et al., 1994). In summary, these studies show that overweight at a younger age is a risk for overweight in adulthood.

Using the data from the Bogalusa Heart Study, Webber et al. (1995) showed ethnic differences in BMI, triceps and subscapular skinfolds. They found no systematic ethnic difference in the median BMI values for males up to 20 years of age. After 20 years, values for the median and upper percentiles were higher for White males. The BMI values were consistently higher for Black females at most ages and at all percentiles.

The triceps skinfold tended to be thicker in White males, as well as the subscapular skinfold (only at young adult ages). For girls, the triceps skinfold was greater in Whites until 22 years of age, when skinfolds in Black women increased abruptly. For the subscapular skinfold, no differences were observed in early childhood between White and Black females; however, beginning in adolescence Black girls showed a steeper increase in the skinfold values.

There is an ethnic variation in the prevalence of obesity and this variation is dependent on the criteria used to define overweight and obesity. The most used criteria are: triceps skinfold (T), BMI, and both triceps and BMI (T+BMI), which also includes the criteria triceps only (T_{only}) and BMI only. Using data from several studies, Malina

(1993a) reported a higher prevalence of obesity by the T criterion than for the BMI in girls. By the BMI criterion, more White and Mexican American older girls (12-17 years) were classified as obese, as well as when T+ BMI were used. More Blacks and Asians girls were defined as obese by the T_{only} criterion. For younger girls (6-12 years), the T criterion classified more White as obese, while for the BMI criterion more Black girls were obese. For T+ BMI and T_{only} criteria, the prevalences were similar among the ethnic groups.

White younger boys showed a higher prevalence of obesity for the T criteria and for both triceps and BMI. By the BMI criterion, American Indians, followed by White boys had the highest prevalences. In older boys, low prevalences and no major differences among ethnic groups were observed for the T criterion, except for the Indian boys who also showed high prevalence for T+ BMI.

Malina and Katzmarzyk (in press) analyzed the validity of the BMI as an indicator of the risk of overweight and overweight in adolescents by comparing the classifications of individuals using the following criteria: triceps skinfold, percentage of body fat, and BMI. They found that BMI has a high specificity (correctly assign individuals at no risk or not overweight); however, the sensitivities (correctly assigning subjects at risk or overweight) were low and variable among ethnic groups, increasing the chances for misclassification. Nevertheless, they concluded that BMI is an acceptable and valid indicator, and should be used as a screening tool for individuals at risk of overweight or overweight.

Fat distribution

Fat distribution has become an important issue in epidemiology of degenerative diseases. A central distribution of body fat is related to higher levels of lipids, BP, insulin, and other metabolic indicators, and is predictive of ischemic heart disease. Fat distribution is a better predictor of CHD than BMI (Larsson, 1988). Central obesity was found to be predictive of ischemic heart disease independent of BMI, cigarette smoking, and age. The association between central obesity and CHD was similar between Black and White men while it was stronger among White females (Freedman et al., 1995). Obesity and regional fat distribution have heritability values ranging from 5% to 25%, while the cultural transmission effect is about 30% (Bouchard and Pérusse, 1994).

Although computed tomography has a higher reproducibility, fat distribution is commonly based on a ratio of trunk (central) and extremity (peripheral) skinfold thicknesses and/or the ratio of waist-to-hip circumferences, due to lower cost and easy measurement in field studies. Higher ratio values indicate more central fat distribution.

Seidell (1996) stated that it is still premature to define cut-off points of fat distribution to classify high and low risk individuals, mainly because of different methods, cut-off points and small sample sizes that have been used in research.

For the ratio of trunk and extremity skinfolds, sex differences are small during childhood. The ratio of upper to lower trunk skinfolds declines with age in both sexes during infancy and during childhood (Malina and Bouchard, 1988). Sex differences increase during adolescence, when males show higher values than females, thus showing a greater fat accumulation in the trunk in males. In both sexes, Blacks and Mexican Americans have a more central distribution of fat than White Americans. Data on waist-hip ratio also show that males have higher ratios than female adults (Malina, 1996a). In adolescent groups, Asian girls have more fat (TER) in the trunk than Mexican, White and Black American girls, especially Whites and Blacks. Black boys and girls tend to have higher TER values than Whites from childhood through adulthood. Fat distribution using WHR as an indicator does not consistently show ethnic variation in either boys or girls (Malina et al., 1995a).

Hammer et al. (1991) studied the impact of sexual maturation on fat distribution among 10-15 year old females of different ethnicity (White, Asian and Mexican American). In all ethnic groups, increase in sexual maturation stages was related to an increase in hip and waist circumferences and a decrease in the waist to hip ratio. However, significant effects were only found for hip circumference and WHR.

van Lenthe et al. (1996a) studied the influence of timing of maturation on fat distribution in boys and girls aged 13 to 27 years. Early, normal and late maturation was determined by skeletal age, peak height velocity (PHV, boys) and age at menarche (girls). They found no difference in fat distribution between early and late maturers based on skeletal age and PHV. Early menarcheal girls tended to have more centrally distributed fat compared to late menarcheal girls.

Sexual maturation influences the relationship of central fat distribution and cardiovascular risk factors. For sexually immature adolescents (based on a combination of stages of breast/genital and pubic hair), the relationship was not significant but it increased later in maturation. It is suggested that the relationship between fat distribution and CHD risk increases with age and becomes significant from late adolescence on (Sangi and Mueller, 1991).

The tracking of fat distribution was investigated by van Lenthe et al. (1996b) using data from the Amsterdam Growth and Health Study subjects aged 13 to 29 years. Interage correlation and generalized estimating equations (GEE) were used in the analyses. The correlation coefficients for TER varied from 0.43 to 0.53 for males and from 0.53 to 0.58 for females, depending on the combination of skinfolds (subscapular(SS)/triceps(T), SS/SS+T, SS+suprailiac/biceps+T+SS+suprailiac). The GEE coefficients varied form 0.56 to 0.67 in boys and from 0.57 to 0.70 in girls.

Katzmarzyk et al. (in press) also investigated the tracking of fat distribution in 7-69 year old individuals. TER adjusted for overall fatness and waist circumference adjusted for the BMI were the fat distribution indicators. Tracking was evaluated by both interage correlation and permanence in the same quintile during the two surveys, which were seven years apart. For TER_{adj}, correlation coefficients ranged from 0.23 to 0.63. The tracking pattern of $waist_{adj}$ was more variable than TER_{adj} and varied from 0.21 to 0.77. For both variables, interage correlation coefficients were consistently higher in females. The tracking was higher in the extremes quintiles.

Television viewing

Television viewing has become a public health concern due to its relationship with obesity, smoking, hostility, and aggression (Hoffman, 1996). The American Academy of Pediatrics has recommended that children should spend no more than 2 hours a day of TV watching (American Academy of Pediatrics, 1986, cited by Gortmaker et al., 1996); however, the reported average time of TV viewing in children and adolescents is 3-4 hours (Stransburger, 1992, cited by Strong and Kelder, 1996). The link between TV watching and obesity is twofold: low physical activity levels are observed during TV watching and the chance of consumption of food, especially nutritionally weak foods, is increased. The relationship between TV watching and obesity appears to become stronger with age.

Dietz et al. (1985) demonstrated a causal relationship between TV viewing and obesity in children aged 6 to 11 years. Cross-sectional and longitudinal data from the NHES (Cycles II and III) were used to investigate the causal relationship. Individuals who daily watched TV for longer periods were more obese, indicating a dose-response effect. This effect remained after controlling for the effects of past history of obesity and SES characteristics of the family. Children with more TV viewing in cycle II were more likely to be obese at cycle III.

Gortmaker et al. (1996) also suggested a dose-response relationship between obesity and TV viewing hours among children 10-15 years. The odds of being overweight were 4.6 times for those watching more than 5 hours a day compared with children who watched 0 to 2 hours. The attributable risk for the effect of TV watching on obesity was 62%. Sidney et al. (1996) found odds ratios for obesity ranging from 1.5 to 2.3 in young White and Black adults (23 to 35 years) of both sexes for individuals watching TV more than 4 hours a day. Conversely, DuRant et al. (1994) found no relationship between observed TV time and activity levels in children 3-4 years, suggesting that the relationship starts after 4 years of age.

Physical activity

Due to the effects of regular exercise on the health of adults, the promotion of physically active lifestyles has been emphasized in children and adolescents to foster adherence to physical activity through the lifespan. The CDC/ACSM (Pate et al., 1995) have issued a position statement emphasizing regular physical activity. The study of physical activity habits is important to understand the determinants of exercise in children and adults and to design programs supporting active lifestyles. Habitual physical activity is influenced by both genetic (29%, due only to biologic transmissible variance) and by environmental factors (71%, Pérusse et al., 1989).

There are a variety of methods for assessing physical activity in populations (Cale and Almond, 1992; Hensley et al., 1993; LaPorte et al., 1985; Montoye and Taylor, 1984; Saris, 1986). The methods are classified as direct and indirect (Paffenberger et al., 1993). The direct methods include questionnaires, diary annotation, and mechanical and electronic monitoring. Indirect methods consist of the assessment of diet, body composition and, physiological fitness assessment; sports and recreational participation; and occupational classification.

Questionnaires are the method of choice in epidemiological studies of large populations because they permit the investigator to collect different variables from one source in a relatively quick, easy, and inexpensive manner (Baranowski, 1988). Questionnaires are also unobtrusive and non-reactive, and generally do not require much effort to complete (Hensley et al., 1993). However, questionnaires have limitations related to validity and reliability; other potential problems include recall limitations and subjectivity in response.

One limitation of assessing physical activity through a questionnaire is that physical activity is a behavior, a multidimensional experience. The assessment may measure a single aspect of physical activity, isolating this aspect from the sociocultural context in which the physical activity occurs. Children may relate physical activity to exertion, competition, play, social interaction or skill development (Brustad, 1991); therefore, they may perceive physical activity differently from how they are probed for reporting the activity behavior. This difference between perception and report affects the validity and reliability of self and interviewed administrated questionnaires.

The accuracy of physical activity reports immediately after a one-hour exercise bout was investigated in 20 normal weight and 24 obese young subjects, 21.9 ± 6.5 years (Klesges et al., 1990). Subjects were interviewed using the seven-day physical activity recall questionnaire (7PAR) at three different occasions over a one week period. In one of the interviews the subjects were asked to perform one hour of exercise. At the end of the exercise, they self reported physical activity time in four categories that express intensity levels: no movement, limb movement but stationary, slow trunk movement, and rapid trunk movement (aerobic activity). Without being noticed, an observer rated the intensities of the exercise in the same manner the subjects reported. Comparing the observer to the subject data, 68% of the subjects overestimated, 18% estimated accurately and 13% underestimated aerobic activity time. The data on 7PAR for the three assessments showed no significant differences. The findings suggest that physical activity recall is overestimated, which would suggest even lower levels of habitual activity in the population.

The subjectivity of responses also offers limitations to physical activity questionnaires. Children have a shorter attention span and lower time estimation than adults, which would influence reports of total time spent on a specific type of activity. A shorter attention span may interfere with encoding information in memory. Recalling physical activities is limited in children, especially in those under 10 years of age. School children (3rd to 6th grades) reported difficulty in making accurate time estimates for self-reported aerobic activity (Baranowski et al., 1984). Time overestimation in vigorous activities and underestimation in regular activities are usual in children (Saris, 1986). The use of a segmented day (such as before, during and after school) appears to increase accuracy in self report of aerobic activity by children (Baranowski et al., 1984). Accuracy also increases when the interval between activity and report is shortened (Sallis, 1991).

Maximal physical work capacity has been used as a physiological marker for questionnaire validation, but an acceptable validation standard is still a problem (Paffenberger et al., 1993). Significant relationships between maximal oxygen consumption and physical activity questionnaires have been reported in adolescents, but correlation coefficients range from -0.39 to 0.59, indicating low to moderate relationships (Morrow and Freedson, 1994). In summary, the validity of self-reported questionnaires shows low and many insignificant relationships (Baranowski, 1988).

The physical activity questionnaire for older children (PAQ-C) was developed to assess levels of moderate to vigorous physical activity in children older than grade 4 during the school year (Kowalski et al., 1997). The PAQ-C is a seven day recall questionnaire that uses nine statements assessing common sports, leisure time activities and games, and activity in physical education classes, recess, lunch, after school, and in the weekends. These statements are used in the calculation of a score, which is a composite mean of the nine statements. Each of the statements ranges from 1 to 5, with higher scores indicating higher levels of physical activity. PAQ-C also includes an activity rating (how active the subject is compared to other of same sex and age), the frequency of physical activity participation, and illness occurrence that may have prevented physical activity in the week being recalled.

PAQ-C was validated against an activity rating, teacher's rating of children's physical activity, moderate to vigorous physical activity recall, 7PAR, a Caltrac motion sensor, leisure time exercise questionnaire, and the Canadian home fitness step test. All correlation coefficients were significant and low to moderate, consistent with other validation efforts. Construct validity was supported by a moderate positive relationship between PAQ-C and Harter's athletic competence. Divergent validity was provided by a non significant relationship with Harter's behavioral conduct scale (Kowalski et al., 1997). Crocker et al. (1997) reported that PAQ-C has acceptable measurement properties, such as average internal consistency, test-retest reliability and reliability of 2 and 3 PAQ-C scores over a year.

Although there are limitations in the use of PAQ-C, it is easy to administrate and has low subject burden (the estimated time to completion is 20 minutes). The main limitations are no discrimination between moderate and vigorous activities and no estimation of energy expenditure (Crocker et al., 1997).

Tracking of physical activity

The tracking of physical activity during childhood and adolescence, and into adulthood is also low to moderate. Both activity and inactivity appear to track. It is suggested that the more experienced individuals in sport and physical activity tend to be more active in early adulthood, especially males (Malina, 1993b). Dennison et al. (1988) also found that the risk for inactivity in young adulthood (23-25 years) increased as the number of low scores on a youth fitness test taken either in childhood or adolescence increased.

Low interage coefficients for habitual physical activity were observed from 13 to 17 years of age (Mechelen and Kemper, 1995). Raitakari et al. (1994) noted significant correlation coefficients ranging from 0.17 to 0.54 when analyzing physical activity habits from adolescence to young adulthood (12 to 24 yrs) in both males and females. Tracking of physical activity in adulthood has also shown low to moderate correlation coefficients (Malina, 1996b).

Physical activity epidemiology

Generally one-quarter to one-third of the population in developed countries is physically inactive (Stephens and Caspersen, 1994). Because low physical activity levels are related to higher risk for degenerative diseases, engagement in more active lifestyles has been promoted. Physical activity levels vary with age, sex, SES, and educational levels. Physical activity levels decrease with age, and the steepest decrease in activity occurs during adolescence.

The steep reduction in physical activity during adolescence is independent of method of assessment (Kemper, 1994). Data from the NCYFS also show decrease in physical activity defined as engagement in activities outside of school physical education (Ross et al., 1985). The results of the YRBS -1995 (CDC, 1996), show the same trend of decreased participation in all types of exercise (vigorous and moderate, stretching, and strengthening) as well as in organized sports and physical education programs. The decline of physical activity patterns seems to continue through older ages. However, there is evidence that older individuals increase activity patterns more than younger adults (Stephens and Caspersen, 1994).

For all ages, males are more likely to be active than females, and the sex difference is more pronounced in vigorous activities than in moderate activities. The difference is about 15% to 25% in school-age children and tends to increase because the rates for decreasing in physical activity patterns are higher in females than in males (Sallis, 1993). Aaron et al. (1993) estimated median values for leisure time activity at 22.5 hours/week in male adolescents and 6.6 hours/week in females. Data from the YRBS -1995 also show sex differences in participation in stretching and strengthening activities, school physical education, and organized sports. More males than females achieved the Healthy People 2000 objectives for physical activity[2] (Aaron et al., 1993).

There may be ethnic differences in physical activity. For all ages, White individuals are more prone to be active than non-Whites (Aaron et al., 1993; CDC, 1993b; CDC, 1995). The same trend is observed for SES (income and education, CDC, 1993b; Stephens and Caspersen, 1994). The fact that non-Whites are overrepresented in lower SES groups may explain the ethnic difference in physical activity. Ford et al. (1991) found a SES difference in overall time spent in physical activity in adult females but not in males. Cauley et al. (1991) reported no differences between low and high SES

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[2] The following criteria were used: light to moderate activity- at least 30 minutes/day (3.5 hr/wk); vigorous activity- 3 or more days/week, at least 20 minutes/day (CDC,1993a).

adult males and females for several physical activity variables: average kilocalories per week, light activities, flights of stairs per day, and blocks walked per day. Significant differences were observed in the vigorous and moderate activities only in males.

Spurr and Reina (1990) investigated the daily pattern of physical activity (expressed as % $\dot{V}O_2$ max) in normal and undernourished Colombian children 6 to 16 years. Children performed a maximal treadmill test, where a direct measure of $\dot{V}O_2$ max and heart rate were collected. During a week day, the subjects wore a heart rate monitor for approximately 10 hours. Data from the heart rate monitor were averaged into 30 minute units, allowing for the estimation of % $\dot{V}O_2$ max achieved during the day. Typical activities included attendance to school, after-school play, homework preparation and TV watching. The assessment of nutritional status was done by using weight- and height-for-age for upper SES Colombian children. Marginal malnutrition was defined as weight-for-age and height-for-age values <95% of the reference. As expected, $\dot{V}O_2$ max was significantly lower in the malnourished boys and girls. No differences were found for average % $\dot{V}O_2$ max during school or free time between nutritional status groups or for time spent in three ranges of % $\dot{V}O_2$ max (<30%, 30-50%, and >50%). The average % $\dot{V}O_2$ /12 hours was also not significant. In the same sample, Spurr (1990) found that undernourished boys had lower daily energy expenditure (assessed by 24 hour heart rate monitoring) and lower energy expended in activity than normal nourished boys. No differences were observed in females.

Physical activity, cardiorespiratory fitness, and risk factors for CHD

The effects of regular physical activity on CHD risk factors are established for the adult population, where changes in body composition, blood pressure and blood lipids are observed in association with activity programs. However, these changes are not well established in children and adolescents. The low prevalence of risk factors in the young population may explain the apparent lack of chronic effect of habitual exercise on healthy adolescents. On the other hand, individuals at higher risk appear to benefit from physical activity interventions.

Hypertension is affected by physical activity and physical fitness level in adolescents. Cross-sectional data show a relationship between physical activity (or physical fitness) and BP. However, when the data are adjusted for a measure of body size or fatness, the relationship tends to be reduced or lose statistical significance (Alpert and Wilmore, 1994).

Comparing fitness levels of boys age 8 to 15 years, Kwee and Wilmore (1990) found differences in BP among the four fitness groups. The boys in the highest fitness group showed significantly lower SBP and DBP. The differences remained unchanged after controlling for fatness, but not after adjusting for age. Tell and Vellar (1988), however, found that the relationship between fitness and BP was independent of the BMI in children 10 to 14 years.

The relationship between cardiorespiratory fitness and BP was investigated in Italian boys and girls 10 to 17 years (Bazzano et al., 1992). Cardiorespiratory fitness was assessed by the 1-mile run, and the Physical Best criterion-referenced standards were used to classify the children as passing or failing the test. No difference was found for

SBP in boys; however, DBP was lower in those who passed the cardiovascular fitness test. No differences were observed for SBP or DBP between the two fitness groups of girls. Sallis et al. (1988) also found a significant relationship between fitness and DBP in boys, 11.9± 1.7 years, but not in girls of the same age.

Physical activity and physical fitness are related to body fatness. Individuals with higher body fat tend to be less active and to have lower motor- and health-related fitness scores, as shown by the data from the Leuven Growth Study of Belgian Boys (Beunen et al, 1983) and of Flemish Girls (Malina et al., 1995a). Fatness had a negative effect on cardiovascular recovery from a step test, and accounted for 3% to 5% of the variance in girls 7 to 17 years. For the PWC 170, fatness explained 0% to 16% of the variance depending on age (Malina et al., 1995a).

Tell and Vellar (1988) also found a negative relationship between the BMI and aerobic capacity among boys and girls. BMI and triceps skinfolds were significantly lower in children in the higher quartiles of $\dot{V}O_2$ max. The difference in body fatness held true for more active males, but not for females. Kemper (1986) found small differences in percentage body fat in the most active male teenagers compared with the least active. In females, the activity level had no effect on body fat.

Obese individuals appear to be less active than their leaner counterparts, although the obese can expend an equal or even higher total amount of energy, due to their larger body size (Bar-Or and Baranowski, 1994). However, obese boys were as active as non-obese siblings in a playground, but were less active inside and outside the home (Waxman and Stunkard, 1980).

Physical activity has been included in multidisciplinary interventions for the obese, due to its effects on body fatness as well as on BP and blood lipids. Physical activity for the obese children and adolescents is especially important because these individuals usually have clusters of CHD risk factors that tend to track into adulthood.

Summary

The main points of this review can be summarized as follows:

1. Effects of nutritional status

   - Malnourished children show lower cardiorespiratory fitness as well as lower work output;

   - No differences were observed in physical activity levels between normal and marginally nourished children.

2. Effects of biological maturation

   - Greater increase in fat mass in females and muscle mass in males;

   - Males have proportionally higher subcutaneous fat accumulation in the trunk;

   - Early maturers have increase risk for obesity as well as an increase in centrally distributed fat;

   - Early maturers also have higher $\dot{V}O_2$ max, however, the difference disappears in late adolescence;

   - Females show higher BP values until 12 years of age, then males have higher values due to the earlier beginning of sexual maturation in females.

3. Racial/ethnic differences

   - Black females have lower $\dot{V}O_2$ max which is independent of body weight and fat-free mass;

- White boys and girls are more likely to smoke than Blacks, although an increase in the prevalence is only observed in Black adolescents;

- Black individuals are more likely to be less active than their White counterparts.

4. SES differences

- Low SES groups are more likely to have higher BP and to be less active.

5. Tracking of risk factors

- Overweight, obesity, fat distribution, high normal blood pressure, and physical activity tracks from adolescence into adulthood with low to moderate coefficients.

CHAPTER 3

METHODOLOGY

The purpose of this study was to investigate selected risk factors for CHD and health-related physical fitness of 8th grade students from the public school system in Niterói, Rio de Janeiro. Eighth grade students, 14-15 years of age, were selected because the 8th grade is the last year of mandatory education. Some graduates do not continue their education, while others enroll in night school so that they can work in the day. In both cases, the 8th grade may be the last time for formal physical education programs and an environment where skills for lifetime physical activity may be pursued. Physical education classes are optional in night school.

The majority of students in the 8th grade are 14 –15 years of age. There are few older students in this grade, but including them in the sample would create small groups at the older ages and problems of low statistical power in the analyses.

The study was approved by the University Committee for Research Involving Human Subjects (UCRIHS, Appendix A) at Michigan State University and followed the guidelines for research involving human subjects of the Brazilian National Council of Health (Ministry of Health, 1996). The data were collected from mid-September to mid-November 1997 and from mid-March to mid-May 1998.

Before describing the methodology, an overview of the social context of Brazil and of Niterói in particular will be presented to establish a background in the peculiarities of the country.

The Brazilian context

Brazil has an area of more than 3 million square miles and is divided into five geographical regions: North, Northeast, Southeast, South and Central West (Appendix B). Diversity among these regions is noticeable from climate (tropical in the North and humid subtropical in the South) to ethnic groups, culture and degree of development.

The 1991 Brazilian Census estimated a population of 156.5 million inhabitants (IBGE, 1993). As a characteristic of developing countries, the Brazilian population is young; 35% is below 15 years of age. However, due to the decrease in mortality rates, especially at young ages as well as a decrease in fertility rates and increase in life expectancy, the population is aging. In the last 3 decades, the population over 65 years of age has almost doubled, from 3% in the 1960s to 5% in the 1990s (IBGE, 1993). The population between 15 and 65 years increased from 54% to 60% in the same period. The aging process poses new demands on the society: in the job market, in the educational system and also in the health care system, especially due to increased prevalence of degenerative diseases.

The population is primarily composed of native Brazilians, and those of European and African ancestry. Brazil was colonized by Portugal, which led to a great immigration of Portuguese to the "new land". The native Brazilian population at the time of discovery was estimated around 3 million people. Decrease in this population occurred due to the different epidemics, smallpox and respiratory diseases, to which the natives were not previously exposed and had no immunity (Crosby, 1972) as well as due to the battles for the ownership of the land. Africans were brought to Brazil as slaves to work in agriculture. In the late 1800s, after abolition of slavery, there was a large immigration of

Europeans, mainly to work in coffee plantations in São Paulo. Approximately one-third of these immigrants were from Italy; the remainder were from Portugal, Spain, and Germany. The immigration of Asians occurred in the beginning of this century and was also related to the agricultural work force (Teixeira, 1993).

In the 1991 Census, 55.3% of the population was White, 4.9% was Black, 39.3% was *Pardo*, and 0.5% was Asian. Pardos are individuals born to interracial relationship, including the admixture between Blacks and Whites, Whites and Natives and Natives and Blacks. The composition of the population varies by geographical region (Table 5). Although a high percentage of Pardos is observed in the North, those Pardos are mainly born to White and Native Brazilian parents.

The assessment of race is based on self-report, which poses limitations to classification. In skin color conscious societies, persons who are phenotypically of one race may define themselves as belonging to another (Dressler, 1991). Even though the country is well-known for racial democracy, racial inequalities do exist and are found in education and income (IBGE, 1993). Blacks and Pardos have a higher rate of illiteracy and a lower educational level. The mean income for all types of jobs among Blacks and Pardos is about one-half of the income of the Whites; however, the opportunity for upward social mobility of Pardos is greater than that for Blacks (Skidmore and Smith, 1997).

Seventy-one percent of the population lives in urban areas. The economic growth of Brazil was accelerated in the 1970s due to external money from institutions such as the World Bank and the International Monetary Fund. The money was applied to sustain industrial growth, mainly in the South and Southeast regions. This industrial growth resulted in migration to these areas as individuals looked for job opportunities and better living conditions. However, in the 1980s external debt obligations increased and export earnings decreased, resulting in almost a decade of negative economic growth (Skidmore and Smith, 1997). The economy started to grow again at a rate of 3.5% per year in the 1990s.

Due to the economic crisis, the income distribution became even more unequal. Brazil has one of the worst income distributions in the world, where the highest 10% of the population share 48% of the income, while the lowest 50% share only 12.1% (IBGE, 1993). The Gross National Product per capita is equivalent to US $ 2,930, which classifies the Brazilian economy as upper middle income (World Bank, 1995). On the other hand, due to the skewed income distribution, 30% of the population is living below the poverty line (IPEA, 1996). The percentage of the population in poverty varies among the five geographical regions, where the Southeast, the South, and the Central West regions have values between 20% and 25% and the North and the Northeast regions have values between 43% and 45%. The mean income of workers older than 15 years in metropolitan areas is 5.73 monthly minimal wages (MMW)[3]. São Paulo is the only metropolitan area with a mean income above the national median (7.14 MMW, IBGE on-line, 1997). Table 6 presents the mean wages for males and females by occupational category for the period of 1981-1990 (Oliveira, 1993).

Migration has increased problems in the urban areas: air pollution, shortage of housing, haphazard growth of marginal populations in unsanitary areas such as slums,

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[3] The MMW in November, 1998 is approximately US$110 (O Globo On, 1998).

underemployment and unemployment, increase in the informal economy, increase in violence (e.g., homicides) and drug addiction, and emergence of human ghettos (PAHO, 1994b). The burden on living conditions in urban areas posed by migration is even greater because there is a lack of resources to maintain the structures needed to sustain development. During the economic crisis, a deterioration in public services, such as education and health, was observed due to low Governmental investments in those areas.

The most vulnerable urban group is children who tend to live in hostile situations, such as poor housing, to have low quality and insufficient amounts of food (thus contributing to undernutrition at young ages), to lack of parental supervision and even abandonment, and to early entry into the labor force to increase family income. Opportunities for education, recreation, and health care are decreased in this group of children (WHO, 1991). Due to poverty, but not exclusively, the number of street children has increased in Brazil in the last two decades. There are approximately 7 million street children in the whole country, most of whom are working children who return to home at night (Swift, 1991). Children living in the streets are a minority; nevertheless, homeless children are a problem that remains to be solved

Poverty is related to children in the work force. Seventeen percent of 10-14 year old children and 50% of 15-17 year old adolescents in Brazil were in the work force in 1990 (IPEA, 1996). Twenty-three percent of these children and 54% of these adolescents came from families with household incomes less than 0.5 MMW. The majority of these youngsters earns up to 1 MMW (Oliveira, 1993).

Table 7 shows the distribution of children and adolescents according to working and studying status and household income. As household income increases, more individuals engage exclusively in studying. Low income limits the access of youth to better education either in terms of having to quit school to work or having less time and resources to study when they work and study. Because of this limitation, these individuals are at a disadvantage in the job market due to their lower qualification compared to individuals who only study; therefore, they have limited social mobility.

Social class determines health and disease status of a population because it determines, to a large extent, lifestyle and exposure to different environments (Marmot et al., 1987). Low SES is associated with high all-cause mortality as well as with other health outcomes. Link and Phelan (1995) indicated that high SES individuals have higher resources, such as easy access to medical care and information, that can be transformed in health-related resources, and thus maintain an advantageous health status. However, these resources are not readily available to low SES groups, creating differences in health outcomes between high and low SES groups.

Education in Brazil

The educational system is divided into two levels: basic (composed by pre-school, elementary and secondary education) and higher education (policy 9394/96, Brazilian Congress, 1997). Elementary education includes the first eight years of education and it is mandatory from 7 to 14 years of age; however, 14% of children in this age were not enrolled in school in 1991. Only 18% of the population graduated from basic education (IPEA, 1996). In 1990, almost 56% of the graduates of elementary education were aged 14 to 15 years, while 35% were older than 15 years (IBGE, 1993).

Secondary education encompasses three years and it is equivalent to the American high school. It can also be designed to prepare individuals to the job market. Only 17% of the population 15 to 19 years are enrolled in secondary school (IPEA, 1996). Recent data show that 27% of adolescents 15-17 years of age are in secondary school (Jornal da Ciência-Email, personal communication, September 4, 1998). Higher education includes both undergraduate and graduate programs, and an estimated 8% of the population has completed a college degree (IPEA, 1996).

Illiteracy characterizes 19% of the population (World Bank, 1995), and 61% of the heads of the households in Brazil in 1989-1990 had no more than four years of education (IBGE, 1993). The mean number of years of education in the country is 5.1 for males and 4.9 for females, and again the more developed areas have higher averages. Mean education also differs among racial groups, where Asians and Whites have higher levels (8.6 years and 5.9 years, respectively) than Blacks and Pardos (3.3 years and 3.6 years, IPEA, 1996). Over the last three decades, mean education has increased in the population, although the difference between sexes and racial groups has persisted.

School period varies from 4.5 to 5 hours a day, 5 days a week in elementary education and 6 days in secondary. The policy 9394/96 (Brazilian Congress, 1997) proposes that public schools become full time in the next few years.

Physical education

Concern about people's health and fitness in the middle of the 1800s influenced the adoption of health and physical education in school systems in the United States (Swanson and Spears, 1995), United Kingdom (Kirk, 1992), Australia (Colquhoun and Kirk, 1987) as well as in Brazil, where it became mandatory in 1855 (Betti, 1991;

Ghiraldelli, 1989).

In the early 1990s, the inclusion of health-related physical fitness in the curriculum was suggested, as the international literature on school physical education pointed out the need for fostering an active lifestyle throughout the lifespan. As the emphasis of physical education programs has been sports activities, the participation of school physical education programs in health education/promotion seems to have been minimal, especially because those who are not skilled tend not to be engaged in activity. A survey of teachers and students of public and private basic education schools in Rio de Janeiro showed that only 3% of students and 4.5% of teachers considered physical activity as a health-related behavior (Boruchovitch et al., 1991).

A new policy (Ministry of Education,1997a) establishes that the purpose of physical education is to enhance participation in physical activities as a way to social integration and leisure, and to learn how to exercise according to individual abilities and limitations. The policy also gives physical education the task of contributing to a more active society through the teaching of the benefits of regular exercise. Schools may play an important role in health promotion and physical education for children and adolescents; however, alternative programs in the community should be considered as they extend the access to health and physical education to those who are out of the school system.

Many schools are adapting their programs to the new policy. The lack of an infrastructure for physical education classes (equipment and physical area) and shortage of professionals appears to be the major limitations for shifting to this new policy in both the public school system and in rural areas of the country.

Health status of the Brazilian population

Brazil combines mortality patterns of both developed and developing countries. Infectious diseases are the major cause of death from 0 to 4 years of age. Infant mortality is 51.6/1,000 live births, although rates vary by geographical region and socioeconomic status. Infant mortality has decreased by 40% in the last decades following economic growth and improvements in living conditions. Life expectancy has increased as well; it was 65.5 years in 1990, although the median age at death was 57 years (IBGE, 1993).

Both prevalence and proportionate mortality rates of degenerative diseases have increased since 1960s while infectious disease mortality has decreased, as the country became more developed. This is consistent with the epidemiological transition proposed by Omran (1971). Figure 1 presents proportionate mortality rates for infectious diseases and diseases of the circulatory system (which includes CHD), cancer, and all external causes of death combined. Data were available for 1977 through 1994 in the IBGE (1993) and DATASUS[4] (1997) resources. Slight increases were observed for the cardiovascular disease, cancer and external causes. Chor et al. (1995) pointed out that studies on the quality of information on death certificates are not available in Brazil; therefore, the data should be viewed as trends in mortality rates. Nevertheless, preventive strategies should be taken in order to identify high risk groups and those with multiple risks.

The leading causes of death change across the life span (PAHO, 1994a). Causes

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[4] DATASUS is the part of the Unified Health System that deals with statistical data of mortality, hospital admissions, and reimbursement to the private health sector.

of death by age group are as follows: (1) conditions originating in the perinatal period for infants under 1 year of age; (2) infectious and parasitic diseases for children aged 1-4; (3) external causes for persons aged 5-39 years; and (4) diseases of the circulatory system for persons 40+ years (Figure 2).

Malnutrition

The prevalence of malnutrition (defined as weight-for-age below -2 z scores) in children under 5 years in Brazil was 18.4% in 1989, varying from 2.5% in the South region to 12.8% in the Northeast region, and from 13.6% in the low income class to 1.4% in the highest income class (Monteiro et al., 1992). There has been a downward trend in the prevalence of malnutrition in children under 5 years of age in all geographic regions and all economic strata (Monteiro et al., 1992).

Malnutrition is associated with decreased immunologic function due to lower protein availability. This depressed immunocompetence increases the risk of infections as well as increases the recovery time from an infection (Kerpel-Fronius, 1983). Infections such as diarrhea, pneumonia and measles are responsible for the high mortality rates in children under 5 years of age, especially in the Northeast region where malnutrition is more prevalent (Monteiro et al., 1995a).

Overnutrition and overweight

A nutritional transition to a high fat and high refined sugar diet is also evident in Brazil (Monteiro et al., 1995b). Obesity is becoming a health problem, but few studies have been carried out to determine the prevalence in the population and unfortunately, data are not available for older children and adolescents.

The prevalence of overweight (based on weight-for-height above 2 z scores) in 0-6 year old children is 2.2% (PAHO, 1994a). Using data from two National Surveys of Households, 1974 and 1989, Monteiro et al. (1995b) showed that the prevalence of overweight (defined as weight-for-height > 2 z-scores for children and BMI > 30 kg/m^2 for adults) remained stable in children 1 to 4 years (sexes combined, 4.6%). However, the prevalence decreased in males and increased in females.

In adults 25 to 64 years of age, the prevalence of overweight increased both in sex-specific or combined sex analyses. The data also showed that the greatest increase in the prevalence of adult overweight occurred in women of low SES (Figure 3). Data from the Ministry of Health (1993) showed that 32% of the Brazilian adult population are overweight, based on a BMI >25 kg/m^2 (41% males and 59% females). Obesity (BMI>30 kg/m^2) was found in 8% of adults (71.3% females).

The recent preliminary results from the Survey on Standards of Life (IBGE on-line, 1998), using data collected in 1996/97, showed similar trends of obesity in adults: 29% of the sample was overweight while 9.8% were obese (BMI >25 kg/m^2 and BMI >30 kg/m^2 criteria, respectively). More females were overweight/obese than males, although the comparison with previous data showed that there was a greater increase in the prevalence in males. There is a higher prevalence of overweight/obesity in the Southeast region compared to the Northeast. The prevalence of overweight/obesity increases with increasing income; however the highest prevalence was observed in the 4th quintile of income.

Hypertension

No direct prevalence data on hypertension are available in Brazil, but it is estimated to range from 11 to 20% (Ribeiro et al., 1988). The Ministry of Health (1993) estimated the prevalence of hypertension at 15% for individuals ages 20+ years. Klein (1981, 1985, cited in Lolio, 1990) reported prevalences of hypertension in two samples of males and females aged 20 to 74 years, and including patients under control of hypertension. One sample was from Porto Alegre, Rio Grande do Sul, South Brazil, and the other from Volta Redonda, Rio de Janeiro, Southeast Brazil. The prevalence of hypertension (systolic blood pressure ≥ 160 mm Hg, and/or diastolic blood pressure ≥ 95 mm Hg) was 11.3% in Porto Alegre and 10.1% in Volta Redonda. Hypertension is the third most common diagnoses in temporary working disability, and it is the leading cause in permanent working disability (Ribeiro et al., 1988).

A higher prevalence of hypertension was observed in blue collar workers than in white collar workers, with prevalences ranging from 2.9 to 17.6% (Cordeiro et al., 1993). As a part of the Multicenter Study in Latin America, a total of 1157 individuals 15 to 64 years from Porto Alegre had their blood pressure, CHD risk factors and SES variables (education, income, and social class) measured. The less privileged males showed a higher prevalence of hypertension, and the inverse was observed in females (Duncan et al., 1993b). Hypertension was more prevalent in Blacks (26.4%) than in Whites (18.4%) from Pelotas, Rio Grande do Sul (Piccini and Victora, 1994). Dressler (1991) suggested that part of the racial/ethnic group differences in blood pressure may be socioculturally mediated.

Cigarette smoking

Data on the use of tobacco in Brazil showed that 23.9% (13.9% males and 10% females) of the sampled subjects were smokers (Ministry of Health, 1993). Except for the age group 50+ years, women had a higher prevalence of smoking than men. This was also true at younger ages, showing that more women start to use cigarettes earlier in life. The prevalences of smoking in children 10-14 years and 15-19 years were approximately 2% and 5% for females and 1% and 4% for males. The highest prevalence was observed for the 30-49 years group. Average usage in males was 11-20 cigarettes a day, and that for females was 5-10 cigarettes a day. The prevalence in males has declined in the last decade, but the reverse has occurred in females (Achutti, 1988, cited in Briscoe, 1990). Although females start smoking earlier than males, they tend to smoke fewer cigarettes per day.

External causes of mortality

External causes of death have increased in Brazil in the last 50 years from 2.6% to 9.3% (Camargo et al., 1995). Males are in general more prone to external causes of mortality than females. The prevalence increases with age, peaking at age group 15-44 years (PAHO, 1994b). The major external cause is motor vehicle traffic accidents, which are most frequently alcohol-related, especially in younger ages. There is an increase in alcohol consumption in young people in countries such as Brazil. A 1989 survey of Brazilian high school students in urban areas, indicated that 25 to 54% drank alcoholic beverages. (PAHO, 1994a).

The increase in urbanization and drug use contribute to the increase in homicides, the second most frequent cause of adolescent deaths. Males have higher risk of homicide than females. Homicides represent 4.8% of the mortality in children 10-14 years; the proportionate mortality rate increases to 25.8% in the 15-19 year group (DATASUS on-line, 1997).

Physical activity level and hours of TV viewing

Preliminary data from the Survey on Standards of Life (IBGE on-line, 1998) showed that only 19.2% of the sample was physically active, i.e., exercised regularly during the week. The males were more active than females: 26% and 12.7%, respectively. In this group, 7.9% of individuals exercised at least 3 times a week for 30 or more minutes (10.8% for males and 5.2% for females). Leisure and aesthetics were the reasons for regular exercising reported by 14.3% of the surveyed individuals. Data from Rio Grande do Sul showed that 47% of middle class and 25% of lower class adults exercise regularly (Achutti et al., 1988, cited by Briscoe, 1990).

Mello et al. (1998) studied the engagement in exercise in a group of 1,000 people from the city of São Paulo. They found that 31.3% participated in physical activities regularly. Walking was the most reported activity (36.4%) followed by soccer (17.3%) and aerobics (16%). Thirty one percent of individuals exercised daily, 29.1% exercised 3 to 6 times a week and 35.8% 1 to 2 times a week. The authors did not report the distribution in age or sex categories. Nevertheless, they stated that the sample was composed of individuals from all social classes and from all geographical regions in the city.

Few studies of physical activity on Brazilian adolescents compare students of low and high SES (Matsudo et al., 1996; Andrade et al., 1996). Matsudo et al. (1996) investigated the physical activity level of adolescent males (mean age= 13 years) of high and low SES. The questionnaire included a self activity rating, a self-report of present activity level, hours of television viewing, duration of regular walking, walking pace, and perceived exertion. Low SES students were more likely to consider themselves as very active than high SES students (45.6% and 25.4%). High SES subjects more often classified themselves as sedentary. The self activity rating showed that low SES adolescents consider themselves more active than sex and age peers more frequently than high SES males (42.9% and 29.5%, respectively). Low SES students walked for a longer duration than high SES adolescents, and no differences were observed for walking pace or TV viewing (mean values 4.2 and 3.6 hrs/day, respectively).

Using the same methodology, Andrade et al. (1998) analyzed the physical activity levels of low and high SES females (mean age= 12 years). They found that low SES females tend to report being more sedentary than high SES girls (9% and 5.7% respectively). More high SES girls reported regular activity. On the other hand, low SES girls were frequently more active than their peers in the high SES group (29.2% vs 12.8%). As in low SES boys, the low SES girls also showed a longer duration in walking, without significant difference in the walking pace. Low SES females were more likely to classify themselves as equally or more active than sex and age peers (87.6% and 80.60% for low and high SES, respectively). Average TV viewing was 4.1 hrs/day for low SES girls and 3.9 hrs/day for peers of high SES.

One hundred and forty one children from a high SES area (mean age= 13.1 and

12.75 years for boys and girls, respectively) had their physical activity profile investigated by Andrade et al. (1996). Fifty three percent of boys and 64.7% of girls reported being regularly active. For the self-activity rating, 59.2% of the boys and 47.8% of girls considered themselves as active as same sex and age peers. Walking was performed by approximately 70% of the sample. Average TV viewing observed was 3.6±1.9 hrs/day for males and 3.9±2.0 hrs/day for females. Results using the same methodology in a low SES sample basically showed similar findings (Matsudo et al., 1998).

The city of the study: Niterói, Rio de Janeiro

Niterói, a city of 51 square miles, is located in the Southeast area of Rio de Janeiro State. The city is separated from the city of Rio de Janeiro by the Guanabara Bay, a distance of 11 miles. The temperature ranges from 14.8° C to 32.2° C (59°-90° F) during the year. The city is divided into five administrative regions: North, East, Bay beaches, Ocean beaches, and Pendotiba, and the two beach regions are the wealthiest regions in the city (Appendix C).

The population in Niterói was estimated as 436,155 inhabitants (46.9% males) in the 1991 Brazilian Census. The annual population growth for the city was 0.85% at that time. The population in Niterói is also young, where 24.5% is under 15 years of age. On the other hand, 7.6% of the population is over 65 years. These two proportions show that Niterói has a relatively older population structure than the general Brazilian population. The age group 10-19 years represents 17% of the population. Table 8 shows the distribution of teenagers in the five administrative regions. Sixty-eight percent of the inhabitants are white, 8% are black, 22% are Pardo and the remaining 2% of individuals are either of Asian or of Native Brazilian origin (IBGE, 1996). The estimated population of 14 and 15 year old males and females in 1997 is shown in Table 9. The median education of adults is 9 years, which is higher than the Brazilian population (PMN/CECITEC, 1994)

Niterói is considered a urban city and approximately 30% of its income is related to services. Naval industry and fishery are also contributors to the city income; however, these contributions are decreasing over the years (Government of Brazil on-line, 1998).

As mentioned before, the health status of the population varies within Brazil according to the degree of development of the area. In this way, the two parameters for measuring health status, life expectancy at birth and infant mortality show better status for Niterói compared to the whole country. Life expectancy at birth is estimated as 70 years while infant mortality is 16/1,000 (65.5 years and 51 6/1,000 respectively for the country). In 1993, proportionate mortality rate for infectious disease was 2.8%, while the values for neoplasms, cardiovascular diseases and external causes were 14.5%, 33.1% and 12.5%, respectively (PMN-CECITEC, 1996b). These values are comparable to the state data and are somewhat lower for infectious disease and higher for cardiovascular diseases comparing to whole country data. The prevalence of malnutrition[5] in children from birth to 5 years of age was investigated by Marins et al. (1995). They found that 20.5% of children were malnourished, while 2.7% of them were classified as moderately and severely malnourished.

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[5] Using Gomez criteria and NCHS reference data.

In terms of leisure physical activity opportunities, Niterói offers several options. There are several beaches (in the Guanabara bay as well as in the open sea), where swimming and beach sports can be performed. At some beaches, sports programs such as beach volleyball and soccer, are offered to children and adolescents at nominal cost. Sports programs in different modalities are also offered at the Caio Martins Sports Complex and at the Fluminense Federal University with low or no cost to the participant. Some of the schools carry their own sports programs and programs are also provided by private sports clubs. Few parks are available for outdoor activities, and as a urban city, the neighborhood does not always offer safe areas for physical activity of children.

Methodological aspects

Sample

The public school system in Niterói includes 71 State and Municipal schools. The criteria for a school entering in the study included having an 8th grade class, a physical education teacher, and a basic sports facility. Using the first criterion, 32 schools were eligible. The schools were grouped according to the five major administrative regions; however, one of these regions (East) had no eligible schools. After obtaining the permission to carry out the study in the schools from both the State and the Municipal Departments of Education (Appendix D), the investigator visited half of the eligible schools, based on accessibility and on the region in which they were located. The sample was intended to be composed as close to the proportion of adolescents in each administrative region.

The visits resulted in the exclusion of three schools; another three schools were selected. Because all but two of the schools had morning classes, scheduling measurement days was limited. Data collection was also restricted by a teacher's strike. The final number of schools in the study was 16 and altogether, 329 individuals were measured and tested (126 males and 203 females). The distribution of schools and subjects across the five administrative regions is shown in Table 10.

In each school, the investigator contacted the principal, explained the study and asked for permission to collect the data in the school. A summary copy of the study proposal was given to the school principal for the school file. After permission was granted, the investigator talked to the 8th grade physical education teacher and requested permission to make the measurements during his/her classes. Several days prior to the data collection, the investigator visited all the 8th grade classes in the school to invite the students to participate in the study and to distribute the parental consent form (Appendix E, both the English and Portuguese versions). Participation in the study was voluntary.

On the day of measurement, only those who had a signed parental consent form were asked about health conditions, such as diabetes, orthopedic limitations for running, respiratory diseases (e.g. asthma). After signing self-assent (Appendix F, both the English and Portuguese versions), the subject was included in the study.

The students were divided into two sub-groups (4 or 5 individuals each), one for anthropometry and blood pressure measurements which were done first, while the other group completed the sociodemographic data form, the self-assessment of sexual maturation, and the physical activity questionnaire. When all the students finished both sections, the 12-minute run was performed. Two research assistants were trained to administer the physical activity questionnaire and the sexual maturation form, as well as to get the distances on the 12 minute run.

A few days later, each participant received a card with some of his/her data (height, weight, estimated percentage of body fat, blood pressure and the distance run in 12 minutes). School principals also received a report with the results for the school.

Variables and Measurement techniques

Sociodemographic Data

Sex

The sex of the subject was recorded on an identification form (Appendix G), which also contained the name of the individual and other sociodemographic data.

Chronological age

The age of the individual was calculated based on birth date and the date of the assessment, to the nearest 0.01 year, according to Eveleth and Tanner (1976).

Social class - socioeconomic status (SES)

Three measures of social class are commonly used in Brazil: occupation, education, and income. These three indicators are both independent and interdependent. They may be used separately or in a composite index. Cooper (1984) pointed out that education and occupation variables may not be comparable across races, and income would be the best indicator of social class. Although income is the best indicator of access to resources, income assessment is a sensitive issue, especially for those in low the SES. Lombardi et al. (1998) proposed a social class classification for epidemiological studies in Brazil based on occupation and education, and also on the relations to the production of goods. Individuals in the middle class are owners or shareholders of medium to small enterprises, or are engaged in occupations that requires a college degree, such as university professors. Persons in the working class are those without a college degree, and are either directly or indirectly related to the production of goods (typical and atypical, respectively). Examples of these two categories are bank tellers and carpenters for in the atypical and typical working class, respectively.

Social class was estimated by using occupation of the head of the household. The parent who signed the consent provided the information on occupation and on the status of employment (employed or self-employed). The occupation of the head of household was categorized according to the classification in the Appendix H. This classification was created by applying the categories proposed by Lombardi et al. (1988) and by using the IBGE list of occupations (1997, on-line), yielding the following categories: upper class, middle class, atypical working class, and typical working class. The atypical working class and typical working class are similar to the American classification of lower middle class and lower class, respectively. For simplification, the American classification will be used.

The subject was also asked if he/she was in the work force. If the subject worked, the occupation was classified in the same manner as that for the head of household. Other sociodemographic data, such as number of individuals in the household and the number of siblings, were also obtained.

Race

Race was self-reported. The subject classified his/her race by using one of the three categories routinely used in Brazilian census: Black, White, and Pardo. Due to the lower number of Black subjects, that group was combined with the Pardo group to form the Non-White group.

Anthropometry

Stature (standing height)

Stature was measured with a portable anthropometer to the nearest 0.1 centimeter. It was measured with the individual standing erect without shoes and with the shoulders relaxed. The head was positioned in the Frankfort horizontal plane. The distance from the floor to the vertex of the skull was measured.

Sitting height

Sitting height was also measured with the portable anthropometer. The individual was sitting erect on a table with the legs freely hanging over the table edge. The head was positioned in the Frankfort horizontal plane. The sitting height was the distance from the table to the vertex of the skull.

Body mass

Body mass was measured on a spring scale to the nearest 454 grams (1 lb.). The subject was wearing light clothes and no shoes. Although the standard technique involves the use of a beam scale, the use of a spring scale is recommended for fieldwork when there is no practical alternative.

Skinfold thicknesses

Six skinfolds were measured to the nearest 0.2 millimeters using a Holtain caliper. Each skinfold was measured three times and the median value was used in the analyses. All measures were taken in the right side of the body. The individual was standing during the measurement.

a. Triceps: it was measured on the back of the arm over the triceps muscle at a level midway between the olecranon and acromial processes.

b. Biceps: it was measured on the anterior aspect of the arm over the biceps muscle at the same level as the triceps skinfold.

c. Subscapular: it was measured on the back just beneath the inferior angle of the scapula, following the natural cleavage line of the skin.

d. Abdominal: it was measured as horizontal fold 3 centimeters lateral and 1 centimeter inferior to the umbilicus.

e. Medial calf: it was measured on the inside of the calf at the level of maximum circumference.

f. Suprailiac: it was measured immediately above the iliac crest in the midaxillary line.

Circumferences

Three circumferences were measured using a flexible, non-stretchable tape. The measurement was taken to the nearest 0.1 centimeter. The individual was standing while the measurements were taken. Each circumference was measured three times and the median value was used in the analyses.

a. Arm (relaxed): it was measured on the relaxed right arm at the site of the triceps skinfold. The arm hanged relaxed with the side during measurement. The tape was in contact with the skin without compressing the underlying soft tissues.

b. Waist: it was measured at the level of the natural waist, the narrowest part of the torso. The clothing was minimal not to interfere with the measurement. No breath holding or contraction of the abdominal muscles was permitted during the measurement.

c. Hip: it was measured at the level of maximal protusion of the buttocks. Gluteal contraction was avoided during the measurement. The measurement was taken over light clothing.

Derived variables

a. Estimated Leg Length (Subischial length): Using both stature and sitting height, leg length was estimated by subtracting sitting height from stature.

b. Sitting height/stature ratio (SHSR): SHSR was used to provide an estimate of relative leg length. It was calculated as

$$SHSR = \frac{\text{sitting height}}{\text{stature}} \times 100$$

c. Body mass index (BMI): BMI was calculated as

$$BMI\,(kg/m^2) = \frac{\text{body mass (kg)}}{\text{stature}^2\,(m^2)}$$

d. Sum of skinfolds: It was calculated by summing the values of the 6 skinfolds (Σ6SF).

e. Mid-upper arm muscle area (UAMA): It was derived with the following equation, using arm circumference (C) and triceps skinfold (T):

$$\text{Upper arm muscle area (cm}^2) = \frac{(C - \pi T)^2}{4\pi}$$

Upper arm muscle area was also calculated by using both triceps and biceps (B) skinfolds, as follows:

$$\text{Upper arm muscle area (cm}^2) = \frac{1}{4\pi}\left[C - \frac{\pi}{2}(T + B)\right]^2$$

f. Waist-hip ratio (WHR): It was calculated by dividing waist circumference by hip circumference.

g. Trunk-extremity ratio (TER): It was calculated as the sum of three trunk skinfolds divided by the sum of the three extremity skinfolds.

$$\text{TER} = \frac{\text{subscapular} + \text{suprailiac} + \text{abdominal}}{\text{triceps} + \text{calf} + \text{biceps}}$$

Sexual maturation

Maturity status was determined by self-assessment of secondary sex characteristics using the protocol of the Fels Research Institute (1993), which uses breast and pubic hair development for girls and genital and pubic hair development for boys. The stages are those described by Tanner (1962) with illustrations from the Dutch national survey (van Wieringen et al., 1971). Breast and genital development were assessed using stages from 1 to 5, while pubic hair development was assessed using stages 1 to 6 (Appendices I and J). Females were also asked to report the age at menarche to the nearest month.

When completing the sexual maturation forms, the individual went to a separate area, so that his/her privacy was guaranteed. After completion of the forms, he/she was asked to place them into an envelope, thus no other person could see the reported values. The maturity stage based on breast and genital development was the variable used in the analyses.

Components of Health-related Physical Fitness

Cardiorespiratory fitness

The subject walked/ran for 12 minutes in a school area specially marked to indicate distances, after the purpose and directions for the test were explained. In most of the schools, the running area was a volleyball court (9x18m); however, the available area ranged from 9x9m to 30x18m. Each running area was divided into 6 marked sub-areas. The distance covered in the 12 minutes was assessed by counting the total number of complete laps and by adding the number of sub-areas the subject covered.

Warm-up and cool-down activities were done respectively, before and after the test. Motivation was given to the subjects during the performance of the test by the investigator, her assistant and other participants in the study. The distance was reported to the nearest meter. In general, the students were used to run laps around the court as warm-up activity in physical education classes. No more than 10 subjects ran at a time, since each recorder was responsible for a maximum of 5 subjects per bout of the 12 minute run.

Physical fitness categories were determined by sex- and age-specific quintiles of distance run in 12 minutes. Quintile cutoff points by age group and sex are shown in

Table 34. Individuals in the first quintile (lowest 20% for distance run in 12 minutes) are included in the risk group for low fitness; those in the other four quintiles form the not at risk group. Therefore, by definition, 20% of the sample is at risk for low cardiorespiratory fitness.

Body composition

Body composition was viewed as fatness. It was determined by using the sum of 6 skinfolds (Σ6SF) and the BMI. The cut-off points for risk for overweight and obesity were defined as the ≥ 85th and ≥ 95th percentiles of the BMI, respectively, as recommended by Himes and Dietz (1994). The values are shown in Table 11.

Selected Risk factors for Cardiovascular disease

Blood Pressure

Blood pressures were measured with an aneroid sphygmomanometer, after the subject had his/her anthropometric data collected, to prevent higher values due to anxiety. Two measures of SBP and DBP were taken 3 to 5 minutes apart and the average was used as the estimate of the BP level (National High Blood Pressure Education Program Working Group on Hypertension Control in children and adolescents, 1996). Cuff size was appropriate for arm size. The pressure within the cuff was released at a rate of approximately 2 to 3 mm Hg per second. SBP was defined as the first Korotkoff sound and DBP as the fifth sound (disappearance of sounds). Both values were reported to the nearest 2 mm Hg. High normal blood pressure was defined as values above the 90th percentile for age-specific reference data, while hypertension was defined as values above the respective 95th percentile.

Cigarette smoking habits

The subject was asked to report if she/he used cigarettes. If she/he did, the average number of cigarettes smoked per day was recorded in the following categories: < 1, 2-5, 6-10, 11-19, ≥ 20 cigarettes (adapted from CDC, 1995).

Physical activity level

Habitual physical activity was assessed with a modified version of the Physical Activity Questionnaire for older children (PAQ- C), which classifies individuals into activity categories from 1 to 5 (Kowalski, 1997). The questionnaire was modified to exclude sports that are not played in Brazil. The assessment of hours of TV viewing in the week was included in the questionnaire, but did not contribute to the final activity score (Appendix K, both English and Portuguese versions).

Each item in the questionnaire was scored on a 5-point scale. For question 1, the activity checklist, it was necessary to transform the score into a 5-point scale, by dividing the total number of points on the item by the number of activities in the checklist, including activities under the *other* section. A similar procedure was needed for question 13, the activity on each day of the week, where the total points are divided by 7. The final score was obtained by the average of items 1 through 7, 9 and 13 (Kowalski, personal communication, September 14, 1995).

The physical activity score represents a spectrum from the very inactive (1) to the very active (5). Based on the score, the subject was classified as inactive, when his/her score was < 3, or active (≥ 3). This classification indicated individuals not at risk and at risk for physical inactivity (active and inactive, respectively).

Overweight

The BMI was used to identify individuals who were at risk for overweight (≥ 85th percentile) and who were overweight (≥ 95th percentile). Age- and sex-specific cut-off points suggested by Himes and Dietz (1994) are indicated in Table 11.

Fat distribution

Relative fat distribution was determined by the waist-hip and trunk-extremity ratios.

Nutritional status

Mid-upper arm muscle area for height was used as an indicator of nutritional status, according to the criteria of Frisancho (1990, p. 51). Mild malnutrition was defined as an upper arm muscle area between the 5th and 15th percentiles, while severe malnutrition was defined as an upper arm muscle area below the 5th percentile.

Technical Error of measurement

All anthropometric and blood pressure measurements were taken by the researcher. To assess intra-observer measurement variability, 4.5 % of the sample (15 individuals) was remeasured within one week after the first assessment (Table 12). The technical error of measurement, σ_e, was calculated after Malina (1995a):

$$\sigma_e = \sqrt{\frac{\Sigma d^2}{2n}},$$

where d is the difference of replicate measures and n is the number of measured pairs.

Intra-observer measurement error for blood pressure (Table 13) was calculated by using the reliability of a single measurement (Foster, 1980), as follows:

$$\hat{\rho} = \frac{MS_A - MS_W}{MS_A + MS_W},$$

where MS_A is the mean square among subjects and MS_W is the mean square within subjects from the one-way analysis of variance table.

Intraclass correlation coefficients were calculated for determining reliability (Baumgartner, 1991) of the anthropometric variables. The formula for the intraclass correlation coefficient (r_{intra}) is as follows:

$$r_{intra} = \frac{(MS_A - MS_W)}{MS_A}$$

The closer the intraclass correlation coefficient is to one, the smaller the error introduced by the observer. The reliability coefficients are presented in Table 14.

The technical errors of measurement for anthropometric variables were similar to those reported in national surveys in the U.S. (Malina, 1995a) and in the Québec Family Study Canada (Bouchard, 1985). The measurement errors for blood pressure were lower than those from the Bogalusa Heart Study (Foster et al., 1980). All of the intraclass correlations for anthropometric and blood pressure variables in this study were similar to those reported by Bouchard (1985) and Foster (1980), except for DBP, where the intraclass correlation was lower (r=0.59). No other comparative data are available for measurement variation in blood pressure; therefore, it is not known if this low coefficient is usual.

Statistical Analyses

Sex- and age-specific descriptive statistics were performed for all variables. Race specific ANCOVAs were done for anthropometric variables, adjusting for age and stage of sexual maturation. Chi-square test for independence was used to analyze the distribution of race and SES for individuals at risk and not at risk for each risk factor variable. Logistic regression analyses were also performed to calculate the odds-ratio (OR), adjusting for chronological age and sexual maturation. Only the significant ORs are reported. ANCOVAs were also performed to compare variables of individuals at risk and not at risk for inactivity and low fitness, adjusting for chronological age and sexual maturation. Variables with skewed distributions, i.e., Σ6SF, BMI, TER, physical activity score, 12 minute run, SBP, and UAMA, were $\log_{10}$ transformed to either eliminate or reduce skewness.

SES was used as a dummy variable to express three categories: middle class, lower middle class and lower class. Lower class was the reference category. In cases where occupation of the head of the household was not sufficiently specific, lower class was assigned. Data were not included when the head of the household was out of the work force.

The variables were grouped as either predictor or dependent variables for the statistical analyses. The predictors were SES and race. The variables, 12 minute run and physical activity score, were dependent variables in some of the analyses and predictors in others. The dependent variables were the selected risk factors: SBP, DBP, BMI, Σ6SF, TER, and WHR.

The analyses for the specific questions were as follows:

1. To what extent do sociodemographic characteristics predict selected risk factors for CHD and health-related physical fitness in adolescents?

Multiple regression analyses were performed using each selected risk factor or each health-related fitness component as the dependent variable, and SES, race and sex as the predictors. Chronological age and stage of sexual maturation were entered as covariates. This analysis attempted to estimate the variance in CHD risk factors and health-related fitness that is accounted for by the sociodemographic characteristics.

2. What is the relationship between cardiorespiratory fitness and selected risk factors for CHD in adolescents?

Multiple regression analyses were performed using each selected risk factor as the dependent variable and cardiorespiratory fitness as the predictor. Chronological age, sex and sexual maturation were entered as covariates. The purpose of this analysis was to estimate the proportion of the variance in the CHD risk factors that is explained by cardiorespiratory fitness.

3. What is the relationship between level of physical activity and selected risk factors for CHD in adolescents?

Multiple regression analyses were performed using each selected risk factor as the dependent variable and physical activity as the predictor. Chronological age, sex and sexual maturation were entered as covariates. This analysis attempted to estimate the variance in CHD risk factors that is accounted for by estimated level of physical activity.

4. Do risk factors for CHD cluster within individuals?

The Chi-square test for independence was used to test the clustering of risk factors for CHD within individuals, following the procedures of Raitakari et al. (1995) in the Young Finns Study.

CHAPTER 4

RESULTS

The first part of the chapter presents the descriptive results for anthropometric, health-related physical fitness and cardiovascular risk variables. The subsequent parts present results of the specific analyses of the research questions addressed in the study.

Descriptive Statistics

Demographic Characteristics

The sample included 329 students (126 males and 203 females) from the public school system in Niterói, Rio de Janeiro. The distribution of sample by age and sex is shown in Table 15. The age- and sex-specific samples, respectively, 1.5% and 2.5%, of the estimated population of boys and girls in 1997. Therefore, the findings in this study should be generalized with caution.

Table 16 shows the self-reported race of the subjects. The race distribution differs significantly ($p<0.01$) from the expected distribution as reported by the 1991 Census (IBGE, 1996). The proportion of White subjects is lower, while the proportions of Blacks and Pardos are higher in each sex, assuming that the proportion in the entire population is constant among 14-15 year old individuals.

Socioeconomic status was determined by the occupation of the head of household, classifying the subjects as middle class, lower middle or lower class. The majority of the subjects came from the lower class (Table 17). Most of the individuals came from families where the head of the household worked as a manual laborer. Males were more likely to be the head of the household; females, however, were responsible for 8% to 14% of the households (Table 18), which is a lower proportion than 26.3% in the Niterói population (PMN/CECITEC, 1996). Table 19 shows the distribution of SES by race. There were no differences among males; however, Non-White females were more likely to be from lower class, i.e., almost all (86%) of the Non-White females came from the lower class. No comparative data are available to explain this higher percentage of Non-Whites in the lower class among females only.

The age groups show similar trends in the number of children per couple and of members in the household (Table 20). These numbers are higher than the mean values for Niterói (2 and 3.5, respectively, PMN/CECITEC, 1994), which may be explained by the tendency of larger families in poorer groups. The number of people working in the household is also similar among the age groups; however, no reference data for Niterói are available. Table 21 shows the work status of the subjects. The majority of subjects are students and are not in the work force. But, more boys are part-time workers than girls, regardless of age.

Anthropometric data

Tables 22 and 23 show the descriptive anthropometry for males and females, respectively. For males, there are no significant differences between the two age groups for any of the variables. However, the data show that older males tend to have lower values for all skinfolds, and higher values for the TER.

For females, there are significant differences for the abdominal skinfold, estimated arm muscle area (S_t+S_b), and hip circumference, where older girls have higher values. Although the other skinfolds are not significantly different, the trend is for thicker skinfolds in the older group.

There is a trend for an increase in body weight and the BMI with age, even though the differences are not statistically significant. The greater estimated arm muscle area (S_t+S_b) in older girls is indicative of increased muscularity with age, which also contributes to greater body weight and BMI.

Comparisons by race, adjusting for chronological age and sexual maturation (Tables 24 and 25), show no significant differences among males, except for the TER; non-Whites have higher values than Whites (1.37 vs 1.27 mm/mm, p<0.05). Non-Whites also show a trend of lower SHSR than Whites; however, the difference is not significant (p=0.07).

For females, Non-whites have a higher waist circumference than Whites (p<0.05). Differences are also evident for the BMI, the subscapular skinfold, and the sum of the subscapular and triceps skinfolds, as they approach significance (p=0.06, p=0.07, and p=0.07, respectively). Non-Whites show higher values than Whites, suggesting that Non-Whites tend to be heavier and to have more subcutaneous fat (Table 25).

Sexual maturation

Distributions of the self-reported stages of sexual maturation are presented in Table 26. The majority of the students rated themselves in the advanced maturity stages. For girls, the advanced stages are consistent with the age at menarche.

Ninety-six percent of the girls were post-menarcheal (Table 27). Since not all the girls had reached menarche, mean age at menarche of the complete sample is actually slightly higher than the value presented. Nevertheless, the mean is within the range of ages at menarche (12.2 to 14.0 years) reported for Brazilian girls (Duarte, 1993). Figure 4 shows the relative distribution of the ages at menarche in the sample. Compared to the data from Colli (1988), the current sample shows a higher percentage of girls in the age groups up to 12 years.

Analyses of secondary sexual characteristics by race in both sexes, age at menarche and distribution of ages at menarche for females show no significant differences between Whites and non-Whites (Tables 28 and 29, Figure 5, respectively). Although the distribution was not significantly different among White and Non-White females for stage of secondary sexual characteristics, the data suggest that more Non-Whites are at a higher maturity stage than Whites.

Cardiorespiratory fitness

Cardiorespiratory fitness was assessed by the 12-minute run. Data were not available for all subjects due to either weather conditions (rain on the day of the test), or to absence on the day the run was scheduled (in two schools the run was performed on a different day than the rest of the data collection). Only two females could not finish the test. There are no differences between age groups in both sexes or between White and Non-white subjects (Table 30).

Sex- and age-specific quintiles of distance run in 12 minutes are shown in Table 31. Individuals in the first quintile are included in the low fitness risk group and those in the other four quintiles form the not at risk group. Therefore, by definition, 20% of the subjects are at risk for low fitness.

Selected risk factors for cardiovascular disease

Blood Pressure

Blood pressures of males and females are presented in Table 32. There are no differences in males by age group in systolic (SBP) or diastolic (DBP) blood pressures. In females, only SBP is statistically significant; older girls show higher values. Data for DBP suggest that older girls also have higher values, although the difference is not significant.

Using age- and sex-specific cut-off values for high normal blood pressure (shown in Table 4), the prevalence of high blood pressures is as follows: 14 year old males have a prevalence of 7.5% for high normal BP (3% SBP and 4.5% DBP), while 15 year old males have a prevalence of 6.7% for high normal BP and of 3.3% for hypertension. There are no cases of either high normal BP or hypertension among younger females, while older females show a prevalence of 2.9% for high normal BP (Table 33).

Cigarette smoking

The subjects responded to a question on cigarette smoking habits (Table 34). None of the younger males used cigarettes at the time of the investigation, while about 7% of the older males smoked. Only one (1%) 14 year old and three (3%) 15 year old females smoked. There are no differences ($p > 0.05$) in cigarette use between age or racial groups.

Physical activity

Results for the physical activity questionnaire and hours of TV viewing are shown in Table 35. The mean number of hours of TV viewing is higher than the 2 hours recommended by the American Academy of Pediatrics (Gortmarker et al., 1996). Younger girls watch more TV than older girls ($p < 0.05$). There are no differences in physical activity scores between age groups in each sex; however, the values represent low levels of activity for the subjects. The majority of subjects of both sexes are classified as either inactive (males) or very inactive (females, Table 36). There are no differences in physical activity scores by race in any age or sex group.

Risk for inactivity was estimated by the physical activity score, with values <3 being at risk and ≥ 3 not at risk. Most subjects were at risk for inactivity; prevalences varied from 83% to 94 % (Table 37).

The frequency with which the subjects performed specific physical activities and the ranks are shown in Tables 38 through Table 41 for males and females, 14 and 15 years of age, respectively. For males in both age groups, the most performed activity is soccer, a traditional sport in Brazil. The next three most performed activities are jogging or running, bicycling and walking for exercise.

The top physical activity for females differs by age group. Younger girls participate more in dance and walking for exercise, while older girls report more walking for exercise and dance (inverted position by rank). Bicycling and jogging or running are the third and fourth activities in rank for both age groups of girls. Capoeira, a martial art originated in Brazil, is the only activity reported by all sex and age groups. Judo and jujitsu are also performed by the different sex and age groups.

Overweight/ obesity

The prevalences of overweight and obesity are presented in Table 42. Younger boys show a prevalence of 7.6% for overweight and no cases of obesity. Overweight is present in 5.0% of older boys and obesity in 1.7%. Among females, 9% of 14 year olds are overweight, while only 1% is obese. For older females, the prevalences of overweight and obesity are 6.8% and 1.9%, respectively. The prevalence of overweight is higher in the younger groups in both sexes than in the older subjects. There are no differences in the prevalence of overweight or obesity by race in either sex.

Nutritional status

The prevalence of undernutrition is shown in Table 43. Younger males present lower prevalences of both mild and severe undernutrition compared with older males. The reverse is evident among females, where older girls have lower prevalences of mild and severe undernutrition. The prevalences of mild and severe undernutrition are almost identical for both males and females in the 14 year old group. Among 15 year olds, males are more likely to be undernourished than females

The effects of sociodemographic characteristics on health-related physical fitness and on selected CHD risk factors.

The first question investigates the proportion of variance in specific components of health-related physical fitness and on selected risk factors explained by sociodemographic variables. Each risk factor and fitness component was analyzed separately by multiple regression analysis using sex, SES and race as the predictors.

All of the dependent variables except DBP were $\log_{10}$ transformed to either correct or decrease the skewness of data. Chronological age and sexual maturation were entered as covariates. Stepwise regression analyses were also performed to determine which variables contributed most to the explained variance.

Tables 44 to 51 show the results of the analyses. Regression coefficients (beta) for the sociodemographic variables were low, showing small effects on the risk factors and on health-related physical fitness. Except for DBP, all stepwise regression analyses included the variable sex. On the other hand, race was not entered in any stepwise analysis.

Sex explained 2% to 41% of the variance of the variables under study. The contribution of sex is greater to cardiorespiratory fitness and WHR (R^2=0.41), followed by Σ6SF (R^2=0.34). The explained variance for the BMI, TER, physical activity and SBP varies from 2% to 6%. Males have higher cardiorespiratory fitness, physical activity level, TER, WHR, SBP and DBP than females, while they have lower BMI and Σ6SF

Age is a significant variable only for SBP, explaining 2% of the variance (Table 49). Older subjects tend to have higher SBP. Sexual maturation enters in the stepwise regression for the BMI and Σ6SF, explaining 6% and 5% of the variance, respectively. More mature individuals show higher BMI and Σ6SF values.

Although race is not significant in any analyses, there is a trend for higher values of cardiorespiratory fitness, the BMI, the Σ6SF, the WHR, the TER and both BPs in Non-White subjects. For physical activity, the tendency is reversed, i.e., Whites showed higher values.

The only SES variable included in the stepwise analyses is lower middle class for the physical activity score (Table 51). Lower middle class explains 3% of the variance in the physical activity score. Adolescents in this class are somewhat more active than their peers.

Sociodemographic variables, chronological age, sexual maturation or sex did not influence DBP (Table 50). The full regression model is not significant and no variables enter in the stepwise analysis.

Comparison by risk status

Groups at risk and not at risk by sex were identified for each risk factor. Comparisons of the sociodemographic variables were performed using ANOVA for age and the Chi-square test of independence for race and SES. Logistic regression analysis adjusting for chronological age and sexual maturation was used to obtain the odds-ratio, and only the significant ORs are reported. The results are shown in Tables 52 through 58. Age is a significant variable for cigarette smoking in boys, DBP in girls, and low fitness in boys. The effects of race are noted in female overweight and physical activity, and male DBP. The only risk factor that is affected by SES is physical activity in females.

There are no differences among the sociodemographic variables for cigarette smoking in either sex (Table 52), except that male smokers are older than non-smokers. The prevalence of smoking (2.7%) is low, but differences might not have been found due to the low prevalence (low power of the analysis). Nevertheless, prevalence of smoking is expected to be low in the age groups considered.

For both sexes, overweight individuals are more likely to be Non-White, although the difference is significant (p<0.05) only in females (Table 53). Logistic regression shows an OR of 4.37 for Non-White females.

There are no differences by race or SES for SBP in either sex group (Table 54). On the other hand, DBP shows differences between White and Non-white males. Non-Whites are more likely to have elevated values. In females, those at risk are older than peers not at risk (Table 55). Logistic regression was performed for DBP using the whole sample and adjusting for sex and sexual maturation, due to unstable ORs when analyzed by sex. The results are shown in Table 56. Older individuals, males and Non-Whites are more likely to have elevated DBP. Although not significant, the ORs for SES suggest that individuals at higher classes are less prone to elevated DBP.

More Non-White females are at risk for inactivity than White girls. There also are differences by SES, where the lower middle class has proportionately more active females (Table 57). There are no differences for males. For the risk of low fitness, males not at risk are younger (p< 0.05); the OR was 3.1 (Table 58). There are no differences in any of the sociodemographic variables in females.

Effects of cardiopulmonary fitness on selected CHD risk factors

Multiple regression analyses were performed similarly, but separately, to estimate the variance in the selected risk factors explained by cardiopulmonary fitness on the. In each analysis, the risk factor was the dependent variable and the 12 minute run was the predictor variable. Due to skewness, the 12 minute run values were $\log_{10}$ transformed. Chronological age, sexual maturation, age and sex were entered into all models as covariates; depending on the risk factor in the model, other covariates were also included. SES was included as a covariate in the analyses of physical activity level due to the effects observed in the previous analyses. For the BMI, the Σ6SF and UAMA were entered as covariates to adjust for different effects of fat and muscle mass on the BMI. Σ6SF was entered as a covariate in the analysis of the trunk-extremity skinfolds ratio, as fat distribution is dependent of overall fatness. WHR was controlled for the BMI, also to adjust for overall fatness. For BPs, body weight was entered as a covariate to control for the positive effects weight has on BP. Stepwise regression analyses were done to identify the variables that contributed the most to the explained variance.

Cardiorespiratory fitness is significantly related to the Σ6SF and the physical activity level ($p<0.001$). The partial R^2 is 0.07 for Σ6SF and 0.10 for physical activity, respectively (Tables 59 and 60). The regression coefficient for the Σ6SF is negative, showing an inverse relationship between these two variables, i.e., fatter youngsters have lower cardiorespiratory fitness. The results of the multiple and stepwise regression analyses for the risk factors not affected by cardiorespiratory fitness are shown in Tables 61 through 65.

Comparison between risk groups

Comparisons of risk factors between individuals at risk and not at risk of low cardiorespiratory fitness were performed with sex-specific ANCOVA, controlling for chronological age and sexual maturation. Results are shown in Tables 66 and 67, for males and females, respectively. In males, individuals at risk are older than those not at risk ($p<0.05$). Those at risk also have higher values for the Σ6SF ($p<0.05$). All smokers are in the group at risk ($p<0.001$). Although there are no significant, those at risk tend to have higher values for the BMI, and both SBP and DBP, and lower values for physical activity level.

Females at risk show differences in the 12 minute run, physical activity and fat-related variables: BMI, Σ6SF, TER and WHR, although for the latter variable the difference is not significant ($p=0.08$). Physical activity is lower in females at risk, while the fat related variables are higher in girls at risk for low fitness. There is no age difference between the two groups. In contrast to boys, all of the smokers are in the group at no risk.

Effects of physical activity level on selected CHD risk factors

Individual analyses were performed to estimate the variance accounted for by physical activity level on the risk factors. Each risk was entered into the analysis as the dependent variable, physical activity as the predictor, and sex, chronological age and sexual maturation as covariates. Similar to the analyses of cardiorespiratory fitness, other covariates were included: race and body weight for BP, Σ6SF for TER and BMI, UAMA for BMI, and BMI for WHR. Stepwise regression identified the variables that most explained the variance. Tables 68 through 74 show the results of the analyses.

For all risk variables but the BMI, physical activity shows a negative relationship, i.e., lower levels of physical activity indicated higher values of the risk variable. Nevertheless, beta coefficients are close to zero except for DBP (Table 73) and BMI (beta =0, Table 68).

Comparison between risk groups

Sex-specific ANCOVAs adjusting for chronological age and sexual maturation were performed to compare risk variables in individuals at risk and not at risk for inactivity (Tables 75 and 76). In males, only DBP is significantly different between the two groups. Individuals at risk for inactivity show higher values for DBP. Once again, all smokers were at risk for inactivity (Table 75).

All differences between risk groups are not significant in females (Table 76). A trend of higher values is evident for the Σ6SF, TER, WHR, SBP and DBP among girls at risk, even though these differences are not significant. As with boys, all smokers are individuals at risk.

Clustering of risk factors

In order to investigate the clustering of risk factors in the sample, an analysis of subjects with complete risk data was performed by listing all of the possible combinations of risk factors: inactivity, elevated blood pressures, overweight, smoking, and low fitness level, and by determining their frequencies in the sample. Expected frequencies were calculated according to the individual probabilities of each risk factor based on its occurrence in the sample (Raitakari et al., 1995). Then, the Chi-square test for independence was performed.

The clustering of risk factors shows that 5% of females and 12% of males are free of risks (Table 77). In those with risks, the majority present just one risk factor (68.2% and 63.3% for females and males, respectively). The maximum cluster of risk factors in females was 3 and for males it was 4. The distributions of risk factors are shown in Tables 78 and 79 for males and females, respectively. The most frequent risk factor is inactivity for both sexes, individually or clustered. The Chi-square analyses, however, show no statistical significance.

Sex-specific ANCOVAs by number of clustered risks, controlling for chronological age and sexual maturation, compared subjects with different number of risk factors. The following trend is suggested: as the number of clustered risk factors increases, the mean value for each of the variables also increases, except for cardiorespiratory fitness and physical activity level, where values decrease (Tables 80 and 81). All variables show significant differences ($p < 0.05$), except WHR in males and TER in both males and females.

CHAPTER 5

DISCUSSION

The purpose of this chapter is to compare the results of this study, presented in the previous chapter, to available data in the literature. The primary focus is comparisons with Brazilian data; however, data on Brazilian adolescents are not always available. The discussion is organized in the sequence of the research questions: General characteristics of the sample; the status of growth and sexual maturation; and CHD risk factors in adolescents.

General characteristics of the sample

It is characteristic of the Brazilian public school system in elementary and secondary education to have students coming from low SES families. As this study surveyed public schools, most of the students were from working class families. Although the classification relied on occupation instead of income, it could detect the higher frequency of low SES individuals. From occupation data, it was possible to infer family income and access to different resources, without actually asking for income information. Inquiring about income is a sensitive issue, especially in times of economic crisis and low wages.

The sex and age groups had similar number of members and working members in the household, and number of children per couple. On the other hand, more males were part-time workers than females. No comparisons can be made to the Brazilian data on working and studying youth, because it is stratified into age groups 10-14 years and 15-17 years by household income. The sample included more Non-White individuals than expected from the 1991 Census for Niterói. The higher frequency of Non-Whites and the composition of the sample varying between 1.5% and 2.5% of the estimated population for Niterói, thus limit the generalization of the present findings.

The status of growth and sexual maturation of adolescents

Growth status is an indicator of health and nutritional status of a population and it is generally assessed by stature and body weight. The findings of this study are compared to U.S. NCHS reference data (Hamill et al., 1979) as suggested by WHO (1983). Additionally, the results are also compared to data from the 1978 Santo André Study (SA, Marques et al., 1982), which also allows for comparisons of sexual maturation and skinfold thickness as well (Colli, 1988; Goldberg, 1986). The SA data are reported in two groups: R1+R2, which represents subjects from lower SES, and R the total SA sample. Data from the 1989 Brazilian National Health and Nutrition Survey (PNSN, Anjos et al., 1998), the 1985/86 Rio de Janeiro Public School Survey (RJ-SS, Einsenstein, 1997) and the 1996/97 Survey of Standards of Life (SSL, IBGE On-line, 1998) are also included in comparisons when appropriate.

Stature

For stature (Table 82), 14 year old boys show similar medians to NCHS and SA(R); in contrast, boys 15 years of age present consistently lower values in all percentiles for both NCHS and SA(R). However, the median of 15 year old boys is similar to the median reported in the Survey on Standards of Life (SSL, IBGE On-line, 1998), which presents more recent data on adolescents. The stature medians for boys in this study are consistently higher than those of boys from SA (R1+R2) and RJ-SS.

For females of both ages, the results are similar to SA(R) and to SSL; they are somewhat lower than NCHS values, the patterns being consistent in all percentiles. As observed in boys, girls in the present study are taller than their peers from SA(R1+R2) and RJ-SS (Table 83).

Body weight

Except for the 14 year old boys, body weight is lower than the SA(R) and NCHS in both sexes, although the 95th percentile tends to be higher than the SA(R). In the former group, body weight is consistently higher than SA(R) and similar to NCHS (Table 82). When comparing to SA(R1+R2) and RJ-SS, both males and females are heavier for all percentiles (Tables 82 and 83).

Secular changes in stature and body weight

The higher values in stature of subjects in this study, who are predominantly from lower SES, compared to the SA(R1+R2), which is also of a lower SES, poses a question on the occurrence of secular changes in stature in individuals from low SES. The time between studies is 19 years and improvements have accompanied economic growth over this span. Secular changes were also empirically investigated based on SHSR of the two groups. Mean values for stature, and the percentiles for sitting height and estimated leg length are not reported for the SA Study. The latter two variables are presented only for the entire group (SA(R)). Therefore, the mean stature value was estimated by adding sitting height and estimated leg length, followed by the calculation of SHSR (Table 84).

SHSR is consistently lower in the subjects of both sexes and ages in this study. Assuming that the difference holds true in the SA(R1+R2) group, it suggests that secular changes in stature are occurring with the characteristic decrease in SHSR, i.e., an increase in relative leg length. However, it should be noted that the racial distribution of the sample is not given for the SA Study. In the present study, about half of subjects are Non-White and it is known that Blacks have lower SHSR (Malina and Bouchard, 1991). On the other hand, Brazilian Non-Whites tend to be over represented in low SES groups; consequently, the relative proportion of Non-Whites in the SA sample may not be much different from that in this study sample.

The higher body weights in the present study also suggest secular changes for lower SES individuals. These increases in weight address the question of the relationship between the increase in body weight and increase in body fat. Comparisons of skinfold thicknesses (triceps and subscapular) were made between this study and SA(R1+R2), as well as SA(R) and NCHS (Table 85). However, comparison of data across studies should consider differences in skinfolds thicknesses due to random variation in manufacture of skinfold calipers (Malina, 1995a).

Boys 14 years of age show higher mean values of the triceps and subscapular skinfolds than SA(R) and SA(R1+R2). For 15 year old boys, both skinfolds are higher than in the SA(R1+R2) group. The triceps is similar to the SA(R) and the subscapular is higher. Comparisons to the NCHS values show that both skinfolds are similar in 14-year-old boys and lower in boys 15 years of age.

In girls, there is a different pattern. For both ages, the skinfolds are consistently similar to SA(R1+R2) girls and lower than SA(R), except for a lower triceps in 15 year old girls in this study. For both ages, triceps means for the NCHS are higher than in this study, while subscapular values are similar.

Sex-specific patterns are suggested from the skinfold data. For females, the increase in body weight seems to be independent of an increase in subcutaneous fat, as the values of both the triceps and subscapular are similar in this study and SA(R1+R2) samples (non significant t-tests). The pattern for males is that the increase in body weight is partially related to an increase in fatness, as shown by consistently higher values of the triceps and subscapular skinfolds in both ages. Comparison of the means showed significant differences ($p < 0.05$) for the triceps and subscapular skinfolds in the 14 year old and the subscapular skinfold in the 15 year old males.

The increase in fatness may be related to the nutritional transition in progress in Brazil as well as the increase in life standards (health care services, food availability, sanitation and education, Monteiro et al., 1995c). However, these facts do not occur selectively for males. The reason for observing an increase in fat only in the boys may rest on the greater stability for the effects of environment on growth in females than in males (Tanner, 1990).

Body mass index

The SA does not provide the 50th percentiles for the BMI; for comparison, they were calculated from median values of body weight and stature. These values are also presented in Tables 82 and 83. BMIs in this study are similar to those in the SA(R) and SA(R1+R2) samples as well to the NCHS, PNSN, and RJ-SS, except for the 14 year old boys, where the BMI is higher than the SA(R1+R2), PNSN and RJ-SS.

Sexual maturation

Figure 6 shows that 14 year old boys are more mature than those from the SA(R), while fewer 15 year old boys reported being in the post-pubertal stage (stage 5 of genital development). In both age groups, girls are more frequently in pubertal stages (stages 2, 3 and 4 of breast development) than SA(R). The fact that 14 year old boys are more mature than peers in SA(R) may explain the higher values of stature, weight and BMI observed in this group

These differences in the distribution of pubertal stages may be due to the methods used in each study. In SA, sexual maturation was assessed by physicians, while in this study by self-assessment. A low concordance (23%-45%) between physician and individual assessment for breast stage 4 was found by Matsudo and Matsudo (1994), indicating a difficulty in identifying the correct stage. Mean age at menarche in this study is similar to that in SA(R) and SA(R1+R2) as well to other Brazilian samples (Duarte, 1993). Therefore the apparent difference in distribution of sexual maturation may be only due to misclassification.

Matsudo and Matsudo (1994) reported high concordance for genital stage 4 in males (84%-86%). However, concordance could not be computed for stage 5 because no males reported being in that stage, even though the age of males included in the study ranged from 6 to 26 years. This fact suggests that Brazilian males in the study of Matsudo and Matsudo (1994) tended to underestimate their genital development. Underestimation could explain the lower frequency in genital stage 5 in 15 year old boys in this study.

On the contrary, Williams et al. (1988) pointed out that younger American boys (10.3-14.8 year of age) tended to overestimate their stage of sexual maturation. Therefore, there is also a possibility that 14 year old boys in this study overestimate their stage, which would explain the higher percentage of mature boys than in SA. As shown by Carvalho (1990), the major discordance was between one stage (47% and 42% for 14 and 15 year old boys, respectively). If similar misclassification had occurred in this study, the sexual maturation distribution would be more similar to the SA.

Nutritional status

The prevalences of undernutrition (mild and severe forms combined) vary from 12.9% to 30% (Table 43). As Johnston and Ouyang (1991) noted, whenever international reference data are applied to developing countries, there is an overestimation of prevalence of undernutrition. Therefore, it is assumed these high prevalences represent an overestimation.

The only data available for older children is for 10-14 years of age (Henao et al., 1992). In 218 children 10-14 years of age from the Ilhabela Longitudinal Study, 30% of boys and 32.2% of girls were undernourished by the criterion UAMA for height < 15th percentile.

Boys are more likely to be undernourished than girls in this study. This increased likelihood may be related to a greater sensitivity to environmental changes in males, so that they are more prone to develop undernutrition if the environment is adverse.

The WHO (1995) suggests that nutritional status of adolescents be evaluated based on BMI for age. For thinness, which assesses acute malnutrition, the criterion is a value below the 5th percentile of the U.S. reference. Anjos et al. (1998) presented the distribution of BMI values for the Brazilian population. The values for the 5th percentile tend to be lower in the Brazilian population compared to U.S. reference data. Johnston and Ouyang (1991) pointed out that local reference data can not be used with confidence because they include undernourished individuals in the sample as well. Nevertheless, for the analyses of malnutrition both Brazilian and American data were used. The cutoff points and the prevalences are shown in Tables 86 and 87, respectively.

In males, the prevalence of undernutrition by the U.S. criteria is higher in both ages than the prevalence by the Brazilian criteria. This difference is expected, as the cutoff points are lower for Brazilian BMI distribution. The reverse occurs for females, where higher prevalences are observed for the Brazilian BMI criteria because of the higher cutoff points. Females also show a lower prevalence of undernutrition than males by the BMI for age criterion.

Using the BMI by age criteria, the prevalences in both sexes and age groups are much lower than by the UAMA for height criteria. The BMI is affected by variation in sexual maturation. During puberty the relationship between stature and weight is altered due to the different timing of the spurts of stature and weight (Malina, 1995a).

Comparing individuals of the same stature but different maturity status, the more mature, in general, will show higher weight; therefore, if he/she were undernourished, there would be more chances of having BMI appropriate for the age. This is a limitation of the criteria.

On the other hand, the UAMA for height criteria are based on estimated muscle mass, which is decreased in undernutrition. Even in more mature individuals, muscle mass would be affected by undernutrition. Although the prevalences of undernutrition are higher by these criteria compared to the BMI for age, most cases are classified as mild and may be the result of overestimation.

The status of health-related physical fitness

As expected for individuals going through puberty, sex differences are found in the present study; males have higher values of cardiorespiratory fitness. Krahenbuhl (1985) has suggested that these differences are partially explained by higher muscle mass and levels of physical activity in males. However, stepwise regression analysis (Table 74) showed that the variance in cardiorespiratory fitness was explained in part by Σ6SF (6%) and physical activity (4%), but not by UAMA, an indicator of muscle mass. The subjects were classified as normally nourished and undernourished based on UAMA, and there were no differences in cardiorespiratory fitness between the two nutritional groups in both sexes. This contrasts the findings of Desai et al. (1984) and Spurr and Reina (1986) in Brazilian and Colombian children, respectively. These authors found lower $\dot{V}O_2$ max in undernourished individuals. However, the definition of undernutrition and the measure of cardiorespiratory fitness varied between the studies and the present study.

It is known that applying international reference data may result in overestimation of malnutrition; therefore, similar values of cardiorespiratory fitness in this study between the two nutritional groups may be due to problems in classification. To rule out the occurrence of classification bias, ANCOVAs by sex were done using three categories of nutritional status: normal, mild and severe undernutrition, adjusting for chronological age and sexual maturation. Once again, there were no differences among the nutritional groups. These results suggest that the 12-minute run may not be a sufficiently powerful cardiorespiratory fitness test to discriminate differences in fitness levels in normally and undernourished children, but it is also possible that there is actually no differences in cardiorespiratory fitness among these individuals.

Fatness is related to poor performance in activities where the body mass has to be displaced. Negative correlations have been reported for the sum of skinfolds and cardiorespiratory fitness, ranging from –0.156 to –0.273 (Pate et al., 1989) and –0.07 to –0.40 (Malina et al., 1995a). In this study, the correlations between Σ6SF and the 12-minute run were –0.34 and –0.21 for males and females. These values are well within the range of those in the cited studies.

There are no racial differences in cardiorespiratory fitness in either sex. The results contrast to the findings of Farrell et al. (1987) and Pivarnik et al. (1995), where Non-White adult and adolescent women had lower cardiorespiratory fitness as measured by a maximal treadmill test. The non-significant difference may be due to the different methods (treadmill vs 12-minute run) for assessing cardiorespiratory fitness. As Armstrong and Welsman (1994) have noted, 12-minute run performance is influenced by motivation and by the subject's judgment of pace. Therefore, a maximal effort is less likely to occur compared to the treadmill test, resulting in no significant differences being detected. Nevertheless, Non-Whites girls would be expected to have lower cardiorespiratory fitness due to their somewhat higher body weight and Σ6SF. It should be noted that Pardo and Black individuals, with various degrees of admixture, form the Non-White group in this study. It may be that comparisons to Black American groups are not appropriate.

Comparisons to Brazilian studies on growth variables and the 12-minute run are shown in Table 88. The 14 year old boys and 15 year old girls have consistently higher values for stature and body weight than the subjects from the other Brazilian studies. The 14 year old girls are taller but not consistently heavier than their peers. However, similar results are observed for the BMI and the 12-minute run. Compared to U.S. percentiles for the 12-minute run (AAHPERD, 1980), this and all the other Brazilian samples have lower values for the 50th percentile, indicating that, on average, Brazilian youth have lower cardiorespiratory fitness than American youth.

The relationship between physical activity and cardiorespiratory fitness is only low to moderate. The proportion of variance in cardiorespiratory fitness due to physical activity in this study, 4%, is similar to the 3% reported by Morrow and Freedson (1994). Boys at risk for low fitness are more likely to be older (OR=3.1) than those not at risk. All females and 91% of boys at risk are sedentary individuals. On the other hand, the majority of sedentary boys and girls are not at risk of low cardiorespiratory fitness since risk was defined as belonging to the lowest quintile of the 12 minute run. The use of a criterion-referenced standard classification would probably increase the percentage of sedentary individuals at risk for low fitness.

The status of CHD risk factors

Low prevalences of CHD risk factors in the Niterói sample are observed among boys and girls. The exceptions are low cardiorespiratory fitness and inactivity, due probably to the definitions used in this study. It is good to have low prevalence of CHD risk factors among adolescents, especially because risk factors tend to track into adulthood. On the other hand, the low prevalence may have generated low statistical power in the analyses, limiting the results of this study, as well as the generalization of the findings.

Cigarette smoking

The prevalence of cigarette smoking in the sample is low in both sexes, 2.7% and 1.8% for males and females, respectively. Most subjects smoked an average of 2-5 cigarettes a day. The prevalences are comparable to those from the 1989 PNSN (Ministry of Health, 1993) for children 10-14 years and 15-19 years of age, although the older boys in this study have somewhat higher values (Table 89). Proportionally, smoking is more frequent among boys, which contrasts the PNSN data, in which females have slightly higher prevalences for the adolescent as well as for young adult years.

Duncan et al. (1993a) found prevalences of smoking of 20% in females and almost 40% in males 15-19 years old in a representative sample surveyed in the middle of the 1980s in Porto Alegre, South Brazil. The 1989 Brazilian survey of high school students (9th to 11th grades) in urban areas showed prevalences ranging from 44% to 75% (PAHO, 1994). The use of different criteria of smoking may result in differences in prevalence and poses limitations in comparing studies. The same criteria were used in the present study and in Duncan et al. (1993a). The lower prevalences in this study may be due to the fact that older subjects were also included in the Porto Alegre group. It is also plausible that the effects of anti-smoking campaigns, more widely used in this decade, are taking effect.

Once the smoking habit is established during early and middle adolescence, it seems fortunate to have low prevalences in late adolescent subjects, especially because smoking status in adolescence tends to track into adulthood (Hunter et al., 1986; Twisk et al., 1995). Nevertheless, since smoking status was self-reported in this study, there is also a possibility of underreporting.

In American adolescents of both sexes, the prevalence of smoking is higher in Whites than in Blacks (Greenlund et al., 1996; CDC, 1998). There is no significant effect of race in this study, but different patterns were observed between males and females. Female smokers were more likely to be White, while the opposite was noted in males. A low power analysis due to low prevalence may explain the non-significant difference. No stratified data by race were found for the Brazilian population; therefore, no conclusions can be made about these findings.

A higher prevalence of smoking of lower educational and/or low SES background is described for adult Americans (CDC, 1993, Hunter et al., 1995) as well as for Brazilians (Duncan et al., 1993b). These SES effects are also observed in Scottish, American, Finnish adolescents (Glendinning et al., 1994; Lowry et al., 1996; Leino et al., 1996) and in this study, especially in males. Glendinning et al. (1994) described a positive relationship between parental and subject smoking status. Therefore, the higher prevalence of smoking among low SES adolescents, who are classified by parental SES status, may be associated with a higher prevalence among their parents.

Blood Pressure

The expected age- and sex-specific differences are observed in this study. SBP and DBP increased with age in both sexes, although only SBP in girls is significantly different. Boys tend to have higher blood pressures than girls. Age explains 2% of the variance in SBP while sex explains 5%. However, these variables do not explain any portion of the variance in DBP.

Comparisons to data for Brazilian children from The Rio de Janeiro Study (Pozzan et al., 1997) are shown in Table 90. Sex- and age-specific median SBP are somewhat lower in this study, while the reverse is observed for DBP. Comparisons to U.S. data compiled by Rosner et al. (1993) and to the data from the study of Cardiovascular Risk in Young Finns (Dahl et al., 1985) show that SBP mean in this study are similar to the U.S. data in both sexes, while Finnish boys and girls tend to have higher SBP values. For DBP, males and females in this study tend to have slightly higher values, especially the males. As for SBP, Finnish adolescents show higher DBP values (Table 91).

The reasons for higher DBP values in this study in comparison to Brazilian and international data are not known. Body weight of 14 year old boys are similar to U.S. data, while older males tended to be lighter than Americans and Finnish boys. Brazilian boys tended to be shorter than American and Finnish counterparts. Females also tend to be shorter and lighter than other females in the U.S. and Finland. Both boys and girls in this study have similar values of the BMI to the Finnish children. Therefore, differences in body size can not explain the higher values in DBP.

Rosner et al. (1993) reported that levels of blood pressure are affected by various factors including type of sphygmomanometer, number of observations used and the criteria for DBP (fourth or fifth Korotkoff sound, K4 or K5). All studies applied the K5 criterion. There are differences for number of observations and sphygmomanometers used among the studies. In the U.S. data, Rosner et al. (1993) used the first measured value; The Rio de Janeiro Study used the last of three measures; while the Young Finns Study used the mean of three; and this study used the mean of two measures. An aneroid sphygmomanometer was used in this study while the others used either a mercury or a random-zero. The extent of the effects of these factors in the blood pressure findings is unknown. Nevertheless, the differences are small.

Body weight is associated with blood pressure; overweight/obese individuals are at higher risk for developing hypertension. The Niterói data show that the effect of weight on blood pressure accounted for 3% of variance in SBP and 6% in DBP. ANCOVA adjusting for chronological age, sexual maturation, and race showed that overweight females had higher blood pressures than those at normal weight; however, these differences were not observed in males (Table 92). In this regard, Krieger and Landsberg (1995) suggested that body weight has a greater effect on blood pressure in females than in males.

In adults, there is a positive relationship between upper body fat distribution and hypertension (Krieger and Landsberg, 1995); however, Siervogel and Baumgartner (1988) suggested that the relationship may be less important in adolescents than in adults.

ANCOVA controlling for chronological age, sexual maturation and race showed that boys at risk for elevated blood pressure have higher values of WHR than those not at risk ($p < 0.01$, Table 93). Similar values of both variables were observed in females.

Racial differences in blood pressure are already observed in early childhood. Black individuals tend to have higher values for both SBP and DBP, but differences are not always significant (Alpert and Fox, 1993). The data from this study show no significant effects of race on blood pressures, after controlling for chronological age, sexual maturation and body weight (Table 94). However, individuals at risk for elevated blood pressure are more likely to be Non-whites in all age- and sex groups (Tables 54, 55 and 56).

SES is also related to blood pressures. Mean blood pressures and the prevalence of hypertension are greater among those in lower SES classes by income, occupation or education classification (Winkleby et al., 1990, 1992). Differences in mean BPs were not observed in this study, i.e., SES did not explain any proportion of variance in both SBP and DBP. For those at risk for elevated blood pressure, 70% of males and 100% of females were in the lower SES group. Although these findings are in agreement with the literature, it must be noted that the majority of the sample is from a lower SES background. This may result in insufficient statistical power to either find differences in mean blood pressures or in the distribution of elevated blood pressures among these groups.

There are no significant effects of cardiorespiratory fitness on blood pressure in this sample. Alpert and Wilmore (1994) suggested that no statistical significance is achieved in most studies controlling for a measure of size or fatness. Després et al. (1990)

also suggested that the association between blood pressure and fitness is weaker during childhood and adolescence. Blood pressure was adjusted for body weight in this study. All relationships between blood pressures and the 12-minute run are positive except for DBP in females. Other studies presented either positive relationships for SBP and DBP in both sexes (Gillum, 1989) or negative correlation coefficients (Sallis et al., 1988) for children 14-15 years and 11.8 years of age, respectively.

Comparing individuals at risk for low fitness to those not at risk, no differences are observed for either blood pressure values after controlling for chronological age, sexual maturation and body weight. Kwee and Wilmore (1990) found significant differences between 8 to 15 year old boys in the lower and those at the higher quartile of cardiorespiratory fitness assessed by a treadmill maximal test. There were no differences among blood pressures in children 10-17 years who passed or failed the Physical Best criterion for cardiorespiratory fitness (Bazzano et al., 1992). Similar blood pressures were reported for 14 year old adolescents in categories of high and low running performance (Bergström et al., 1997).

There is an inverse association between physical activity and blood pressure, but physical activity level only explains variance in DBP (3%). Sallis et al. (1988) also observed a negative relationship, except for SBP in boys; however, the correlation coefficients were not significant.

Among individuals at risk for inactivity, only DBP in males was significantly higher than in the active counterparts, although sedentary youngsters tended to show slightly higher blood pressures. The lack of significant differences may be due to the small number of active adolescents in both sex groups, resulting in low power in the analysis. Similar differences in blood pressure by activity levels were reported by Strazzullo et al. (1988) for children 11.3 years of age.

Overweight

Overweight was determined using the BMI as the criterion. As discussed for undernutrition, the use of an international reference potentially results in misclassification of subjects. In the case of overweight, the misclassification appears to move in the direction of underestimation. Anjos et al. (1998) showed that Brazilian values for the 95th percentile of the BMI were consistently lower than those for the U.S. population, and that the differences were greater among males.

The prevalence of overweight is presented in Table 95 using both cutoff points. In females, the prevalence is somewhat higher with the Brazilian cutoff. A discrepancy in prevalence is clearly observed among males, where prevalences by the Brazilian criterion are at least two times greater than by the U.S. criterion in both age groups. A possible reason for the discrepancy may be that some individuals classified as overweight by the Brazilian criterion have more muscle mass (which would increase the BMI) than those classified by both criteria. ANCOVA, controlling for chronological age and sexual maturation, showed that individuals classified as overweight only by the Brazilian cutoff tended to have larger estimated mid-upper arm muscle area, but the difference was not significant (38.0 cm^2 versus 36.4 cm^2 for those classified by both criteria).

By the Brazilian criterion, the prevalence of overweight was higher in boys than in girls. This suggests that the use of this criterion may be inappropriate for boys since it is well established that overweight is more prevalent in females. This is also true for the

Brazilian population. The highest prevalence occurs in 14 year old boys, who are consistently taller and heavier than other Brazilian samples, and also have higher BMI values. In addition, median body weight and the BMI in these boys are similar to those of American boys, so that an overestimation of overweight by the Brazilian criterion is expected for this age. Comparisons of the triceps and subscapular skinfolds indicate similar conclusions.

On the other hand, in 15 year old boys the values for body weight, stature, BMI, and the triceps and subscapular skinfolds are within values reported in other Brazilian studies and somewhat lower than NCHS values. However, the prevalence by the Brazilian criterion is twice the prevalence by the U.S. criterion. The fact that there are no comparative data for Brazilian adolescents limits the discussion and emphasizes the use of U.S. reference data.

A greater increase in the prevalence of overweight among adult Brazilian males than in females is observed in a comparison of 1989 PNSN and 1996/97 SSL (IBGE On-line, 1998). The Brazilian BMI percentiles used to classify overweight individuals comes from the PNSN data; therefore, it is reasonable to believe that the BMI distribution is becoming more skewed towards higher values, causing an overestimation of prevalence in a comparison of recent data to PNSN percentiles. In females, the prevalence by each criteria does not differ significantly because there are smaller differences between the Brazilian and U.S. BMI distributions.

There is no standard definition of overweight and obesity. In this study, the classification of individuals at risk overweight and overweight was based on the cutoff values suggested by Himes and Dietz (1994) and referred by the WHO (1995). However, different cutoff points and distributions are applied in the literature, making it difficult to compare data on overweight/obesity.

In both sexes, overweight youngsters are more likely to be Non-Whites than Whites. Data from the Bogalusa Heart Study only show systematic racial variation in girls, where Blacks have a higher BMI (Webber et al., 1995). On the contrary, Malina (1993a) showed that, by the BMI criterion, White 12-17 year old boys and girls have a higher prevalence of obesity. Malina (1993a) also suggests that estimates of prevalence due to ethnicity vary according to the obesity indicator used.

As higher prevalences are observed with increases in income quintiles among Brazilian adults, it was expected that more middle class adolescents would be overweight. In this study, the prevalence of overweight is higher in middle class females and similar values are observed between lower middle and lower classes. Overweight is more prevalent in lower class males, although the difference between prevalence in middle and lower classes is small.

There is a positive association between obesity and hours of TV viewing. The major link seems to be the decreased physical activity while watching TV. However, TV viewing is also associated with increased food intake, by increasing the opportunity for snacking especially high-caloric foods. A survey of nutrition behavior among middle-class secondary students (11th grade) in Manaus, North Brazil, showed that 23% of subjects often had snacks while watching TV (Doyle and Feldman, 1997). Thus, the increase in food intake during TV watching may be not a major concern among Brazilian adolescents.

A significant dose-response effect of time of TV viewing and prevalence of obesity was observed only in females in the present study, where each additional hour of TV viewing increased the risk for overweight to 20% (OR=1.20, adjusted for chronological age, sexual maturation and race). The OR for males was 1.13, and not significant (C.I.= 0.85 – 1.52). Table 96 shows the prevalence of overweight by hours of TV viewing. Obesity is found in subjects who watch TV for at least 3 hs/day; however, the linear trend is significant only for females.

The mean hours of TV viewing was 4.4 hs/day and 4.9 hs/day for males and females, respectively, in the present study. These means are slightly higher than those reported for the Brazilian children, especially in girls. Among 13 years old youth, females watch 3.9 hs/day while males of the same age watch 3.6 hs/day (Andrade et al., 1996). Boys from the lower class spend, on average, 4.2 hs/day watching TV; peers from the upper middle class watch TV for 3.6 hs/day (Matsudo et al., 1996).

Boys in the present study have similar values to boys of lower class, which is expected since the majority of the participants come from lower class households. The higher values observed in females may be explained by the difference in social class between the girls from this study and those from Andrade et al. (1996). The latter sample came from a middle class background. The variation in TV viewing between social classes is probably due to the different access to leisure options. Adolescents from lower class may have fewer options due to limited financial resources and rely more often on TV viewing for leisure. At least one TV set is found in almost all households in the Southeast region of Brazil (IBGE On-line, 1998).

Brazilian children watch more TV than American and Canadian youth. The estimated mean time for TV watching in the U.S. is between 2 and 3 hs/day (Pate et al., 1994). However, Gortmaker (1996) reported the mean value of TV viewing as 4.8 hs/day, in a sample of children 10 to 15 years of age. Katzmarzyk and Malina (1998) reported mean times of 2.0hs/day and 3.6 hs/day for 10-14 year old youth engaged and not engaged in sports, respectively ($p<0.001$). Data from the Quebec Family Study (1979-1981) showed that Canadian boys and girls spent 2.3 hs/day and 2.4 hs/day, respectively, watching TV (Kartzmarzyk et al., 1998).

Part of this higher values in TV watching is explained by the fact that Brazilian children spend less time in school, since the school day has 5 hours. Thus, children have more free time, which may be spent in front of a TV set if they have fewer options for leisure activities.

Physical inactivity is negatively related to overweight. In this sample of Brazilian adolescents, Spearman correlations show are –0.16 for boys and –0.11 for girls. However, with the PAQ-C protocol, females and almost all males were classified as inactive. Even a small change in the activity category from very inactive to inactive, shows a decrease in the prevalence of obesity. Comparing physical activity, overweight and TV viewing, 76.9% of the very inactive and 66.7% of the inactive overweight girls watch 5+ hs/day. On the other hand, only in the very inactive overweight group, the majority (66.7%) of boys spend 5+hs/days watching TV. Long periods of TV watching potentially take time away from physical activity, but it is possible that children are spending much of their spare time in front of TV due to lack of choices in activity pursuits. Preliminary analysis of sport participation of adolescents in this study shows that many subjects did not participate in sports due to lack of opportunity.

Fat distribution

There are sex differences for both the TER and WHR in this study sample; boys have higher ratios than girls, indicating proportionally more subcutaneous fat on the trunk. The TER and WHR were similar by age group or by sexual maturity status (pubertal vs post pubertal, controlling for age). Beunen et al. (1994) showed that late maturing 13 to 17 year old boys have lower TER; however, this study did not find differences between sexual maturity groups. These contrasting findings may be due to the assessment of maturation. Beunen et al. (1994) used age at peak height velocity as the maturity indicator, while the present study used self-reported secondary sex characteristics. The possible bias due to misclassification has been previously discussed.

Hammer et al. (1991) indicated a lower WHR in more mature girls aged 10 to 15 years (age was a covariate in the analyses of covariance). Self-assessment of sexual maturation was also the indicator of maturity status. The same trend was not observed in the girls from this study. The variability in sexual maturation was smaller in this study because these girls were older.

Racial differences in fat distribution have been reported. Black adolescent males and females tend to have more fat centrally distributed (Malina, 1996a). In this study, Non-White boys also had higher values of TER ($p<0.05$). No differences were noted among Non-White girls. Similar values of TER and WHR were found when data were stratified by social class, in both boys and girls.

Cardiorespiratory fitness and level of physical activity showed no significant relationship to fat distribution in this study. In males at risk for low fitness, there were no differences for TER and WHR. In contrast, females at risk had higher TER ($p<0.05$) and

WHR (p=0.08). Similarly, females at risk for inactivity also had higher TER and WHR than those not at risk. There were no differences in fat distribution between active and inactive boys.

Deutsch et al. (1985) described a relationship between obesity and fat distribution. Obese adolescents and obese young adults had more centrally distributed fat than non-obese individuals. This study showed the same trends. Youngsters at risk for overweight had higher TER and WHR, after controlling for chronological age and sexual maturation (Table 97). Only the difference in WHR in boys was significant, although it approaches significance in girls.

Data on fat distribution in Brazilian adolescents are based only on the subscapular-triceps skinfold ratio (STR, Guedes, 1993). Adolescents in this study have consistently higher STR values. The triceps skinfolds are similar in males from the two samples; however, the subscapular skinfolds are lower in Guedes' boys, yielding a lower STR (Table 98). Girls in the present study tend to have lower values for the triceps and higher values for the subscapular skinfold. These differences result in a higher STR than those for the females in Guedes (1993). Additionally, boys and girls in this study are taller and heavier, and have a higher BMI than their peers (Table 88). This indicated that the adolescents in the present study have more overall fat and more centrally distributed fat as well.

Physical activity

Recent Brazilian data on physical activity patterns of adults show that 26% of males and almost 13% of females are regularly active (IGBE On-line, 1998). When using the PAQ-C scores to classify individuals as active or sedentary, the majority of adolescents in this study are in the sedentary category.

The prevalence of inactivity is 85% for boys and 84% for girls. The high values are somewhat corroborated by the long periods of TV watching in the sample. Although there are no significant differences between individuals at various levels of physical activity, TV viewing time tends to be higher in inactive subjects, especially in girls. One of the reasons for a lack of differences between sedentary and active boys and girls is that only few subjects are classified as *moderately active* with maximum PAQ-C scores of 3.8 and 3.7, respectively, for boys and girls.

Another factor that contributes to inactivity is part-time working, since it decreases the free time after school. Twelve percent of boys and 6% of girls are part-time workers, and almost all of them are classified as sedentary (93.8% and 100%, respectively). Differences in physical activity scores are found only in females, where part-time workers have lower scores compared to those not in the work force (1.6 vs 2.0, $p<0.01$).

The PAQ-C does not account for labor activity. Therefore, part-time workers may be actually getting their physical activity in the workplace. More boys tend to work in manual activities, such as janitor and car washer, than in non-manual occupations (sales counter clerk, for example). The reverse is observed for females; they more frequently work in non-manual job positions. Consequently, individuals who are engaged in manual occupations have higher amounts of physical activity in their daily life due to job related chores, even though they are classified a s inactive by the PAQ-C.

Social factors also influence the physical activity patterns of adolescents.

Anderssen and Wold (1992) noted that the pattern of physical activity of 7th grade boys and girls was associated with the activity level of their best friend and parents, and with direct support (encouragement) and help (in organizing activity) from parents. Considering the high prevalence of inactivity observed in Brazil, it may be expected that the influence of peers and parents is in the direction of low levels of activity. On the other hand, direct support and help from parents tend to be sex-specific, with boys being more motivated to be active (Anderrsen and Wold, 1992). This may also be true in Brazilian society.

The physical environment also influences physical activity. Environments rich in resources for physical activity may facilitate activity, while those with poor resources pose a barrier to regular activity (Sallis et al., 1997). Unsafe neighborhoods have negative effects on physical activity, especially in children and adolescents. Unfortunately, large cities in Brazil are known for high crime rates. Although Niterói is a medium size city, it also has problems with safety. Therefore, not many children are permitted to play on the streets, which contributes to a decrease in the opportunities for physical activity.

The availability of convenient facilities also has an effect on physical activity. As most of subjects in this study come from lower SES families, they depend on facilities and programs that have no or low cost. Niterói has few such facilities and programs, and the available programs do not serve as many children as desired. Trost et al. (1997) showed that community sports are the strongest predictor of vigorous and moderate to vigorous physical activity in 11-14 year old rural boys and girls of South Carolina, U.S. Bungum and Vincent (1997) found similar results in 14-18 year old females. As stated previously, lack of opportunity to participate in sports was reported as a barrier to activity by many students in the sample.

This high prevalence of inactivity is of concern, especially because levels of physical activity tend to decrease through the adolescent years. Consequently, these sedentary children may be prone to become sedentary adults. A higher probability for inactivity among these children when they are adults is also expected due to the marginal tracking of physical activity from adolescence to adulthood (Malina, 1993b; Raitakari et al., 1994; Mechelen and Kemper, 1995). However, data are lacking on events and factors that influence physical activity and inactivity in Brazil.

The mean values for the physical activity score (PAQ-C) are lower in both sexes in the present study than those reported by Kowalski et al. (1997) in youth from 8 to 14 years. As physical activity decreases with age during adolescence, this may explain the lower scores observed in this study, since the subjects are older than the sample upon which the PAQ-C was validated.

The lower scores may also indicate that the questionnaire is not sensitive to cultural differences related to the perception of physical activity in Brazilian youth. Few other studies on physical activity have been carried out among Brazilian youngsters, and this study was the first to use this instrument in Brazil. The evidence, therefore, may be not sufficient to conclude that the PAQ-C is not a valid method of assessing physical activity habits in Brazilian adolescents. In fact, the correlation between the self-reported activity rating[6] and the PAQ-C score was 0.40 ($p<0.001$), which is slightly lower than the coefficient of 0.63 reported by Kowalski et al. (1997). Table 100 shows the PAQ-C

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[6] Question 12 in the modified questionnaire (Appendix K), which is not included in the computation of the score.

scores by categories of the self-reported activity rating. For both sexes, PAQ-C scores increase as the subjects classify themselves in to higher activity categories than peers.

Racial differences in physical activity levels are reported in the literature (Aaron at al., 1993; CDC, 1993, 1995), where Non-Whites are likely to be less active. There are no differences in physical activity scores among White and Non-White boys and girls in this study. Non-White females are more likely to be sedentary (OR=3.7, C.I.= 0.96-13.97) than Whites, and the reverse is apparent in males ($OR_{Non-White}$= 0.81, C.I. =0.29-2.20).

Individuals from the low SES tend to be less active than those from higher classes, when either education or income is used as the indicator of SES (CDC, 1993; Stephens and Caspersen, 1994). Occupation of the head of household was the indicator of SES in this study. Significant differences in physical activity levels are found only in females, although the lower SES boys tend to have lower scores. In both sexes, physical activity is greater in subjects from lower middle class (Table 101). A possible explanation is that boys and girls from this class show the lowest proportion of part-time workers. Since working subjects have lower activity scores, having fewer workers in the group may increase the mean score. However, the trend of more part-time workers among middle class females is contradictory to Brazilian data showing that the number of part-time working students decreases as the household income increases (Table 7). The results of the regression analyses show that lower middle class explains about 3% of the variance on the physical activity score (Table 51).

Soccer, the most popular sport in Brazil, is the most performed physical activity among males in both age groups. Among girls, dance and walking for exercise are the on the top of the rank, although the first and second places in rank are inverted for each age group. Walking for exercise is the most performed activity by older females. Bicycling and jogging or running for exercise are other popular activities in both sex and age groups. Except for soccer, these activities are non-competitive.

Other studies have shown that jogging/running and bicycling are consistently popular activities among adolescent males, while walking, jogging/running and dance (ballroom) are the favorite activities among females (Shephard, 1986; Ross et al.,1985; Huang, 1994). In the Bogalusa Heart Study (Myers et al., 1996), the most performed activities among White and Black boys and girls enrolled in 5th to 8th grade were walking, walk/run, and running. Calisthenics and bicycling were also frequent activities.

Four Brazilian studies on physical activity patterns among adolescents in São Paulo were available at the time of this study (Andrade et al., 1996, 1998; Matsudo et al., 1996, 1998). These studies used a self-reported activity rating, and time spent and pace of walking as the measures of physical activity. Unfortunately, results of theses studies are presented only as abstracts so that the specifics are not available. The results were presented only as relative distributions.

Although PAQ-C has a question on self-activity rating and the São Paulo studies also used a self-activity rating, there is no guarantee that the questions were formulated in the same way, and thus evaluate the same perception. This may explain the differences in the relative distribution of the categories of self-activity rating observed in the present study and in the São Paulo studies.

Another limitation is that the authors use broad age ranges: 11-18 years, and 10-15 years, while the other two studies provide only a mean age. Nevertheless, it was assumed that the age ranges are also wider than in the present study. These age groups contrast the limited range, 14-15 years, in this study, thus comparisons are difficult since the results are not age-stratified. The relevance of using age-stratified physical activity levels is rather obvious, i.e., activity levels, on average, decrease with increasing age with the steepest decline occurring in the adolescent years.

There is only one similarity between the data from this study and those from São Paulo. A lower percentage of low[7] SES girls classified themselves as *less active than peers* than those in the high SES (31.8% vs 53.4%, respectively). The same trend is observed among males in this study, 15.6% vs 21.4% for the low and high SES, respectively. However, data are not available for high SES boys from São Paulo. Whether or not the perception of activity levels differs between low and high SES individuals remains to be investigated.

Clustering risk factors

Because the chance for disease occurrence increases as the number of risk factors for CHD are clustered within an individual, it is important to identify those who are at greater risk for a clustering of risk factors. In the present study, the clustering of risks was assessed by the distribution of clustered risks. The analysis was based on the distribution of five risk factors: inactivity, overweight, smoking, elevated blood pressure, and low fitness. Few subjects were free of risks (12% and 5%, in males and females, respectively). Most subjects had a single risk factor.

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[7] Low SES is defined here as a combination of lower middle class and lower class.

Inactivity was the most frequent risk factor, either individually or clustered. However, caution may be used since the physical activity score may be not represent the actual level of physical activity of Brazilian adolescents. Inactivity was the only risk for 59% of males and 66% of females. Inactivity and low fitness clustered in 11% of males and 16% of females. An overweight and inactivity cluster was observed in approximately 5% of the subjects. As the number of risk variables increased, the number of subjects decreased. No subject had all five risk factors.

Adolescents with clustered risk factors may be at higher risk to cluster risk factors in adulthood. In the Bogalusa Heart Study, Myers et al. (1995) showed that young adults (19-32 years) who clustered high values of blood pressures, ponderal index (a measure of body fatness) and total cholesterol, had higher age-, sex-, and race-specific z-scores for these risk factors in childhood (5-14 years). The likelihood of clustering risk factors in adulthood increases with the increasing number of risk factors during childhood, even though the presence of any single risk in childhood increases the probability of clustering risk factors in adulthood by six times compared to those who have no risk in early ages.

Other data from the Bogalusa Heart Study (Bao et al., 1994) also showed that individuals at the highest tertile of the ponderal index had higher tracking of the multiple risk index (SBP, insulin and total cholesterol/ HDL ratio) than those at the lowest tertiles in a 8-year follow-up. The baseline ages ranged from 5-17 years. Also, the tracking of multiple risks was stronger in children with clustered risk factors than those with a single risk.

Increased body weight, BMI and triceps skinfold thickness in childhood (8-18 years) are associated with the early development of coronary artery calcification in young adult males. Higher SBP is an additional predictor of coronary artery calcification in females (Mahoney et al., 1996). Therefore, the analyses of the clustering of risk factors in young individuals may help to identify of those with higher probability for future CHD event.

It has been reported that Black girls and White boys aged 5 to 14 years in the Bogalusa Heart Study had the greatest proportions of clustering of blood pressures, overweight and cholesterol (Webber et al., 1979). Even though the subjects in this study are older than those from the Bogalusa Heart Study and no data on cholesterol levels were taken, similar findings are suggested in females. Fewer Non-white girls had none or one risk factor, while for 2 and 3 clustered risks they showed higher proportions. Non-White and White males, on the other hand, had similar values for a number of clustered risk factors, except for the 4 clustered risks, where all of the boys were Non-White. Analyses by SES showed no clear pattern.

CHAPTER 6

SUMMARY AND CONCLUSIONS

Summary

This study investigated the status of selected coronary heart disease (CHD) risk factors and components of health-related physical fitness in Brazilian adolescents, taking into account race, SES and sexual maturation. Data were collected from October to December 1997 and from March to May 1998 in public schools in Niterói, Rio de Janeiro, Brazil. All 8th grade students aged 14-15 years were eligible to participate. A total of 329 subjects (126 males and 203 females) were included in the study. Data on each subject included sociodemographic characteristics (sex, chronological age, socioeconomic status, and race), anthropometry (stature, sitting height, body mass, skinfolds at the biceps, triceps, subscapular, abdominal, medial calf, and suprailiac sites, circumferences of the arm, waist, and hip), selected risk factors (blood pressures, cigarette smoking, physical activity level, overweight, low fitness, subcutaneous fat distribution), components of health-related physical fitness (cardiorespiratory fitness and body composition), and self-assessed sexual maturation. The following variables were derived: estimated leg length, sitting height/stature ratio, body mass index (BMI), sum of six skinfolds, upper arm muscle area, waist-hip circumference ratio, and trunk-extremity skinfold ratio.

The analyses included descriptive statistics (means, standard deviations, comparison of means, frequencies) for each variable; multiple regression analyses to explore the relationships of sociodemographic variables with CHD risk factors and health-related physical fitness; the relationship of cardiorespiratory fitness and physical activity level with CHD risk factors; and Chi square test of independence to determine clustering of risk factors among adolescents. Data were analyzed with the SPSS package.

Technical errors of measurement for anthropometry were similar to those reported for national surveys in the United States (Malina, 1995). Measurement errors for blood pressures was lower than in the Bogalusa Heart Study (Foster et al., 1980). Intraclass correlations for anthropometry and blood pressures were comparable to those from the Quebec Family Study (Bouchard, 1985) and the Bogalusa Heart Study (Foster et al., 1980).

Within the limitations of the study, the major findings of the study are as follows:

Race has no relationship with cardiorespiratory fitness, level of physical activity, or CHD risk factors. However, Non-Whites tend to show a higher prevalence of elevated BPs and overweight, and also more centrally distributed subcutaneous fat. Non-White males are more likely to be smokers, while the reverse occurs among females. Non-White females tend to cluster risk factors more frequently than Whites.

SES does not explain any part of the variance in cardiorespiratory fitness or in CHD risk factors. Lower middle class status explained 3% of the variance in physical activity level. Lower SES individuals are at higher risk for smoking, elevated BPs and inactivity. Middle class girls and lower class boys are more likely to be overweight. Individuals in lower SES tend to be more at risk than subjects from other SES classes.

Cardiorespiratory fitness has no relationship with BPs, BMI, TER, or WHR. Cardiorespiratory fitness is inversely related to Σ6SF, correlations varying from –0.34 to —0.21 in both sexes. Physical activity has a slight positive relationship with cardiorespiratory fitness, explaining 4% of the variance. Boys at risk for low fitness tend to have lower physical activity scores, higher BPs, and significantly higher Σ6SF. Significantly lower physical activity scores, higher BMI, Σ6SF and TER are characteristic of females at risk. BPs also tend to be higher among these girls. Boys and girls at risk for low fitness tend to show an adverse risk profile.

Physical activity does no explain any part of the variance in Σ6SF, BMI, TER, WHR, or SBP. Physical activity is inversely related to DBP (R^2=0.03) and cardiovascular fitness (R^2= 0.04). Inactive boys tend to show higher BP values, while girls tend to have lower CF and higher Σ6SF, TER, WHR, and BPs. As with individuals at risk for low fitness, inactive subjects also tend to have an adverse risk profile.

Risk factors tend to cluster among adolescents; only 12% of boys and 5% of girls were free of risk. The majority had a single risk factor: inactivity, and all clusters included inactivity. No one clustered with 5 risks, and no female had 4 clustered risks. The prevalence of clustered risks was 24.8% for boys and 26.8% for girls. Non-White females had higher proportions of clustered risks, suggesting that they may be at higher risk for CHD. There were no differences among boys. Clustering of risk factors was similar among individuals of different SES.

Conclusions

The following conclusions can be derived from the present study:

1. The sociodemographic variables race and social class have no relationship with cardiorespiratory fitness or the selected CHD risk factors. The exception is physical

activity level, in which lower middle class status explains 3% of variance.

2. Non-White individuals and those from the lower class are more likely to present a higher risk profile.

3. Cardiorespiratory fitness is only related to Σ6SF and level of physical activity.

4. Boys and girls at risk for low fitness tend to show an overall adverse risk profile.

5. In addition to the relationship with cardiorespiratory fitness, physical activity level is inversely related to DBP.

6. Individuals at risk for inactivity tend to show an overall adverse risk profile.

7. Risk factors cluster within approximately 25% of the adolescents. Inactivity is present in all clusters. Few individuals cluster 3 and 4 risk variables. Non-White females tend to cluster risk factors more frequently than Whites, suggesting that they may be at higher risk for CHD.

Recommendations

This study has generated data on physical activity levels and other risk factors for CHD among Brazilian adolescents. Comparative data for other samples of Brazilian adolescents are presently limited. Therefore, it is difficult to make specific comparisons and to respond to questions indicated by the results. Further research addressing these questions is required and should include large sample sizes of randomly selected individuals.

This study has demonstrated a high prevalence of inactivity among Brazilian adolescents. It may be due to the questionnaire used to estimate physical activity in this study. Therefore, more research should look at the validity of questionnaires to assess physical activity for international comparisons. The development of a more culturally sensitive instrument is indicated. Research should also focus on physical activity levels from childhood through adolescence. The present study is limited to individuals 14-15 years of age.

The determinants of inactivity in Brazilian adolescents should also be investigated. Since most of the individuals in this study come from lower SES families, it is possible that the high inactivity is due to limited access to activity programs and facilities, among other factors. Therefore, it seems appropriate to increase the opportunities for activity for adolescents in the community, and the school the logical place to provide such programs in addition to the regular physical education. However, many public schools have limited resources to run activity programs, including physical education.

The results also show that activities such as soccer for boys and dance and walking for girls are among the most popular among this sample of Brazilian adolescents. These activities should be included in activity programs for this age group to enhance the adherence to the programs. The increase in regular physical activity is important for all adolescents, especially those having risk factors for CHD. Although the prevalence of risk factors is low in this age group, those at a higher risk may benefit the most.

This study also demonstrated that Non-White and lower SES adolescents are more likely to present risk factors, individually or clustered. Further studies should investigate risk factors in more detail, including blood lipids, family aggregation of risks, and tracking of the risk variables. Research also needs to examine access to preventive health services, especially for those at higher risk.

Considering that being Non-White and from lower SES increase the probability of having CHD risk factors and, in the case of females, also having increased probability for clustering risk variables, these individuals may have a special need for health care services. The lower class depends almost exclusively on public health facilities. In the few last decades, investments in health have been decreasing in Brazil. Therefore, these individuals may be not getting the required health attention, thus further increasing risk for CHD, especially because individuals at risk during adolescence tend to track into adulthood. A better understanding of risk factors in youth will help provide a sound basis for the design of strategies for disease prevention and health promotion in youth, and for the more effective use of preventive health resources and services in the developing country that Brazil still is.

TABLES

Table 1. Relative distribution (%) of stages of genital and breast development in Brazilian males and females, respectively, by age group from 10 to 19 years.

Age (years)	Stage 1	2	3	4	5
			Genital development		
10 –	38.2	58.2	3.6	0	0
11 –	16.1	69.9	11.8	1.6	0.5
12 –	6.7	56.5	26.7	8.8	1.3
13 –	3.0	30.2	33.7	26.0	7.1
14 –	1.2	12.4	26.8	37.3	22.3
15 –	0.3	4.9	9.7	36.1	49.1
16 –	0	0.5	3.2	30	66.3
17 –	0	0.3	1.1	15.2	83.4
18 –	0	0	0.3	6.2	93.5
19 –	0	0	0	1.8	98.2
			Breast development		
10 –	47.2	34.4	13.5	3.7	1.2
11 –	14.7	31.1	31.6	14.2	8.4
12 –	5.2	15.7	33.1	24.0	22.0
13 –	1.1	5.0	16.2	32.5	45.2
14 –	0.3	0.5	4.6	25.7	68.9
15 –	0	0	2.7	16.8	80.5
16 –	0.3	0	0.3	16.5	82.9
17 –	0	0	0	12.6	82.9
18 –	0	0	0	13.2	86.8
19 –	0	0	0	7.2	92.8

Adapted from Colli (1988).

Table 2. Relative distribution (%) of stages of pubic hair stages in Brazilian males and females, respectively, by age group from 10 to 19 years.

Age (years)	Stage 1	2	3	4	5	6
			Males			
10 -	78.8	20.6	0.6	0	0	0
11 -	61.3	31.7	4.8	2.2	0	0
12 -	38.1	43.0	13.0	5.7	0	0
13 -	16.7	35.4	20.9	23.8	2.0	1.2
14 -	7.0	17.6	21.6	40.6	8.2	4.9
15 -	2.6	4.6	11.0	45	14.6	22.2
16 -	0.3	0.5	2.6	39.5	15.1	41.9
17 -	0.3	0.3	0.8	26.8	13.0	58.8
18 -	0	0	0	17.1	12.9	70.0
19 -	0	0	0	14.5	7.1	78.4
			Females			
10 -	49.1	36.8	9.8	3.7	0.6	0
11 -	8.4	34.2	25.3	11.6	10.5	0
12 -	7.7	22.6	21.2	24.5	23.4	0.6
13 -	1.5	7.2	12.7	24.6	52.9	1.1
14 -	0.3	1.5	2.8	16.7	74.6	4.1
15 -	0.3	1.3	1.6	8.9	82.4	5.4
16 -	0	0	0	3.5	85.6	10.8
17 -	0	0	0	3.5	85.6	10.8
18 -	0	0	0	1.3	84.1	14.6
19 -	0	0	0	2.1	78.4	19.5

Adapted from Colli (1988).

Table 3. Correlations between self and physician assessments of secondary characteristics in several Brazilian adolescents by sex.

	Females		Males	
Comparison of trials	*Breast*	*Pubic Hair*	*Genitals*	*Pubic Hair*
Self, trial 1 vs trial 2	0.97	0.97	0.93	0.99
Physician, trial 1 vs trial 2	0.98	0.97	0.76	0.89
Self vs physician, trial 1	0.89	0.92	0.80	0.84
Self vs physician, trial 2	0.93	0.92	0.79	0.84

Adapted from Matsudo and Matsudo (1994).

Table 4. Percentile values for high normal blood pressure and hypertension by age and sex during adolescence.

	High Normal Blood Pressure (mm Hg) (>90th percentile)		Significant Hypertension (mm Hg) (> 95th percentile)	
Age	*Systolic*	*Diastolic*	*Systolic*	*Diastolic*
13-15 years	130-135	80-85	136-143	86-91

Adapted from the Second Task Force on Blood Pressure in Children (1987).

Table 5. Relative composition (%) of the Brazilian population by race and geographic region.

Race	Geographic Regions				
	*North**	*Northeast*	*Southeast*	*South*	*Central West*
Whites	27.4	29.4	66.0	82.8	47.4
Blacks	1.5	5.3	5.9	3.0	3.2
Pardos	71.0	65.3	27.1	13.6	49.2
Asians	0.1	0.0	1.0	0.6	0.2

Data for the North region are from urban areas; no data are available for rural areas.
Adapted from IBGE (1993).

Table 6. Mean wages by occupational category and sex in Brazil, 1981-1990.

Occupation	Sector (MMW)[a]		
	Public	*Private*	*Self-employed*
		Males	
Professional and managerial	17.3	16.3	20.5
Technicians and related support	5.7	6.7	9.8
Manual	3.1	3.2	4.9
		Females	
Professional and managerial	9.1	9.0	4.5
Technicians and related support	4.1	4.1	5.1
Manual	1.6	1.9	2.1

Adapted from Oliveira (1993) [a] MMW: minimum monthly wage (U$110)

Table 7. Work and study status of Brazilian adolescents by household income.

Household Income (MMW[a])	Age groups: 10-14 years (%) Only studying	Working and studying	Only working	Age groups: 15-17 years (%) Only studying	Working and studying	Only working
< 0.25	59.6	14.7	12.3	26.5	14.9	39.8
0.25-0.50	63.8	11.7	11.7	28.6	15.2	39.8
0.50-1.00	73.2	10.3	8.0	30.7	20.3	34.8
1.00-2.00	83.1	8.3	4.0	36.8	24.8	28.4
> 2.00	91.5	5.1	1.2	56.1	23.8	14.5

Adapted from IPEA (1996). [a] MMW (monthly minimum wage).

Table 8. Number and percentage of adolescents 10-19 years of age in the five administrative regions of Niterói.

Administrative region	Adolescent Population: N	%
North	30176	40
East	38309	38
Ocean Beaches	9072	12
Bay beaches	6510	9
Pendotiba	915	1

Adapted from PMN/CECITEC (1996a).

Table 9. Estimated population of 14 and 15 year old youth in Niterói in 1997.

Age (years)	Sex			
	Males		*Females*	
	N	%[a]	N	%[a]
14 +	3965	0.8	4073	0.9
15 +	4145	0.9	4157	0.9

[a] Proportional to the entire population. Data from DATASUS On-line (1998).

Table 10. Number of schools and subjects according to the administrative areas in Niterói.

	Number of schools		Number of subjects (%)	
Administrative region	*Eligible*	*Included*	*Males*	*Females*
North	15	5	44 (34.9)	52 (25.6)
Ocean Beaches	2	2	13 (16.2)	33 (16.2)
Bay Beaches	11	7	58 (46.1)	99 (48.8)
Pendotiba	4	2	11 (8.7)	19 (9.4)

Table 11. Age- and sex-specific cut-off points of the body mass index (BMI) for the risk of overweight and for overweight as recommended by Himes and Dietz (1994).

	BMI (kg/m^2)			
	At risk for overweight		*Overweight*	
Age (years)	Males	Females	Males	Females
14 –	23	24	27	28
15 –	24	24	28	29

Table 12. Intra-observer technical errors of measurement for anthropometric variables.

Variables	Measurement Error			
	This study	*HES-III* [a]	*HHANES* [b]	*Quebec Family Study* [c]
Height (cm)	0.6	0.5	1.3	0.3
Weight (kg)	0.7			0.4
Sitting height (cm)	0.5	0.5	0.6	
Circumferences (cm)				
Relaxed arm	0.4	0.4	0.7	
Waist	1.2	1.3		
Hip	0.9	1.2		
Skinfolds (mm)				
Triceps	0.6	0.8	1.6	1.2
Biceps	0.7			1
Calf	1.1	1.4	2.7	1.9
Subscapular	0.6	1.8	2.2	1.4
Suprailiac	1.1	1.9	3.3	2.1
Abdominal	0.7			2
Sum of 6 skinfolds	2.7			4.9
Extremity trunk ratio (mm mm)	0.1			0.1

[a] U.S. Health Examination Survey, Cycle III (Malina, 1995a). [b] U.S. Hispanic Health and Nutrition Examination Survey (Malina, 1995a). [c] Bouchard (1985).

Table 13. Intra-observer measurement errors for blood pressures.

Blood Pressure (mm Hg)	Measurement Error (mm Hg)	
	This study	*Bogalusa Heart Study*[a]
Systolic	3.7	5.0
Diastolic	3.5	5.0

[a] Measurement errors in the 1976-1977 sample (Foster et al., 1980).

Table 14. Intraclass correlation coefficients for the anthropometric and blood pressure variables.

Variables	Intraclass R		
	This study	*Quebec Family Study*[a]	*Bogalusa Heart Study*[b]
Height (cm)	1	1	1
Weight (kg)	1	1	1
Sitting height (cm)	1		
Circumferences (cm)			
Relaxed arm	0.96		
Waist	0.76		
Hip	1		
Skinfolds (mm)			
Abdominal	0.97	0.98	
Biceps	0.89	0.96	
Calf	1	0.94	
Subscapular	0.99	0.98	
Suprailiac	0.96	0.96	
Triceps	0.97	0.98	0.99
Sum of 6 skinfolds	0.98	0.99	
Trunk-extremity ratio (mm.mm)	1	0.97	
Blood Pressure (mm Hg)			
Systolic	0.83		0.84
Diastolic	0.59		0.79

[a] Bouchard (1985) [b] Foster et al. (1980)

Table 15. Age distribution and descriptive statistics for age of the study sample by sex.

	Sex							
	Male				Female			
Age (years)	N	Mean	SD	Median	N	Mean	SD	Median
14-	66	14.6	0.3	14.6	100	14.6	0.3	14.6
15-	60	15.4	0.3	15.4	103	15.4	0.3	15.4
Total	126	15.0	0.5	14.9	203	15.0	0.5	15.0

Table 16. Composition of the study sample by race within each sex.

	Age group (years)					
	14-		*15-*		*Total*	
Race	N	%	N	%	N	%
			Males			
White	35	53	27	45	62	49
Mixed Black (Pardo)	18	27	31	52	49	39
Black	12	18	2	3	14	11
Missing data	1	2	0	0	1	1
Total	66		60		126	
			Females			
White	49	49	46	45	95	47
Mixed Black (Pardo)	43	43	43	42	86	42
Black	8	8	14	14	22	11
Total	100		103		203	

Table 17. Distribution of socioeconomic status categories in the study sample by age group and sex.

Socioeconomic status	Age group (years) 14- N	%	15- N	%
		Males		
Middle class[a]	7	10.6	7	11.7
Lower middle class[b]	13	19.7	13	21.7
Lower class[c]	36	54.5	29	48.3
Not in work forced[d]	4	6.1	5	8.3
Missing or not well defined	6	9.1	6	10
Total	66		60	
		Females		
Middle class[a]	6	6	9	8.7
Lower middle class[b]	12	12	13	12.6
Lower class[c]	59	59	61	59.2
Not in work forced[d]	8	8	4	3.9
Missing or not well defined	15	15	16	15.5
Total	100		103	

[a] owners and shareholders of medium and small enterprises, executive, administrative, managerial and professional occupations. [b] technicians and related support, sales, and administrative support (including clerical) occupations. [c] laborers, craft, operatives and service workers. [d] retired or unemployed head of household, housewife under pension.

Table 18. Heads of the household of the study sample by age group and sex.

Head of household	Age group (years) 14- N	%	15- N	%
		Males		
Male parent	59	89	55	92
Female parent	7	11	5	8
Total	66		60	
		Females		
Male parent	86	86	90	87
Female parent	14	14	13	13
Total	100		103	

Table 19. Distribution of subjects by social class (socioeconomic status) by race by sex.

	Race	
	White	*Non-White*
Social Class	N (%)	N (%)
	Males[a]	
Middle	7 (13.2)	5 (9.1)
Lower Middle	14 (26.4)	11 (20.0)
Lower	32 (60.4)	30 (70.9)
	Females[b]	
Middle	9 (11.7)	6 (6.5)
Lower Middle	17 (22.1)	7 (7.5)
Lower	51 (66.2)	80 (86.0)

[a] Chi-square= 1.35, df=2, $p>0.05$

[b] Chi-square= 9.75, df=2, $p<0.01$

Table 20. Characteristics of the households of the study sample by age and sex..

	Age group (years)					
	14-			*15*		
Variable	N	Mean	SD	N	Mean	SD
			Males			
Number of children per couple, n	66	2.5	1.4	60	2.8	1.7
Members in the household, n	66	4.3	1.3	60	4.5	1.7
Workers in the household, n	66	1.7	0.8	60	1.7	1.0
			Females			
Number of children per couple, n	100	3.0	1.7	103	2.8	1.4
Members in the household, n	100	4.3	1.2	103	4.6	2.5
Workers in the household, n	99	1.7	0.8	103	1.8	0.9

Table 21. Working status of the subjects by age group and sex.

	Age group (years)			
	14-		*15-*	
Working status	N	%	N	%
		Males		
Not in work force	59	89.4	50	83.3
Part-time workers	7	10.6	9	15.0
Missing data	0	0	1	1.7
Total	66		60	
		Females		
Not in work force	93	93.0	98	95.1
Part-time workers	7	7.0	5	4.9
Total	100		103	

Table 22. Descriptive statistics for anthropometric variables in males by age.

Variable	Age group (years) 14				15				F value	p
	N	Mean	SD	Median	N	Mean	SD	Median		
Body weight (kg)	66	55.4	12.0	53.8	60	54.9	10.6	53.6	0.05	ns
Stature (cm)	66	166.8	9.3		60	166.7	7.2		0.01	ns
Sitting Height (cm)	66	85.3	5.0		59	85.4	4.5		0.01	ns
Estimated leg length (cm)	66	81.5	5.1		59	81.3	4.2		0.06	ns
Sitting Height/stature ratio (cm)	66	51.16	1.24		59	51.24	1.38		0.13	ns
Body Mass Index (kg/m^2)	66	19.7	2.8	19.8	60	19.6	2.8	19.6	0.00	ns
Triceps skinfold (mm)	66	10.3	4.0	9.8	60	9.1	3.4	7.9	3.42	ns
Biceps skinfold (mm)	66	5.5	2.2	4.8	60	5.1	2.3	4.2	1.38	ns
Calf skinfold (mm)	66	11.1	5.1	9.8	60	9.4	4.8	7.8	3.82	ns
Subscapular skinfold (mm)	66	9.3	3.8	8.2	60	9.2	3.4	8.6	0.02	ns
Suprailiac skinfold (mm)	66	10.0	4.9	8.4	60	8.6	5.3	7.6	2.43	ns
Abdominal skinfold (mm)	66	14.8	6.5	13.1	60	13.4	7.0	11.3	1.33	ns
Sum of six skinfolds (mm)	66	61.1	24.5	53.5	60	54.8	24.1	46.5	2.11	ns
Sum of triceps and subscapular (mm)	66	19.6	7.4	17.9	60	18.3	6.4	16.1	1.11	ns
Trunk extremity ratio (mm/mm)	66	1.28	0.24	1.24	60	1.34	0.31	1.30	1.35	ns
Arm circumference (cm)	66	24.8	2.9		60	24.3	2.8		1.20	ns
Arm muscle area (S_t, cm^2)	66	37.6	8.4		60	37.0	8.4		0.13	ns
Arm muscle area (S_t+S_h, cm^2)	66	38.3	8.9		60	41.3	8.5		3.71	ns
Hip circumference (cm)	65	86.6	8.0	86.3	60	86.1	6.9	85.4	0.12	ns
Waist circumference (cm)	66	70.0	7.0	69.4	60	69.2	6.4	68.2	0.47	ns
Waist to hip ratio (cm/cm)	65	80.93	3.45	80.85	60	80.33	3.97	80.34	0.81	ns

ns= not significant at p<0.05

Table 23. Descriptive statistics for anthropometric variables in females by age.

	Age group (years)									
	14				*15*					
Variable	N	Mean	SD	Median	N	Mean	SD	Median	F value	*p*
Body weight (kg)	100	50.6	8.8	49.3	103	52.8	8.9	51.3	3.28	ns
Stature (cm)	100	159.5	5.9		103	160.0	5.8		0.40	ns
Sitting Height (cm)	100	83.9	3.3		103	83.6	3.1		0.22	ns
Estimated leg length (cm)	100	75.6	3.8		103	76.4	3.8		1.71	ns
Sitting Height/stature ratio (cm)	100	52.59	1.28		103	52.28	1.24		2.26	ns
Body Mass Index (kg/m^2)	100	19.8	3.0	19.5	103	20.6	2.7	19.9	3.15	ns
Triceps skinfold (mm)	100	15.2	4.9	14.3	103	15.6	4.5	14.6	0.35	ns
Biceps skinfold (mm)	100	7.7	3.1	6.8	103	8.1	3.0	7.4	0.68	ns
Calf skinfold (mm)	100	15.7	6.0	14.3	103	16.9	5.5	16.2	2.19	ns
Subscapular skinfold (mm)	100	12.7	4.4	11.7	103	13.6	4.4	12.4	2.01	ns
Suprailiac skinfold (mm)	100	13.5	6.5	11.1	103	14.1	6.0	12.4	0.35	ns
Abdominal skinfold (mm)	100	19.6	5.8	19.2	103	21.3	5.5	20.4	4.56	0.03*
Sum of six skinfolds (mm)	100	84.4	27.7	77.9	103	89.5	24.7	83.8	1.87	ns
Sum of triceps and subscapular (mm)	100	27.9	8.7	26.5	103	29.2	8.3	27.0	1.11	ns
Trunk extremity ratio (mm/mm)	100	1.21	0.23	1.20	103	1.23	0.25	1.18	0.39	ns
Arm circumference (cm)	100	24.0	2.7		103	24.5	2.6		2.05	ns
Arm muscle area (S_t, cm^2)	100	29.6	5.6		103	30.8	5.7		2.41	ns
Arm muscle area (S_t+S_b, cm^2)	100	31.3	5.1		103	36.6	6.2		43.12	< 0.001*
Hip circumference (cm)	100	88.7	7.1	88.0	103	90.8	7.4	89.5	4.23	0.04*
Waist circumference (cm)	100	65.6	6.0	64.8	103	66.9	5.4	66.4	2.74	ns
Waist to hip ratio (cm/cm)	100	74.02	3.68	73.97	103	73.87	4.04	73.73	0.08	ns

*$p<0.05$, ns = not significant

Table 24. Descriptive statistics for age and anthropometric variables in males by race, age groups combined.

	Race group [a]							
	Whites			*Non- Whites*				
Variable	N	Mean	SE	N	Mean	SE	F value	*p*
Age (years)	61	14.9	0.6	61	15.0	0.5	0.70	ns
Body weight (kg)	61	54.8	1.5	61	55.5	1.5	0.12	ns
Stature (cm)	61	166.2	1.1	61	167.3	1.1	0.53	ns
Sitting Height (cm)	61	85.4	0.6	61	85.3	0.6	0.03	ns
Estimated leg length (cm)	61	80.7	0.6	61	82.0	0.6	2.05	ns
Sitting Height/stature ratio (cm)	61	51.4	0.16	61	51.0	0.16	3.42	ns
Body Mass Index (kg/m^2)	61	19.7	0.4	61	19.7	0.4	0.00	ns
Triceps skinfold (mm)	61	9.9	0.5	61	9.5	0.5	0.40	ns
Biceps skinfold (mm)	61	5.3	0.3	61	5.3	0. 3	0.00	ns
Calf skinfold (mm)	61	10.4	0.6	61	10.0	0.6	0.28	ns
Subscapular skinfold (mm)	61	9.0	0.5	61	9.5	0.5	0.49	ns
Suprailiac skinfold (mm)	61	9.1	0.7	61	9.7	0.7	0.51	ns
Abdominal skinfold (mm)	61	14.1	0.9	61	14.1	0.9	0.00	ns
Sum of six skinfolds (mm)	61	57.8	3.2	61	58.1	3.2	0.00	ns
Sum of triceps and subscapular (mm)	61	18.9	0.9	61	19.0	0.9	0.00	ns
Trunk extremity ratio (mm/mm)	61	1.27	0.03	61	1.37	0.03	4.16	0.04*
Arm circumference (cm)	61	24.6	0.4	61	24.6	0.4	0.00	ns
Arm muscle area (S_t, cm^2)	61	37.1	1.1	61	37.7	1.1	0.17	ns
Arm muscle area (S_t+S_b, cm^2)	61	39.2	1.1	61	40.3	1.1	0.50	ns
Hip circumference (cm)	61	86.3	1.0	61	86.4	1.0	0.01	ns
Waist circumference (cm)	61	69.1	0.9	61	70.1	0.9	0.60	ns
Waist to hip ratio (cm/cm)	61	54.8	1.45	61	55.5	1.45	0.12	ns

[a] adjusted for chronological age and sexual maturation. * $p<0.05$, ns=not significant

Table 25. Descriptive statistics for age and anthropometric variables in females by race, age groups combined.

	Race group							
	Whites			*Non-Whites*				
Variable	N	Mean	SE	N	Mean	SE	F value	*p*
Age (years)	94	15.0	0.5	107	15.0	0.5	0.42	ns
Body weight (kg)	94	50.7	0.9	107	52.5	0.8	2.25	ns
Stature (cm)	94	159.8	0.6	107	159.7	0.6	0.04	ns
Sitting Height (cm)	94	84.0	0.3	107	83.5	0.3	1.04	ns
Estimated leg length (cm)	94	75.8	0.4	107	76.1	0.4	0.29	ns
Sitting Height/stature ratio (cm)	94	52.6	0.13	107	52.3	0.12	1.57	ns
Body Mass Index (kg/m^2)	94	19.8	0.3	107	20.5	0.3	3.79	ns
Triceps skinfold (mm)	94	14.8	0.5	107	15.8	0.4	2.42	ns
Biceps skinfold (mm)	94	7.5	0.3	107	8.2	0.3	2.23	ns
Calf skinfold (mm)	94	16.0	0.6	107	16.4	0.5	0.22	ns
Subscapular skinfold (mm)	94	12.5	0.4	107	13.6	0.4	3.32	ns
Suprailiac skinfold (mm)	94	13.2	0.6	107	14.2	0.6	1.38	ns
Abdominal skinfold (mm)	94	20.2	0.6	107	20.6	0.5	0.22	ns
Sum of six skinfolds (mm)	94	84.3	2.5	107	88.7	2.4	1.61	ns
Sum of triceps and subscapular (mm)	94	27.3	0.8	107	29.4	0.8	3.24	ns
Trunk extremity ratio (mm/mm)	94	1.22	0.02	107	1.22	0.02	0.02	ns
Arm circumference (cm)	94	23.9	0.3	107	24.5	0.2	3.20	ns
Arm muscle area (S_t, cm^2)	94	29.7	0.6	107	30.7	0.5	1.72	ns
Arm muscle area (S_t+S_b, cm^2)	94	33.6	0.6	107	34.3	0.6	0.65	ns
Hip circumference (cm)	94	89.0	0.7	107	90.2	0.6	1.62	ns
Waist circumference (cm)	94	65.4	0.5	107	67.0	0.5	4.21	0.04[b]
Waist to hip ratio (cm/cm)	94	73.6	0.40	107	74.3	0.37	1.99	ns

[a] adjusted for chronological age and sexual maturation. [b] $p<0.05$. ns=not significant

Table 26. Distribution (%) of self-assessed stages of secondary sex characteristics in males and females by age.

	Stage				
Age groups (years)	*1*	*2*	*3*	*4*	*5*
			Males		
			Genital		
14–	0	3.1	4.6	63.1	29.2
15–	0	0	6.7	63.3	30.0
			Pubic hair		
14–	0	3.1	3.1	18.5	75.4
15–	0	0	3.3	20.0	76.7
			Females		
			Breast		
14–	0	3.0	22.0	61.6	13.1
15–	0	0	23.5	58.8	17.6
			Pubic hair		
14–	0	3.1	4.1	38.1	54.6
15–	0	0	2.9	35.0	62.1

Table 27. Menarcheal status and descriptive statistics for age at menarche by age group and in the total sample.

	Menarcheal status							
	Yes		*No*		Age at menarche (years)			
Age (years)	N	%	N	%	N [b]	Mean	SD	Median
14– [a]	93	93.0	6	6.0	91	12.4	1.4	12.6
15–	102	99.0	1	1.0	100	12.4	1.4	12.6
Total	195	96.5	7	3.5	191	12.4	1.4	12.6

[a] missing data for one subject. [b] several subjects could not recall when menarche was attained.

Table 28. Distribution (%) of self-assessed stages of secondary sex characteristics in males and females by race, age groups combined.

Race	Stage				
	1	*2*	*3*	*4*	*5*
			Males		
			Genital[a]		
White	0	3.2	3.2	64.5	29.0
Non-White	0	0	8.1	62.9	29.0
			Pubic hair[b]		
White	0	3.3	4.9	18.0	73.8
Non-White	0	0	1.6	20.6	77.8
			Females		
			Breast[c]		
White	0	2.1	25.5	61.7	10.6
Non-White	0	0.9	20.6	58.9	19.6
			Pubic hair[d]		
White	0	0	4.2	43.2	52.6
Non-White	0	2.8	2.8	29.9	64.5

[a] Chi-square=3.30, df=3, ns [b] Chi-square=3.30, df=4, ns

[c] Chi-square=3.70, df=3, ns [d] Chi-square=7.30, df=4, ns

Table 29. Menarcheal status and descriptive statistics for age at menarche by race, age groups combined.

	Menarcheal status							
	Yes		*No*		Age at menarche (years)			
Race	N	%	N	%	N [b]	Mean	SD	Median
White[a]	89	94.7	5	5.3	88	12.5	1.3	12.6
Non-White	106	98.1	2	1.9	103	12.3	1.4	12.6

[a] missing data for one subject. [b] several subjects could not recall when menarche was attained.

Table 30. Distance covered in the 12-minute run by age and sex, and by race and sex, age groups combined.

	Distance run in 12 minutes (meters)					
	Males			*Females*		
	N	Mean	SD[a]	N	Mean	SD
Age (years)						
14	63	2248.0	286.2	90	1743.8	251.6
15	55	2252.2	418.9	92	1737.6	272.9
Total sample	118	2249.9	352.7	182	1740.7	261.9
Race[b]						
White	59	2245.4	46.5	83	1733.4	29.0
Non-White	57	2265.7	47.3	97	1750.7	26.8

[a] SE for the race analyses. [b] ANCOVA adjusting for chronological age and sexual maturation.

Table 31. Quintile cutoff points of cardiorespiratory fitness by age group and sex.

Sex	Quintiles cutoff points of the12 minute run (m)				
	1	*2*	*3*	*4*	*5*
			14+ years		
Males	1574.0	1999.2	2196	2357.4	2515.4
Females	1233.0	1510.6	1665	1783.8	1935.0
			15+ years		
Males	1549.0	1886.2	2128.6	2379.0	2503.4
Females	1154.0	1526.4	1665.0	1774.6	1963.8

Table 32. Descriptive statistics for blood pressures (mm Hg) by age group and sex.

Blood pressure (mm Hg)	Age groups (years)									
	14+			*15+*					Total	
	N	*Mean*	*SD*	*N*	*Mean*	*SD*	F value	*p*	*N*	*SD*
					Males					
Systolic	66	109.5	8.1	60	110.9	9.5	0.82	ns	110.2	8.8
Diastolic	66	67.8	6.8	60	66.3	9.7	1.08	ns	67.1	8.3
					Females					
Systolic	100	105.2	6.9	103	107.6	8.6	4.56	0.03*	106.4	7.9
Diastolic	100	65.3	6.2	103	66.7	6.4	2.30	ns	66.0	6.3

ns=not significant *$p<0.05$

Table 33. Prevalence of high blood pressure and hypertension by age and sex.

		Criteria									
		SBP [a]		*DBP* [b]		*SBP only*		*DBP only*		*Both*	
Age (years)	Risk	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
						Males					
14+											
	high normal [a]	2	3.0	3	4.5	2	3.0	3	4.5	0	0
15+											
	high normal	1	1.7	4	6.7	0	0	3	5.0	1	1.7
	hypertension [b]	0	0	2	3.3	0	0	2	3.3	0	0
						Females					
14+											
	high normal	0	0	0	0	0	0	0	0	0	0
15+											
	high normal	2	1.9	3	2.9	1	1.0	2	1.9	1	1.0

SBP – systolic blood pressure, DBP – diastolic blood pressure

[a] SBP and/or DBP >90th percentile for age. [b] SBP and/or DBP >95th percentile for age.

Table 34. Cigarette smoking status by age group and sex.

	Cigarette smoking status							
	No		*Yes (average number of cigarette per day)*					
			<1		2 to 5		6 to 10	
Age (years)	N	%	N	%	N	%	N	%
				Males				
14+	66	100.0	0	0	0	0	0	0
15+ [a]	55	91.7	1	1.7	2	3.3	1	1.7
				Females				
14+ [a]	97	97.0	0	0	1	1.0	0	0
15+ [a]	99	96.1	1	1.0	1	1.0	1	1.0

[a] missing values complete the 100% of the sample.

Table 35. Physical activity scores and hours of television viewing by age group and sex, and in the total sample by sex.

	Age (years)										
	14			*15*					Total		
Variable	N	Mean	SD	N	Mean	SD	F value	*p*	N	Mean	SD
					Males						
Physical activity level[a]	66	2.3	0.6	60	2.3	0.6	0.40	ns	126	2.3	0.6
TV viewing (min/day)	66	255	125	59	269	166	0.31	ns	125	262	145
TV viewing (hours/day)	66	4.3	2.1	59	4.5	2.8	0.31	ns	125	4.4	2.4
					Females						
Physical activity level	100	2.0	0.6	103	2.0	0.5	0.27	ns	203	2.0	0.6
TV viewing (min/day)	99	320.9	193	103	270	167	4.05	0.04*	202	294	181
TV viewing (hours/day)	99	5.3	3.2	103	4.5	2.8	5.05	0.04*	202	4.9	3.0

[a] scores for activity level range from 1 to 5. ns= not significant * $p<0.05$

Table 36. Physical activity status in the past 7 days by age group and sex.

	Age (years)			
	14–		*15–*	
Category (score)	N	%	N	%
		Males		
Very inactive (1)	22	33.3	21	35.0
Inactive (2)	35	53.0	29	48.3
Moderately active (3)	9	13.6	10	16.7
		Females		
Very inactive (1)	55	55.0	51	49.5
Inactive (2)	39	39.0	46	44.7
Moderately active (3)	6	6.0	6	5.8

Table 37. Prevalence of the risk for inactivity by age group and sex.

	Age (years)			
	14–		*15–*	
Risk for inactivity[a]	N	%	N	%
		Males		
Not at risk	9	13.6	10	16.7
At risk	57	86.4	50	83.3
		Females		
Not at risk	6	6	6	5.8
At risk	94	94	97	94.2

[a] at risk when physical activity score <3.

Table 38. Relative frequency of different physical activities in 14 year old males.

Activity	Frequency of physical activity (%) *No*	*1-2*	*3-4*	*5-6*	*7+*	Total percentage of participants	Rank
Soccer	24.2	22.7	24.2	9.1	19.7	75.8	1
Jogging or running	37.9	28.8	12.1	9.1	12.1	62.1	2
Walking for exercise	40.9	12.1	19.7	6.1	21.2	59.1	3
Bicycling	40.9	12.1	19.7	6.1	21.2	59.1	3
Tag	48.5	34.8	4.5	4.5	7.6	51.5	5
Skipping	68.2	10.6	7.6	1.5	12.1	31.8	6
Volleyball	80.3	15.2	1.5	1.5	1.5	19.7	7
Dance	81.8	9.1	7.6		1.5	18.2	8
Swimming	84.8	10.6	3.0		1.5	15.2	9
Basketball	87.9	9.1	3.0			12.1	10
Skateboarding	89.4	4.5	1.5		4.5	10.6	11
Creative Playground	89.4	7.6	3.0			10.6	11
Dodgeball	95.5	3.0		1.5		4.5	13
Aerobics	97.0				3.0	3.0	14
Other activities							
Capoeira[a]		0	4.0	0	1.0	5.0	
Handball		0	0	1.0	0	1.0	
Roller-skating		1.0	1.0	0	0	2.0	
Gymnastics		0	1.0	0	1.0	2.0	

[a] capoeira is a martial art originated in Brazil.

Table 39. Relative frequency of different physical activities in 15 year old males.

Activity	*No*	*1-2 times*	*3-4 times*	*5-6 times*	*7+ times*	Total percentage of participants	Rank
	Frequency of physical activity (%)						
Soccer	25.0	31.7	11.7	8.3	23.3	75.0	1
Jogging or running	38.3	25.0	20.0	5.0	11.7	61.7	2
Walking for exercise	45.0	23.3	8.3	3.3	20.0	55.0	3
Bicycling	46.7	18.3	15.0	3.3	16.7	53.3	4
Tag	60.0	23.3	3.3	5.0	8.3	40.0	5
Skipping	66.7	6.7	5.0	3.3	18.3	33.3	6
Dance	73.3	15.0	1.7	3.3	6.7	26.7	7
Volleyball	75.0	15.0	3.3	3.3	3.3	25.0	8
Swimming	81.7	15.0	1.7		1.7	18.3	9
Skateboarding	83.3	11.7		1.7	3.3	16.7	10
Basketball	86.7	11.7	1.7			13.3	11
Creative Playground	88.3	6.7	3.3		1.7	11.7	12
Aerobics	91.7	3.3	3.3		1.7	8.3	13
Dodgeball	93.3	3.3	1.7		1.7	6.7	14
Other activities							
Capoeira		0.9	1.8	0	0	2.7	
Judo		0	0.9	0	0	0.9	

[a] capoeira is a martial art originated in Brazil.

Table 40. Relative frequency of different physical activities in 14 year old females.

Activity	Frequency of physical activity (%) *No*	*1-2 times*	*3-4 times*	*5-6 times*	*7+ times*	Total percentage of participants	Rank
Dance	36.0	30.0	11.0	7.0	16.0	64.0	1
Walking for exercise	38.0	30.0	8.0	4.0	20.0	62.0	2
Bicycling	52.0	21.0	10.0	3.0	14.0	48.0	3
Jogging or running	63.0	19.0	7.0	4.0	7.0	37.0	4
Volleyball	72.0	15.0	8.0	2.0	3.0	28.0	5
Soccer	77.0	15.0	3.0	1.0	4.0	23.0	6
Dodgeball	77.0	15.0	3.0	2.0	3.0	23.0	6
Tag	80.0	12.0	4.0	2.0	2.0	20.0	8
Aerobics	82.0	12.0	5.0	1.0	0.0	18.0	9
Skipping	85.0	7.0	3.0	2.0	3.0	15.0	10
Swimming	88.0	9.0	1.0		2.0	12.0	11
Creative Playground	90.0	8.0	1.0	1.0		10.0	12
Basketball	94.0	4.0	2.0			6.0	13
Skateboarding	96.0	1.0	1.0		2.0	4.0	14
Other activities							
Capoeira[a]		0	0	0	1.5	1.5	
Judo		0	0	1.5	0	1.5	
Jujitsu		0	1.5	1.5	0	3.0	
Surfing		3.0	0	0	0	3.0	
Futvolley[b]		1.5	0	0	0	1.5	
Roller-skating		0	1.5	0	1.5	3.0	

[a] capoeira is a martial art originated in Brazil. [b] futvolley is a game where basic volleyball rules are applied however the ball is touched by the foot, trunk or head as in soccer.

Table 41. Relative frequency of different physical activities in 15 year old females.

Activity	Frequency of physical activity (%)					Total percentage of participants	Rank
	No	*1-2*	*3-4*	*5-6*	*7+*		
Walking for exercise	28.2	35.0	10.7	5.8	20.4	71.8	1
Dance	43.7	25.2	9.7	5.8	15.5	56.3	2
Bicycling	52.4	17.5	15.5	6.8	7.8	47.6	3
Jogging or running	65.0	24.3	5.8	1.9	2.9	35.0	4
Soccer	71.8	17.5	5.8	1.9	2.9	28.2	5
Volleyball	80.6	10.7	3.9	1.0	3.9	19.4	6
Skipping	83.5	6.8	2.9	1.9	4.9	16.5	7
Dodgeball	85.4	10.7	2.9	1.0		14.6	8
Tag	87.4	6.8	3.9	1.0	1.0	12.6	9
Aerobics	87.4	6.8	1.9	1.0	2.9	12.6	9
Swimming	87.4	7.8	1.9	1.0	1.9	12.6	9
Creative Playground	92.2	4.9	1.9		1.0	7.8	12
Basketball	95.1	3.9	1.0			4.9	13
Skateboarding	99.0	1.0				1.0	14
Other activities							
Handball		1.6	0	0	0	1.6	
Capoeira[a]		0	0	1.6	0	1.6	
Judo		1.6	0	0	0	1.6	
Jujitsu		1.6	1.6	0	0	3.2	
Table tennis		1.6	0	0	0	1.6	
Tennis		0	1.6	0	0	1.6	

[a] capoeira is a martial art originated in Brazil.

Table 42. Prevalence of the risk for overweight and of obesity by age group and sex.

		BMI Criteria [a]	
Age (years)	Risk	N	%
		Males	
14+			
	overweight [b]	5	7.6
15+			
	overweight	3	5.0
	obesity [c]	1	1.7
		Females	
14+			
	overweight	9	9.0
	obesity	1	1.0
15-			
	overweight	7	6.8
	obesity	2	1.9

[a] According to Himes and Dietz (1994). [b] BMI > 85th percentile for age.

[c] BMI > 95th percentile for age.

Table 43. Prevalence of undernutrition be age group and sex.

	Age (years)			
	14-		*15-*	
Nutritional status [a]	N	%	N	%
		Males		
Normal nutrition	53	80.3	42	70.0
Mild malnutrition [b]	9	13.6	11	18.3
Severe malnutrition [c]	4	6.1	7	11.7
		Females		
Normal nutrition	79	79.0	89	86.4
Mild malnutrition	14	14.0	11	10.7
Severe malnutrition	7	7.0	3	2.9

[a] Criteria by Frisancho (1990). [b] Mild malnutrition- is defined as UAMA for height between 5th and 15th percentile. [c] Severe malnutrition- is defined as UAMA for height below 5th percentile.

Table 44. Regression analysis of cardiorespiratory fitness (12 minute run) on the sociodemographic variables.

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	0.0003	0.01	-0.31	ns					
Sex (male)	0.113	0.01	13.01	<0.001*	0.11	0.01	13.69	<0.001*	0.41
Middle class	-0.010	0.01	-0.70	ns					
Lower middle class	0.008	0.01	0.74	ns					
Race (Non-White)	0.005	0.01	0.58	ns					
Sexual maturation	-0.002	0.01	0.04	ns					
Constant	3.235	0.12	27.12	<0.001*	3.23	0.01	630.00	<0.001*	

[a] 12 minute run values were $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant

Full model: $R^2 = 0.41$ F=31.09 (p<0.001) N=277 observed power=1.00

Stepwise model: $R^2 = 0.41$ F=187.31 (p<0.001)

Table 45. **Regression analysis of the body mass index (BMI) on the sociodemographic variables.**

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	0.005	0.01	0.71	ns					
Sex (male)	-0.02	0.01	-2.49	0.01*	-0.02	0.01	-2.61	<0.001*	0.02
Middle class	0.002	0.01	0.19	ns					
Lower middle class	0.002	0.01	0.23	ns					
Race (Non-White)	0.01	0.01	1.59	ns					
Sexual maturation	0.02	0.01	4.23	<0.001*	0.02	0.01	4.44	<0.001*	0.06
Constant	1.14	0.10	11.61	<0.001*	1.21	0.02	56.28	<0.001*	

[a] The BMI values were log_{10} transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant

Full model $R^2 = 0.08$ F=4.19 ($p<0.001$) N=306 observed power=0.98

Stepwise model $R^2 = 0.07$ F=11.02 ($p<0.001$)

Table 46. Regression analysis of the sum of six skinfolds (Σ6SF) on the sociodemographic variables.

	Multiple regression[a]				Stepwise regression				
Variables	*Beta*	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial* R^2
Age (years)	-0.01	0.02	-0.70	ns					
Sex (Male)	-0.21	0.02	-12.27	<0.001*	-0.21	0.02	-12.42	<0.001*	0.34
Middle class	0.02	0.03	0.86	ns					
Lower middle class	0.001	0.02	0.05	ns					
Race (Non-White)	0.01	0.02	0.91	ns					
Sexual maturation	0.05	0.01	3.98	<0.001*	0.05	0.01	4.03	<0.001*	0.05
Constant	1.87	0.23	8.15	<0.001*	1.72	0.05	34.23	<0.001*	

[a] The Σ6SF values were $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant

Full model $R^2 = 0.34$ F=25.97 ($p<0.001$) N=306 observed power=1.00

Stepwise model $R^2 = 0.34$ F=77.56 ($p<0.001$)

Table 47. Regression analysis of the waist-hip ratio on the sociodemographic variables.

	Multiple regression[a]				Stepwise regression				
Variables	*Beta*	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	-0.002	0.002	-1.01	ns					
Sex (Male)	0.04	0.003	13.79	<0.001*	0.04	0.003	14.59	<0.001*	0.41
Middle class	0.01	0.004	1.20	ns					
Lower middle class	0.001	0.003	0.21	ns					
Race (Non-White)	0.004	0.003	1.55	ns					
Sexual maturation	0.0002	0.002	0.08	ns					
Constant	1.90	0.04	52.65	<0.001*	1.87	0.002	1196.74	<0.001*	

[a] The waist-hip ratio values were $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant

Full model $R^2 = 0.42$ F=36.14($p<0.001$) N=305 observed power=1.00

Stepwise model $R^2 = 0.41$ F=212.97 ($p<0.001$)

Table 48. Regression analysis of the trunk-extremity skinfold ratio on the sociodemographic variables.

	Multiple regression[a]				Stepwise regression				
Variables	*Beta*	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial* R^2
Age (years)	0.01	0.01	1.44	ns					
Sex (Male)	0.03	0.01	2.87	<0.001*	0.03	0.01	3.19	<0.001*	0.03
Middle class	0.01	0.02	0.42	ns					
Lower middle class	0.00	0.01	-0.25	ns					
Race (Non-White)	0.01	0.01	1.01	ns					
Sexual maturation	0.01	0.01	1.03	ns					
Constant	-0.17	0.14	-1.16	0.25	0.08	0.01	12.32	<0.001*	

[a] The trunk-extremity ratio values were $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant

Full model $R^2 = 0.04$ F=2.55($p<0.05$) N=306 observed power=0.76

Stepwise model $R^2 = 0.03$ F=10.19 ($p<0.05$)

Table 49. Regression analysis of systolic blood pressure on the sociodemographic variables.

	Multiple regression[a]				Stepwise regression				
Variables	*Beta*	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial* R^2
Age (years)	0.01	0.004	2.26	0.02*	0.01	0.004	2.42	0.02*	0.02
Sex (male)	0.01	0.004	3.61	<0.001*	0.02	0.004	4.20	<0.001*	0.05
Middle class	0.0001	0.01	0.02	ns					
Lower middle class	0.005	0.01	0.95	ns					
Race (Non-White)	0.004	0.004	0.95	ns					
Sexual maturation	0.004	0.003	1.18	ns					
Constant	1.89	0.05	34.87	<0.001*	1.90	0.05	35.47		

[a] Systolic blood pressure values were log_{10} transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant

Full model $R^2 = 0.08$ $F=4.29 (p<0.001)$ N=306 observed power=0.98

Stepwise model $R^2 = 0.07$ $F=11.35 (p<0.001)$

Table 50. Regression analysis of diastolic blood pressure on the sociodemographic variables.

	Multiple regression			
Variables	*Beta*	*SE*	*t*	*p*
Age (years)	0.83	0.78	1.07	ns
Sex (Male)	1.01	0.87	1.17	ns
Middle class	-0.72	1.40	-0.52	ns
Lower middle class	-0.81	1.11	-0.74	ns
Race (Non-White)	0.86	0.82	1.06	ns
Sexual maturation	0.36	0.65	0.56	ns
Constant	51.88	11.70	4.43	<0.001*

* regression coefficients significant at $p < 0.05$, ns=not significant

Full model $R^2 = 0.02$ F=0.88 ($p>0.05$) N=306 observed power= 0.41

Table 51. Regression analysis of physical activity score on the sociodemographic variables.

	Multiple regression[a]				Stepwise regression				
Variables	*Beta*	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	0.001	0.01	0.05	ns					
Sex (Male)	0.05	0.01	3.51	<0.001*	0.05	0.01	3.50	<0.001*	0.04
Middle class	-0.01	0.02	-0.49	ns					
Lower middle class	0.05	0.02	2.87	<0.001*	0.06	0.02	3.20	<0.001*	0.03
Race (Non-White)	-0.02	0.01	-1.49	ns					
Constant	0.28	0.20	1.42	0.16	0.28	0.01	30.98	<0.001*	

[a] Physical activity scores were $\log_{10}$ transformed.

* regression coefficients significant at $p< 0.05$, ns=not significant

Full model $R^2 = 0.08$ F=5.57($p<0.001$) N=307 observed power=0.98

Stepwise model $R^2 = 0.08$ F=12.78 ($p<0.001$)

Table 52. Mean and relative distribution (%) of sociodemographic variables by risk status of cigarette smoking by sex.

Variables	Risk for cigarette smoking[a] *No risk*	*At risk*	*p*
	Males		
N (%)	105 (97.3)	3 (2.7)	
Age (years)[b]			
Mean	14.94	15.46	0.02*
SD	0.49	0.34	
Race (N (%))			
White	52 (98.1)	1 (1.9)	ns
Non-White	52 (96.3)	2 (3.7)	
Socioeconomic status (%)			
Middle class	11 (100.0)	0	ns
Lower middle class	25 (100.0)	0	
Lower class	69 (95.8)	3 (4.2)	
	Females		
N (%)	165 (98.2)	3 (1.8)	
Age (years)			
Mean	15.02	14.91	ns
SD	0.53	0.66	
Race (N(%))			
White	74 (97.4)	2 (2.6)	ns
Non-White	91 (98.9)	1 (1.1)	
Socioeconomic status (%)			
Middle class	14 (93.3)	1 (6.7)	ns
Lower middle class	23 (100.0)	0	
Lower class	128 (98.5)	2 (1.5)	

[a] Not at risk = non-smoker, at risk=smokers [b] ANOVA

*p <0.05 , ns=not significant.

Table 53. Mean and relative distribution (%) of sociodemographic variables by risk status of overweight by sex.

Variables	Risk for overweight[a] No risk	At risk	*p*	OR[b]	CI[c]
		Males			
N (%)	100 (91.7)	9 (8.3)			
Age (years)[d]					
Mean	14.97	14.89	ns		
SD	0.49	0.53			
Race (N(%))					
White	51 (96.2)	2 (3.8)	ns		
Non-White	48 (87.3)	7 (12.7)			
Socioeconomic status (%)					
Middle class	11 (91.7)	1 (8.3)	ns		
Lower middle class	24 (96.0)	1 (4.0)			
Lower class	65 (90.3)	7 (9.7)			
		Females			
N (%)	153 (90.0)	17 (10.0)			
Age (years)					
Mean	15.01	15.06	ns		
SD	0.51	0.66			
Race (N(%))					
White	74 (96.1)	2 (3.9)	0.02*		
Non-White	79 (84.9)	14 (15.1)		4.37	1.20-15.82
Socioeconomic status (%)					
Middle class	13 (86.7)	2 (13.3)	ns		
Lower middle class	22 (91.7)	2 (8.3)			
Lower class	118 (90.1)	13 (9.9)			

[a] Not at risk= below the 85th percentile of BMI for sex and age. [b] Logistic regression adjusting for chronological age and sexual maturation. [c] 95% confidence interval.
[d] ANOVA *$p < 0.05$, ns=not significant.

Table 54. Mean and relative distribution (%) of sociodemographic variables by risk status of systolic blood pressure by sex.

Variables	Risk for elevated systolic blood pressure[a]		
	No risk	*At risk*	*p*
	Males		
N(%)	106 (97.2)	3 (2.7)	
Age (years)[b]			
Mean	14.95	15.11	ns
SD	0.49	0.68	
Race (N (%))			
White	52 (98.1)	1 (1.9)	ns
Non-White	53 (96.4)	2 (3.6)	
Socioeconomic status (%)			
Middle class	12 (100.0)	0	ns
Lower middle class	23 (92.0)	2 (8.0)	
Lower class	71 (98.6)	1 (1.4)	
	Females		
N (%)	168 (98.8)	2 (1.2)	
Age (years)			
Mean	15.01	15.46	ns
SD	0.53	0.64	
Race (N, (%))			
White	77 (100.0)	0	ns
Non-White	91 (97.8)	2 (2.2)	
Socioeconomic status (%)			
Middle class	15 (100.0)	0	ns
Lower middle class	24 (100.0)	0	
Lower class	129 (98.5)	2 (1.5)	

[a] Not at risk= SBP value below 85th percentile for age. [b] ANOVA ns=not significant.

Table 55. Mean and relative distribution (%) of sociodemographic variables by risk status of diastolic blood pressure by sex.

Variables	Risk for elevated diastolic blood pressure[a]		
	No risk	*At risk*	*p*
	Males		
N (%)	102 (93.6)	7 (6.4)	
Age (years) [b]			
Mean	14.94	15.22	ns
SD	0.49	0.53	
Race (N (%))			
White	53 (100.0)	0	0.01*
Non-White	48 (87.3)	7 (12.7)	
Socioeconomic status (%)			
Middle class	12 (100.0)	0	ns
Lower middle class	24 (96.0)	1 (4.0)	
Lower class	66 (91.7)	6 (8.3)	
	Females		
N (%)	168 (98.8)	2 (1.2)	
Age (years)			
Mean	15.01	15.92	0.02*
SD	0.52	0.01	
Race (N (%))			
White	77 (100.0)	0	ns
Non-White	91 (97.8)	2 (2.2)	
Socioeconomic status (%)			
Middle class	15 (100.0)	0	ns
Lower middle class	24 (100.0)	0	
Lower class	129 (98.5)	2 (1.5)	

[a] not at risk= DBP value below 85th percentile for age. [b] ANOVA

*p <0.05 , ns=not significant.

Table 56. Logistic regression analysis of elevated diastolic blood pressure by sociodemographic variables.

Variables	Odds Ratio[a]	Confidence Interval[b]
Age (years)	11.9	2.1-67.9
Sex (male)	6.9	1.6-30.9
Race (Non-White)	9.9	1.2-83.9
Socioeconomic status		
Middle class	0.5	0.04-5.6
Lower middle class	0.4	0.04-3.9

[a] Logistic regression adjusting for sexual maturation.

Table 57. Mean and relative distribution (%) of sociodemographic variables by risk status of inactivity by sex.

Variables	Risk for inactivity[a] No risk	At risk	*p*	OR[b]	CI[c]
		Males			
N (%)	18 (16.5)	91 (83.5)			
Age (years)[d]					
Mean	15.07	14.94	ns		
SD	0.45	0.50			
Race (N%))[e]					
White	8 (15.1)	45 (84.9)	ns		
Non-White	9 (16.4)	46 (83.6)			
Socioeconomic status (%)[e]					
Middle class	2 (16.7)	10 (83.3)	ns		
Lower middle class	4 (16.0)	21 (84.0)			
Lower class	12 (16.7)	60 (83.3)			
		Females			
N (%)	9 (5.3)	161 (94.7)			
Age (years)					
Mean	14.91	15.02	ns		
SD	0.48	0.53			
Race (N(%))					
White	7 (9.1)	70 (90.9)	0.04 *		
Non-White	2 (2.2)	91 (97.8)			
Socioeconomic status (%)					
Middle class	0	15 (100.0)	< 0.01 *		
Lower middle class	5 (20.8)	19 (79.2)		0.11	0 .03-0.43
Lower class	4 (3.1)	127 (96.9)			

[a] Not at risk= physical activity score below 3. [b] Logistic regression adjusting for chronological age and sexual maturation [c] 95% Confidence interval. [e] Chi-square
*p <0.05 , ns=not significant

Table 58. Mean and relative distribution (%) of sociodemographic variables by risk status of low cardiorespiratory fitness by sex.

Variables	Risk for low fitness[a] No risk	At risk	p	OR[b]	CI[c]
N (%)	86 (78.9)	23 (21.1)			
Age (years)[d]					
Mean	14.90	15.16	0.02*	3.10	1.15-8.35
SD	0.46	0.56			
Race (N (%))[e]					
White	39 (73.6)	14 (26.4)	ns		
Non-White	46 (83.6)	9 (16.4)			
Socioeconomic status (%)[e]					
Middle class	11 (91.7)	1 (8.3)	ns		
Lower middle class	22 (88.0)	3 (12.0)			
Lower class	53 (73.6)	19 (26.4)			
	Females				
N (%)	136 (80.0)	34 (20.0)			
Age (years)					
Mean	15.03	14.94	ns		
SD	0.51	0.57			
Race (N (%))					
White	63 (81.8)	14 (18.2)	ns		
Non-White	73 (78.5)	20 (21.5)			
Socioeconomic status (%)					
Middle class	13(86.7)	2 (13.3)	ns		
Lower middle class	20(83.3)	4 (16.7)			
Lower class	103 (78.6)	28 (21.4)			

[a] Not at risk= 12 minute run above the first quintile. [b] Logistic regression adjusting for chronological age and sexual maturation. [c] 95% Confidence interval. [d] ANOVA [e] Chi-square * p <0.05 , ns=not significant.

Table 59. Regression analysis of the sum of six skinfolds on cardiorespiratory fitness, adjusting for sex, chronological age, race and sexual maturation.

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	0.001	0.02	0.04	ns					
Sex (male)	-0.14	0.02	-6.67	<0.001*	-0.14	0.02	-6.76	<0.001*	0.14
Race (Non-White)	0.009	0.02	0.57	ns					
Sexual maturation	0.05	0.01	3.79	<0.001*	0.05	0.01	3.92	<0.001*	0.05
12 minute run (m)	-0.530	0.12	-4.50	<0.001*	-0.53	0.12	-4.51	<0.001*	0.07
Constant	3.45	0.45	7.70	<0.001*	3.45	0.39	8.93	<0.001*	

[a] Sum of six skinfolds and 12 minute run were log_{10} transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant.

Full model $R^2 = 0.37$ F=34.70 (p 0.001) N=296 observed power=1.00

Stepwise model $R^2 = 0.37$ F=58.07 ($p<0.001$)

Table 60. Regression analysis of physical activity level on cardiorespiratory fitness, adjusting for sex, chronological age, race and sexual maturation.

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial* R^2
Age (years)	0.01	0.01	0.04	0.97					
Sex (Male)	0.02	0.02	0.95	0.34					
Race (Non-White)	-0.01	0.02	-0.98	0.37					
Middle class	0.01	0.02	-0.36	0.72					
Lower middle class	0.06	0.02	3.09	0.002*	0.06	0.02	3.45	0.001*	0.04
Sexual maturation	-0.03	0.01	-2.17	0.03*	-0.02	0.01	-2.15	0.03*	0.01
12 minute run (m)	0.39	0.11	3.68	<0.001*	0.45	0.083	5.47	<0.001*	0.10
Constant	-0.89	0.40	-2.22	0.03*	-1.10	0.27	-4.09	<0.001*	

[a] Physical activity scores and 12 minute run values were log_{10} transformed.
* regression coefficients significant at $p < 0.05$, ns=not significant.
Full model $R^2 = 0.16$ F=7.08 (p 0.001) N=277 observed power=1.00
Stepwise model $R^2 = 0.15$ F=15.97 ($p<0.001$)

Table 61. Regression analysis of the body mass index (BMI) on cardiorespiratory fitness, adjusting for sex, chronological age, race, sexual maturation, the sum of six skinfolds (Σ6SF), and the mid–upper arm muscle area (UAMA).

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	0.01	0.004	2.31	0.02*	0.01	0.004	2.13	0.03*	0.02
Sex (male)	0.05	0.006	8.33	<0.001*	0.06	0.01	11.39	<0.001*	0.03
Race (Non-White)	0.01	0.004	1.92	0.06	0.01	0.004	2.13	0.03*	0.02
Sexual maturation	0.01	0.003	1.81	ns					
12 minute run (m)	0.03	0.03	0.97	ns					
Sum of six skinfolds (mm)	0.34	0.02	22.63	<0.001*	0.34	0.01	24.21	<0.001*	0.67
Mid-upper arm muscle area (cm^2)	0.01	0.02	-0.38	ns					
Constant	0.34	0.13	3.05	<0.001*	0.49	0.06	7.77	<0.001*	

[a] The BMI, 12 minute run, Σ6SF, and UAMA values were $\log_{10}$ transformed.
* regression coefficients significant at $p < 0.05$, ns=not significant.
Full model $R^2 = 0.68$ F=88.70 ($p<0.001$) N=296 observed power= 1.00
Stepwise model $R^2 = 0.68$ F=153.37 ($p<0.001$)

Table 62. Regression analysis of the trunk-extremity ratio on cardiorespiratory fitness, adjusting for sex, chronological age, sexual maturation, and the sum of six skinfolds (Σ6SF).

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	0.02	0.01	1.48	ns					
Sex (male)	0.03	0.02	1.92	0.06	0.03	0.01	2.86	0.005*	0.03
Sexual maturation	0.003	0.01	0.30	ns					
12 minute run (m)	0.12	0.08	1.54	ns					
Sum of six skinfolds (mm)	0.07	0.04	1.75	ns					
Constant	-0.68	0.32	-2.12	0.04*	0.08	0.01	11.84	<0.001*	

[a] The trunk-extremity ratio, 12 minute run, and Σ6SF values were $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=non-significant.

Full model $R^2 = 0.05$ F=3.10 (p=0.01) N=297 observed power= 0.87

Stepwise model $R^2 = 0.03$ F=8.18 (p=0.005)

Table 63. Regression analysis of the waist-hip ratio on cardiorespiratory fitness, adjusting for sex, chronological age, sexual maturation, and the body mass index (BMI).

	Multiple regression[a]				Stepwise regression				
Variables	*Beta*	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	-0.004	0.002	-1.76	ns					
Sex (male)	0 04	0.003	11.88	<0.001*	0.04	0.00	15.33	<0.001*	0.44
Race (Non-White)	0.01	0.002	2.15	0.03*					
Sexual maturation	-0.003	0.002	-1.44	ns					
12 minute run (m)	0.004	0.02	0.21	ns					
Body mass index (kg/m^2)	0 07	0.02	3.28	<0.001*	0.06	0.02	3.08	0.002*	0.02
Constant	1.83	0.08	23.86	<0.001*	1.79	0.03	67.53	<0.001*	

[a] $\log_{10}$ transformed variables.

* regression coefficients significant at $p< 0.05$, ns=not significant.

Full model $R^2 = 0.47$ F=42.12 ($p<0.001$) N=295 observed power= 1.00

Stepwise model $R^2 = 0.45$ F=119.34 ($p<0.001$)

Table 64. Regression analysis of systolic blood pressure on cardiorespiratory fitness, adjusting for sex, chronological age, sexual maturation, and body weight.

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	0.01	0.004	2.77	0.006*	0.01	0.004	2.78	0.006*	0.03
Sex (male)	0.01	0.005	2.47	0.014*	0.01	0.00	3.97	<0.001*	0.05
Sexual maturation	-0.001	0.003	-0.25	ns					
12 minute run (m)	0.02	0.03	0.85	ns					
Body weight (kg)	0.001	0.00	2.94	0.004*	0.0005	0.00	2.87	0.004*	0.03
Constant	1.77	0.11	16.35	<0.001*	2.02	0.00	34.29	<0.001*	

[a] Systolic blood pressure and 12 minute run were log_{10} transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant.

Full model R^2 = 0.0.12 F=7.63 (p 0.001) N=297 observed power=0.99

Stepwise model R^2 = 0.11 F=12.51 ($p<0.001$)

Table 65. Regression analysis of diastolic blood pressure on cardiorespiratory fitness, adjusting for sex, chronological age, sexual maturation, and body weight.

	Multiple regression[a]				Stepwise regression				
Variables	*Beta*	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	1.11	0.80	1.39	ns					
Sex (male)	0.72	1.13	0.63	ns					
Sexual maturation	0.17	0.66	0.26	ns					
12 minute run (m)	-1.80	6.28	-0.29	ns					
Body weight (kg)	0.16	0.04	3.66	<0.001*	0.18	0.04	4.31	<0.001*	0.06
Constant	46.12	23.76	1.94	0.05*	56.99	2.18	26.10	<0.001*	

[a] Diastolic blood pressure and 12 minute run were $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant.

Full model $R^2 = 0.07$ F=4.20 (p 0.001) N=297 observed power=0.96

Stepwise model $R^2 = 0.06$ F=18.60 ($p<0.001$)

Table 66. Comparisons of risk factors in males at risk and not at risk of low cardiorespiratory fitness[a].

Variables	Low fitness[b] *No risk*	*At risk*	F	*p*
N (%)	85 (79.4)	22 (21.6)		
Age (years)				
Mean	14.9	15.2	5.49	0.02*
SD	0.5	0.6		
12 minute run (m)				
Mean	2387.7	1732.5	106.50	<0.001*
SD	28.2	56.3		
Physical activity score				
Mean	2.3	2.1	2.43	ns
SD	0.1	0.1		
Body mass index (kg m^{-2})				
Mean	19.6	20.5	1.66	ns
SD	0.3	0.6		
Sum of six skinfolds (mm)				
Mean	55.0	71.3	7.68	0.01*
SD	2.6	5.2		
Trunk-extremity ratio (mm mm)				
Mean	1.33	1.26	1.00	ns
SD	0.03	0.06		
Waist-hip ratio (cm cm)				
Mean	80.83	79.82	1.18	ns
SD	0.41	0.82		
Systolic blood pressure (mm Hg)				
Mean	109.9	112.2	1.08	ns
SD	1.0	1.9		
Diastolic blood pressure (mm Hg)				
Mean	66.7	68.0	0.43	ns
SD	0.9	1.8		
Smoking status (%)				
No	85 (80)	19 (17)	12.06 [c]	<0.001*
Yes	0.0	3 (3)		

[a] not at risk= 12 minute run above the first quintile. [b] ANCOVA adjusting for chronological age and sexual maturation. [c] Chi-square value. * $p < 0.05$, ns=not significant.

Table 67. Comparisons of risk factors in females at risk and not at risk of low cardiorespiratory fitness[a].

Variables	Low fitness[b]			
	No risk	*At risk*	F	*p*
N (%)	136 (80.0)	34 (20.0)		
Age (years)				
Mean	15.0	14.9	0.80	ns
SD	0.5	0.6		
12 minute run (m)				
Mean	1819.5	1399.4	120.41	<0.001*
SD	17.1	34.2		
Physical activity score				
Mean	2.1	1.8	7.97	0.01*
SD	0.0	0.1		
Body mass index (kg m^{-2})				
Mean	19.9	21.3	6.18	0.01*
SD	0.2	0.5		
Sum of six skinfolds (mm)				
Mean	84.9	97.0	6.68	0.01*
SD	2.1	4.2		
Trunk-extremity ratio (mm mm)				
Mean	1.20	1.29	4.68	0.03*
SD	0.02	0.04		
Waist-hip ratio(cm cm)				
Mean	73.67	74.99	3.20	ns
SD	0.33	0.66		
Systolic blood pressure (mm Hg)				
Mean	105.9	107.0	0.53	ns
SD	0.7	1.3		
Diastolic blood pressure (mm Hg)				
Mean	65.7	66.9	1.08	ns
SD	0.5	1.1		
Smoking status (%)				
No	131 (78)	34(20)	0.78[c]	ns
Yes	3(2)	0		

[a] not at risk= 12 minute run above the first quintile. [b] ANCOVA adjusting for chronological age and sexual maturation. [c] Chi-square value. * $p < 0.05$, ns=not significant.

Table 68. Regression analysis of the body mass index (BMI) on physical activity level, adjusting for sex, chronological age, sexual maturation, the sum of six skinfolds (Σ6SF), and mid-upper arm muscle area (UAMA).

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	0.008	0.004	2.31	0.02*	0.008	0.004	2.35	0.02*	0.02
Sex (Male)	0.05	0.005	1.96	<0.001*	0.05	0.01	10.43	<0.001*	0.25
Race (Non-White)	0.01	0.004	1.60	ns					
Sexual maturation	0.01	0.003	1.97	0.04*	0.006	0.003	1.97	0.04*	0.01
Physical activity score	0.00	0.00	1.04	ns					
Sum of six skinfolds (mm)	0.34	0.10	24.43	<0.001*	0.34	0.01	24.57		0.65
Mid-upper arm muscle area (cm^2)	-0.01	0.02	-0.37	ns					
Constant	0.49	0.06	7.74	<0.001*	0.50	0.06	8.35	<0.001*	

[a] The BMI, physical activity score, the Σ6SF and the UAMA were $\log_{10}$ transformed.
* regression coefficients significant at $p < 0.05$, ns=not significant.
Full model $R^2 = 0.69$ F=98.81 ($p<0.001$) N=325 observed power= 1.00
Stepwise model $R^2 = 0.68$ F=171.73 ($p<0.001$)

Table 69. Regression analysis of the sum of six skinfolds (Σ6SF) on physical activity level, adjusting for sex, chronological age, and sexual maturation.

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	-0.002	0.02	-0.15	ns					
Sex (Male)	-0.20	0.02	-12.09	<0.001*	-0.20	0.02	-12.73	<0.001*	0.33
Sexual maturation	0.05	0.01	4.34	<0.001*	0.05	0.01	4.51	<0.001*	0.06
Physical activity level	-0.01	0.01	-1.00	ns					
Constant	1.77	0.22	8.01	<0.001*	1.71	0.05	36.30	<0.001*	

[a] The Σ6SF and physical activity level were $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant.

Full model $R^2 = 0.34$ F=41.29 (p 0.001) N=326 observed power=1.00

Stepwise model $R^2 = 0.33$ F=136.22 ($p<0.001$).

Table 70. Regression analysis of the trunk-extremity ratio on physical activity level, adjusting for sex, chronological age, sexual maturation, and the sum of six skinfolds (Σ6SF).

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	0.01	0.01	1.56	ns					
Sex (male)	0.04	0.01	3.20	<0.001*	0.03	0.01	2.89	0.004*	0.02
Sexual maturation	0.004	0.01	0.51	ns					
Physical activity level	-0.01	0.01	-1.39	ns					
Sum of six skinfolds (mm)	0.05	0.04	1.42	ns					
Constant	-0.23	0.16	-1.47	0.14	0.08	0.01	12.70		

[a] The trunk-extremity ratio, physical activity level, and the Σ6SF were $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant.

Full model $R^2 = 0.05$ F=3.31 (p=0.01) N=326 observed power= 0.87

Stepwise model $R^2 = 0.03$ F=8.35 (p=0.005)

Table 71. Regression analysis of the waist-hip ratio on physical activity level fitness, adjusting for sex, chronological age, sexual maturation, and the body mass index (BMI).

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p value*	*Beta*	*SE*	*t*	*p value*	*Partial R^2*
Age (years)	-0.003	0.002	-1.28	ns					
Sex (male)	0.04	0.003	15.24	<0.001*	0.04	0.00	15.78	<0.001*	0.43
Sexual maturation	-0.002	0.002	-1.06	ns					
Physical activity level	-0.002	0.02	-0.87	ns					
Body mass index (kg/m^2)	0.06	0.02	3.19	0.002*	0.06	0.02	2.96	0.003*	0.03
Constant	1.84	0.04	3.19	<0.001*	0.06	0.02	2.96	<0.001*	

[a] The waist-hip ratio, physical activity level, and the BMI were $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant.

Full model $R^2 = 0.44$ F=51.02 ($p<0.001$) N=325 observed power= 1.00

Stepwise model $R^2 = 0.44$ F=236.75 ($p<0.001$)

Table 72. Regression analysis of systolic blood pressure on physical activity level, adjusting for sex, race, chronological age, sexual maturation, and body weight.

Variables	Multiple regression[a]				Stepwise regression				
	Beta	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	0.009	0.003	2.70	0.01*	0.009	0.003	2.77	0.01*	0.02
Sex (male)	0.01	0.004	3.87	< 0.001*	0.01	0	3.74	< 0.001*	0.04
Race (Non-White)	0.003	0.004	0.84	ns					
Sexual maturation	0.0008	0.003	0.30	ns					
Physical activity level	-0.0050	0.00	-1.48	ns					
Body weight (kg)	0.0006	0.00	2.67	0.01*	0.0006	0	3.06	< 0.001*	0.03
Constant	1.87	0.05	36.07	< 0.001*	1.86	0.05	36.45	< 0.001*	

[a] Systolic blood pressure and physical activity level were $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant.

Full model $R^2 = 0.11$ F=6.69 (p 0.001) N=325 observed power=0.99

Stepwise model $R^2 = 0.10$ F=17.13 ($p<0.001$)

Table 73. Regression analysis of diastolic blood pressure on physical activity level, adjusting for sex, chronological age, sexual maturation, and body weight.

	Multiple regression[a]				Stepwise regression				
Variables	*Beta*	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial R^2*
Age (years)	1.05	0.74	1.43	ns					
Sex (Male)	1.24	0.84	1.47	ns					
Race (Non-White)	0.61	0.78	0.79	ns					
Sexual maturation	-0.26	0.63	-0.41	ns					
Physical activity level	-2.10	0.68	-3.12	0.002*	-1.91	0.65	-2.93	0.004*	0.03
Body weight (kg)	0.14	0.04	3.42	0.001*	0.15	0.04	3.96	<0.001*	0.05
Constant	47.93	11.23	4.27	<0.001*	62.38	2.54	24.53	<0.001*	

[a] Physical activity level was $\log_{10}$ transformed.

* regression coefficients significant at $p < 0.05$, ns=not significant.

Full model $R^2 = 0.09$ F=4.99 (p 0.001) N=325 observed power=0.99.

Stepwise model $R^2 = 0.07$ F=16.33 ($p<0.001$).

Table 74. Regression analysis of cardiorespiratory fitness (12 minute run) on physical activity level, adjusting for sex, chronological age, race, sexual maturation, the sum of six skinfolds (Σ6SF), and mid-upper arm muscle area (UAMA).

	Multiple regression[a]				Stepwise regression				
Variables	*Beta*	*SE*	*t*	*p*	*Beta*	*SE*	*t*	*p*	*Partial* R^2
Age (years)	0.002	0.01	0.30	ns					
Sex (male)	0.09	0.01	8.55	< 0.001*	0.08	0.01	9.33	< 0.001*	0.23
Race (Non-White)	0.01	0.01	0.78	ns					
Sexual maturation	0.01	0.01	0.87	ns					
Physical activity level	0.11	0.03	3.62	< 0.001*	0.11	0.03	3.50	< 0.001*	0.04
Sum of six skinfolds (mm)	-0.12	0.03	-4.49	< 0.001*	-0.11	0.03	-4.32	< 0.001*	0.06
Mid-upper arm muscle area (cm^2)	-0.06	0.04	-1.25	ns					
Constant	3.46	0.12	27.97	< 0.001*	3.42	0.05	66.58	< 0.001*	

[a] 12 minute run, physical activity level, the Σ6SF, and UAMA were $\log_{10}$ transformed.
* regression coefficients significant at $p < 0.05$, ns=not significant
Full model $R^2 = 0.47$ F=36.69 ($p<0.001$) N=297 observed power=1.00
Stepwise model $R^2 = 0.47$ F=85.05($p<0.001$)

Table 75. Comparisons of risk factors in males at risk and not at risk for inactivity[a].

Variables	Inactivity[b] *Not at risk*	*At risk*	F	*p*
N (%)	18 (16.8)	89 (83.2)		
Age (years)				
Mean	15.1	14.9	1.16	ns
SD	0.5	0.5		
12 minute run (m)				
Mean	2333.2	2236.8	1.02	ns
SE	86.9	38.9		
Body mass index (kg m^{-2})				
Mean	19.2	19.9	0.77	ns
SE	0.7	0.3		
Sum of six skinfolds (mm)				
Mean	57.2	58.6	0.05	ns
SE	5.9	2.6		
Trunk-extremity ratio (mm mm)				
Mean	1.34	1.31	0.01	ns
SE	0.07	0.03		
Waist-hip ratio (cm cm)				
Mean	80.5	80.7	0.03	ns
SE	0.9	0.4		
Systolic blood pressure (mm Hg)				
Mean	108.3	110.8	1.18	ns
SE	2.1	0.9		
Diastolic blood pressure(mm Hg)				
Mean	63.1	67.7	4.82	0.03*
SE	1.9	0.9		
Smoking status (%)[c]				
No	18 (16.7)	86 (80.3)	0.15[d]	ns
Yes	0	3 (2.8)		

[a] physical activity score <3 [b] ANCOVA adjusting for chronological age and sexual maturation. [c] missing data for 1 subject. [d] Chi-square value

* $p<0.05$, ns=not significant.

Table 76. Comparisons of risk factors in females at risk and not at risk for inactivity[a].

Variables	Inactivity[b] *Not at risk*	*At risk*	F	*p*
N (%)	9 (5.3)	161 (94.7)		
Age (years)				
Mean	14.9	15.0	0.37	ns
SD	0.5	0.5		
12 minute run (m)				
Mean	1855.0	1728.7	1.99	ns
SE	86.9	20.5		
Body mass index (kg m^{-2})				
Mean	19.5	20.2	0.65	ns
SE	0.9	0.2		
Sum of six skinfolds (mm)				
Mean	75.3	88.0	2.24	ns
SE	8.3	1.9		
Trunk-extremity ratio(mm mm)				
Mean	1.16	1.22	0.41	ns
SE	0.10	0.02		
Waist-hip ratio (cm cm)				
Mean	72.5	74.0	1.39	ns
SE	1.3	0.3		
Systolic blood pressure (mm Hg)				
Mean	104.2	106.2	0.59	ns
SE	2.6	0.6		
Diastolic blood pressure (mm Hg)				
Mean	62.9	66.1	2.01	ns
SE	2.1	0.5		
Smoking status (%)[c]				
No	8 (4.8)	157 (93.5)	0.15[d]	ns
Yes	0	3 (1.8)		

[a] physical activity score <3. [b] ANCOVA adjusting for chronological age and sexual maturation. [c] missing data for 2 subjects. [d] Chi-square value

$p<0.05$, ns=not significant.

Table 77. Clustering of risk factors by sex.

	Sex			
	Males		*Females*	
Number of risks	N	%	N	%
None	14	12.0	9	5.0
One	74	63.2	122	68.2
Two	24	20.5	44	22.3
Three	3	2.6	8	4.5
Four	2	1.7	0	0
Five	0	0	0	0

Table 78. Distribution of risk factors and clusters in males.

Number of risks	Risk: *BP*	*Overweight*	*Inactivity*	*Smoking*	*Low fitness*	Observed frequency	%	Expected frequency
None	-	-	-	-	-	14	12.0	12.9
One risk	+	-	-	-	-	2	1.7	1.2
	-	+	-	-	-	1	0.9	1.2
	-	-	+	-	-	69	59.0	65.5
	-	-	-	+	-	0		0.4
	-	-	-	-	+	2	1.7	3.5
Two risks	+	+	-	-	-	0		0.1
	+	-	+	-	-	4	3.4	6.1
	+	-	-	+	-	0		0.04
	+	-	-	-	+	0		0.23
	-	+	+	-	-	5	4.3	5.4
	-	+	-	+	-	0		0.02
	-	+	-	-	+	0		0.23
	-	-	+	+	-	0		1.64
	-	-	+	-	+	13	11.1	15.1
	-	-	-	+	+	0		0.08

Table 78. Continued.

	Risk							
Number of risks	*BP*	*Overweight*	*Inactivity*	*Smoking*	*Low fitness*	Observed frequency	%	Expected frequency
Three risks	+	+	+	-	-	0		0.47
	+	+	-	+	-	0		0.002
	+	+	-	-	+	0		0.02
	+	-	+	+	-	0		0.12
	+	-	+	-	+	1	0.9	1.4
	+	-	-	+	+	0		0.007
	-	+	+	+	-	0		0.14
	-	+	+	-	+	1	0.9	1.29
	-	+	-	+	+	0		0.007
	-	-	+	+	+	2	1.7	0.35
Four risks	+	+	+	+	-	0		0.012
	+	+	+	-	+	2	1.7	0.12
	+	+	-	+	+		0	0.0006
	+	-	+	+	+			0.035
	-	+	+	+	+		0	0.035
Five risks	+	+	+	+	+		0	0.0035

Chi-square=2.68, df=3, $p>0.05$

Table 79. Distribution of risk factors and clusters in females.

Number of risks	Risk: *BP*	*Overweight*	*Inactivity*	*Smoking*	*Low fitness*	Observed frequency	%	Expected frequency
None	-	-	-	-	-	9	5.0	6.27
One risk	+	-	-	-	-	0		0.11
	-	+	-	-	-	0		0.72
	-	-	+	-	-	119	66.5	118.14
	-	-	-	+	-	0		0.11
	-	-	-	-	+	0		1.61
Two risks	+	+	-	-	-	0		0.01
	+	-	+	-	-	1	0.6	2.15
	+	-	-	+	-	0		0.002
	+	-	-	-	+	0		0.04
	-	+	+	-	-	10	5.6	12.53
	-	+	-	+	-	0		0.01
	-	+	-	-	+	0		0.16
	-	-	+	+	-	3	1.7	2.15
	-	-	+	-	+	29	16.2	29.17
	-	-	-	+	+	0		0.36

Table 79. Continued.

Number of risks	*BP*	*Overweight*	Inactivity	*Smoking*	*Low fitness*	Observed frequency	%	Expected frequency
Three risks	+	+	+	-	-	1	0.6	0.22
	+	+	-	+	-	0		0.0002
	+	+	-	-	+	0		0.01
	+	-	+	+	-	0		0.36
	+	-	+	-	+	1	0.6	0.52
	+	-	-	+	+	0		0.0005
	-	+	+	+	-	0		0.22
	-	+	+	-	+	6	3.4	3.04
	-	+	-	+	+	0		0.004
	-	-	+	+	+	0		0.54
Four risks	+	+	+	+	-	0		0.004
	+	+	+	-	+	0		0.54
	+	+	-	+	+	0		0.004
	+	-	+	+	+	0		0.05
	-	+	+	+	+	0		0.0005
Five risks	+	+	+	+	+	0		0.00009

Risk (spanning header over BP, Overweight, Inactivity, Smoking, Low fitness)

Chi-square =3.40, df=3, $p>0.05$

Table 80. Comparisons of selected variables in males grouped by number of clustered risk factors.

	Number of risk factors				
Variables[a]	*0*	*1*	*2*	*3*	*4*
N	14	74	24	3	2
Body mass index (kg m⁻²)					
Mean	18.4	19.2	21.1	21.1	24.0
SE	0.7	0.3	0.5	1.3	1.5
Sum of six skinfolds (mm)					
Mean	51.4	52.2	73.8	75.6	94.3
SE	6.0	2.5	4.7	11.3	12.9
Trunk-extremity ratio (mm mm)					
Mean	1.3	1.3	1.3	1.1	1.5
SE	0.1	0.0	0.1	0.1	0.2
Waist-hip ratio(cm cm)					
Mean	81.1	80.0	81.7	81.5	84.2
SE	1.0	0.4	0.8	1.9	2.1
Systolic blood pressure (mm Hg)					
Mean	106.4	109.9	110.7	114.4	125.0
SE	2.3	1.0	1.8	4.3	4.9
Diastolic blood pressure (mm Hg)					
Mean	61.9	66.6	70.7	63.3	80.6
SE	2.1	0.9	1.6	4.0	4.5
Physical activity score					
Mean	3.3	2.2	2.0	2.1	1.7
SE	0.1	0.1	0.1	0.2	0.3
Cardiovascular fitness (m)					
Mean	2369.4	2361.6	1979.9	1742.9	1708.5
SE	80.7	35.5	65.6	153.4	174.2

[a] ANCOVA adjusting for chronological age and sexual maturation.

Table 81. Comparisons of selected variables by number of clustered risk factors in females.

Variables[a]	Number of risk factors 0	1	2	3
N	9	122	44	8
Body mass index (kg m^{-2})				
Mean	19.4	19.5	21.4	26.9
SE	0.6	0.2	0.3	0.8
Sum of six skinfolds (mm)				
Mean	74.6	81.8	93.7	145.9
SE	6.1	1.8	3.1	7.5
Trunk-extremity ratio (mm mm)				
Mean	1.2	1.2	1.3	1.3
SE	0.1	0.0	0.0	0.1
Waist-hip ratio (cm cm)				
Mean	73.9	73.6	74.8	75.5
SE	1.1	0.3	0.6	1.4
Systolic blood pressure (mm Hg)				
Mean	104.5	105.7	107.7	112.9
SE	2.2	0.7	1.1	2.8
Diastolic blood pressure (mm Hg)				
Mean	62.9	65.7	66.4	72.8
SE	1.8	0.5	0.9	2.2
Physical activity score				
Mean	3.3	2.0	1.8	1.8
SE	0.1	0.0	0.1	0.2
Cardiovascular fitness (m)				
Mean	1867.9	1835.6	1505.5	1438.3
SE	68.3	19.6	33.1	77.2

[a] ANCOVA adjusting for chronological age and sexual maturation.

Table 82. Comparison of Percentiles of stature, weight and the BMI in Brazilian males by age.

		Percentiles						
		Stature (cm)			*Weight (kg)*			*BMI (kg/m²)*[a]
Age (years)		Median	5th	95th	Median	5th	95th	Median
14+	This study	167.5	147.9	181.2	53.8	34.7	75.7	19.8
	NCHS	166.2	152.0	179.5	53.8	40.7	75.6	19.5
	Santo André (R1+R2)[b]	156.7	143.7	169.8	44.5	31.2	57.7	18.1
	Santo André (R)[b]	164.1	152.0	176.3	52.4	36.0	68.8	19.5
	Rio de Janeiro S Survey	158.2			45.8			18.3
	PNSN[c]							18.3
	SSL[d]	159.0						
15+	This study	166.4	154.2	180.8	53.6	38.3	76.7	19.6
	NCHS	171.5	158.3	183.9	59.5	45.5	82.5	20.2
	Santo André (R1+R2)	161.7	148.6	174.7	49.4	36.1	62.7	18.9
	Santo André (R)	169.1	157.0	181.2	57.5	41.2	73.9	20.1
	Rio de Janeiro S Survey	163.0			50.1			18.9
	PNSN							19.1
	SSL	166.0						

[a] Estimated from median weight and stature for NCHS, Santo André and Rio de Janeiro School Survey data.
[b] SA(R1+R2) sample is composed by lower SES subjects, SA(R) is the entire sample. [c] Brazilian National Survey on Health and Nutrition. [d] Survey on Standards of Life.

Table 83. Comparison of percentiles of stature, weight and BMI in Brazilian females by age.

		Percentiles						
		Stature (cm)			*Weight (kg)*			*BMI*$(kg\ m^{-2})$[a]
Age (years)		Median	5th	95th	Median	5th	95th	Median
14 +	This study	159.5	150.2	170.6	49.3	39.0	68.5	19.5
	NCHS	161.2	149.7	172.2	52.1	39.5	75.6	20.0
	Santo André (R1+R2)[b]	154.2	143.6	164.8	46.4	33.6	59.2	19.5
	Santo André (R)[b]	159.0	148.4	169.5	50.6	37.4	63.9	20.0
	Rio de Janeiro S Survey	155.7			47.3			19.5
	PNSN [c]							20.0
	SSL [d]	158.0						
15 +	This study	160.3	151.0	170.8	51.3	41.3	67.1	19.9
	NCHS	162.1	151.1	173.1	54.9	42.3	79.6	20.9
	Santo André (R1+R2)	155.8	145.2	166.4	48.6	35.8	61.4	20.0
	Santo André (R)	159.7	149.2	170.2	52.4	39.1	65.6	20.5
	Rio de Janeiro S Survey	157.0			50.0			20.3
	PNSN							20.6
	SSL	160.0						

[a] Estimated from median weight and stature for NCHS, Santo André and Rio de Janeiro School Survey data.
[b] Santo André (R1+R2) sample is composed by lower SES subjects, Santo André (R) is the entire sample. [c] Brazilian National Survey on Health and Nutrition. [d]Survey on Standards of Life.

Table 84. Stature, components of stature, and the sitting height/stature ratio (SHSR) in Brazilian adolescents by age and sex.

		Stature (cm) [a]	Sitting height (cm)		Estimated Leg length (cm)[a]		SHSR (%)[b]
Age (years)	Study	Mean	Mean	SD	Mean	SD	
				Males			
14 +	This study	167.1	85.6	5.0	81.5	5.1	51.2
	Santo André (R)[c]	160.2	83.4	5.2	76.8	5.2	52.1
15 +	This study	166.8	85.5	4.5	81.3	4.1	51.3
	Santo André (R)	165.9	86.6	6.2	79.3	6.2	52.2
				Females			
14 +	This study	159.5	83.9	3.3	75.6	3.8	52.6
	Santo André (R)	156.8	83.3	5.3	73.5	5.3	53.1
15 +	This study	160.0	83.6	3.1	76.4	3.8	52.3
	Santo André (R)	157.9	84.2	5.7	73.7	4.7	53.3

[a] Stature minus sitting height. [b] Sitting height divided by stature. [c] Santo André (R) is the entire study sample.

Table 85. Means, standard deviations, and medians for skinfold thicknesses of Brazilian adolescents by sex and age.

		Triceps (mm)			Subscapular (mm)		
Age (years)	Study	Mean	SD	Median	Mean	SD	Median
				Males			
14 +	This study	10.3	4.0	9.8	9.3	3.8	8.2
	Santo André (R1+R2)[a]	8.9	3.3	7.6	6.9	3.0	6.3
	Santo André (R)[b]	10.0	4.3	9.1	7.7	3.7	6.8
	NHANES II[c]	10.4	5.8	9.0	8.9	5.3	7.0
15 +	This study	9.1	3.4	7.9	9.2	3.4	8.6
	Santo André (R1+R2)	8.4	2.8	7.6	7.0	1.7	6.7
	Santo André (R)	9.2	3.4	8.2	8.0	3.2	7.2
	NHANES II	10.1	7.2	7.5	10.0	8.2	7.5
				Females			
14 +	This study	15.2	4.9	14.3	12.7	4.4	11.7
	Santo André (R1+R2)	15.7	5.8	14.3	12.9	6.2	11.2
	Santo André (R)	16.7	5.9	15.6	13.6	6.6	11.5
	NHANES II	17.6	7.5	17.0	13.2	7.7	10.5
15 +	This study	15.6	4.5	14.6	13.6	4.4	12.4
	Santo André (R1+R2)	16.4	5.3	16.2	14.0	5.6	12.9
	Santo André (R)	17.6	5.3	17.1	14.6	6.3	13.2
	NHANES II	17.1	7.1	16.5	13.1	6.9	10.5

[a] Santo André (R1+R2) sample is composed by lower SES subjects. [b] Santo André (R) is the entire sample. [c] Najjar and Rowland (1987).

Table 86. Comparison of recommended cutoff points for undernutrition and overweight for the body mass index (BMI) in Brazilian and U.S. adolescents by age and sex.

	Percentiles of BMI by age (kg/m^2)			
	Brazil[a]		*U.S.*[b]	
Age (years)	5th	85th	5th	85th
		Males		
14 +	15.4	20.8	16.2	23.0
15 +	15.7	21.7	16.6	24.0
		Females		
14 +	16.1	23.3	15.7	24.0
15 +	17.1	23.6	16.0	24.0

[a] Anjos et al. (1998). [b] Himes and Dietz (1994).

Table 87. Prevalence of undernutrition by sex and age according to different BMI criteria.

	Prevalence of malnutrition (%)	
Age (years)	*Brazilian BMI criteria*[a]	*U.S. BMI criteria*[b]
	Males	
14 +	6.0	13.6
15 +	3.3	8.3
	Females	
14 +	6.0	4.0
15 +	2.9	1.0

[a] Anjos et al. (1998). [b] Himes and Dietz (1994).

Table 88. Comparative data for body size and cardiorespiratory fitness (12 minute run) in Brazilian adolescents.

		Stature (cm)		Weight (kg)		BMI (kg/m^2)		12-minute run (m)	
Age (years)	Study	Mean	SD	Mean	SD	Mean	SD	Mean	SD
					Males				
14	This study	166.9	9.3	55.6	12.0	19.7	2.81	2248.0	286.2
	Barbanti (1982) [a]	160.4	8.8	48.1	11.8	18.7		2555.0	235.6
	Queiroz (1992) [a]	163.0	8.3	52.5	9.9	19.8		2248.0	424.4
	Silva (1992)[a]	165.3	7.6	54.1	10.0	19.8		2241.5	316.3
	Guedes (1994)	159.0	9.0	48.1	10.9	18.8	2.9	2308.2	342.3
15	This study	166.7	7.2	54.9	10.6	19.6	2.8	2252.2	418.9
	Silva (1992)[a]	167.5	6.6	57.0	10.1	20.3		2289.8	335.0
	Guedes (1994)	165.1	8.7	52.1	11.6	18.9	2.8	2384.8	318.2
					Females				
14	This study	159.5	5.9	50.6	8.8	19.8	3.0	1743.8	251.6
	Barbanti (1982) [a]	157.5	7.7	51.1	10.6	20.6		1882.0	276.5
	Queiroz (1992) [a]	158.0	6.3	50.6	7.7	20.3		1668.0	235.9
	Silva (1992)[a]	158.0	5.9	50.4	7.6	20.2		1656.2	240.1
	Guedes (1994)	157.1	6.1	47.9	7.6	19.4	2.4	1798.9	254.4
15	This study	160.0	5.8	52.8	8.9	20.6	2.7	1737.6	272.9
	Silva (1992)[a]	158.1	5.5	50.9	8.5	20.4		1663.0	273.5
	Guedes (1994)	158.2	6.0	50.5	7.6	20.2	2.9	1812.8	254.5

[a] estimated BMI from mean weight and stature. [b] medians.

Table 89. Prevalence of cigarette smoking by age group and sex in the present study and in the Brazilian National Health and Nutrition Survey (PNSN).

	Prevalence (%)	
Age (years)	*This study*	*PNSN* [a]
	Males	
10-14		1.0
14-	0	
15-	6.7	
15-19		4.0
	Females	
10-14		2.0
14-	1.0	
15-	3.0	
15-19		5.0

[a] Ministry of Health (1993).

Table 90. Comparison of blood pressures in Brazilian adolescents by age and sex.

Age (years)	Median blood pressure (mm Hg)			
	Systolic		*Diastolic*	
	This study	The Rio de Janeiro Study [a]	This study	The Rio de Janeiro Study [a]
		Males		
14-	107.5	115.0	67.0	59.0
15-	112.5	117.0	65.0	61.0
		Females		
14-	104.0	110.0	65.5	60.0
15-	106.0	110.0	66.0	62.0

[a] Pozzan et al. (1997)

Table 91. Comparison of blood pressures of the study sample with adolescents in the U.S. and Finland by age and sex.

	Blood pressure (mm Hg)					
	This study		*U.S.*[a]		*Finland*[b]	
Age (years)	Mean	SD	Mean	SD	Mean	SD
			Systolic			
Males						
14–	109.5	8.1	110.7	12.2		
15–	110.9	9.5	112.3	10.3	120.0	12.0
Females						
14–	105.2	6.9	108.0	11.1		
15–	107.6	8.6	107.6	11.3	117.0	10.0
			Diastolic			
Males						
14–	67.8	6.8	59.2	14.1		
15–	66.3	9.7	61.0	12.0	69.0	11.0
Females						
14–	65.3	6.2	62.9	12.5		
15–	66.7	6.4	61.2	10.6	70.0	9.0

[a] Rosner et al. (1993)

[b] Dahl et al. (1985)

Table 92. Blood pressure by weight status and sex in the study sample.

Blood pressure (mm Hg)	Weight status *Normal* Mean[a]	SE	*Overweight* Mean[a]	SE	F value	*p*
			Males			
Systolic	110.3	0.8	110.6	2.9	0.01	ns
Diastolic	66.9	0.8	68.2	2.8	0.16	ns
			Females			
Systolic	105.8	0.6	111.7	1.9	8.85	0.003*
Diastolic	65.6	0.5	69.9	1.5	7.56	0.007*

[a] ANCOVA adjusting for chronological age, sexual maturation and body weight.
*$p<0.05$, ns=not significant.

Table 93. Fat distribution and risk for elevated blood pressure by sex in the study sample.

Fat distribution	Elevated blood pressure[a] *Not at risk* Mean	SE	*At risk* Mean	SE	F ratio	*p*
			Males			
TER (mm mm)	1.28	1.02	1.39	1.06	1.79	ns
WHR (cm cm)	80.17	1.00	83.75	1.01	8.89	< 0.01*
			Females			
TER (mm mm)	1.20	1.01	1.21	1.10	0.01	ns
WHR (cm cm)	73.96	1.00	73.45	1.03	0.06	ns

[a] ANCOVA adjusting for chronological age, sexual maturation and race. *$p < 0.05$

Table 94. Blood pressure by sex and race in the study sample.

	Race					
	White		*Non-white*			
Blood pressure (mm Hg)	Mean[a]	SE	Mean	SE	F value	*p*
	Males					
Systolic	109.8	1.2	110.9	1.2	0.48	ns
Diastolic	66.7	1.1	67.1	1.1	0.06	ns
	Females					
Systolic	105.4	0.8	106.6	0.8	1.08	ns
Diastolic	65.6	0.7	65.9	0.6	0.12	ns

[a] ANCOVA adjusting for chronological age, sexual maturation and body weight.
ns=not significant.

Table 95. Prevalence of overweight by age and sex in the study sample according to Brazilian and U.S. criteria for the body mass index (BMI).

	Prevalence of overweight (%)	
Age (years)	*Brazilian BMI criteria*[a]	*U.S. BMI criteria*[b]
	Males	
14 +	27.3	7.6
15 +	13.3	6.7
	Females	
14 +	12.0	10.0
15 +	10.7	8.7

[a] Anjos et al. (1998). [b] Himes and Dietz (1994).

Table 96. Prevalence of overweight by hours of TV viewing in each sex.

	Overweight	
TV viewing (hs/day)	*N*	%
	Males[a]	
<1	7	0
2.0-2.9	23	0
3-3.9	24	1
4-4.9	23	4
5+	48	4
	Females[b]	
<1	24	0
2.0-2.9	22	0
3-3.9	37	2
4-4.9	25	3.0
5+	94	14

[a] Chi-square =6.33, df=4, $p>0.05$ Chi-square linear=2.60, df=1, $p>0.05$

[b] Chi-square =8.99, df=4, $p=0.06$ Chi-square linear=8.61, df=1, $p<0.05$

Table 97. Relative fat distribution in males and females of the study sample at risk and not at risk for overweight.

	Overweight[a]					
	Not at risk		*At risk*			
Relative fat distribution	Mean[b]	SE	Mean[b]	SE	F ratio	*p*
	Males					
Trunk-extremity ratio (mm mm)	1.31	0.03	1.39	0.09	0.83	ns
Waist-hip ratio (cm cm)	80.3	0.3	85.0	1.2	14.80	$< 0.001^*$
	Females					
Trunk-extremity ratio (mm mm)	1.22	0.02	1.26	0.06	0.37	ns
Waist-hip ratio (cm cm)	73.8	0.3	75.7	0.9	3.6	0.06

[a] defined as values > 85th percentile for age and sex.

[b] ANCOVA adjusting for chronological age and sexual maturation.

* $p < 0.05$, ns=not significant.

Table 98. Skinfold thicknesses and the subscapular/triceps ratio by sex and age in this study and a comparable sample of Brazilian adolescents.

Variable	This study		Guedes (1993)	
	Mean	SD	Mean	SD
		Males		
Triceps skinfold (mm)				
14+ years	10.3	4.0	10.7	5.7
15+ years	9.1	3.4	9.6	5.2
Subscapular skinfold (mm)				
14+ years	9.3	3.8	8.0	5.0
15+ years	9.2	3.4	7.9	4.7
Subscapular-triceps ratio (mm mm)				
14+ years	0.93[a]	0.21	0.79	0.19
15+ years	1.05	0.25	0.85	0.20
		Females		
Triceps skinfold (mm)				
14+ years	15.2	4.9	16.3	6.3
15+ years	15.6	4.5	17.9	7.0
Subscapular skinfold (mm)				
14+ years	12.7	4.4	11.1	4.8
15+ years	13.6	4.4	12.6	5.4
Subscapular-triceps ratio (mm mm)				
14+ years	0.85	0.17	0.69	0.16
15+ years	0.88	0.19	0.72	0.17

[a] significant age difference ($p<0.01$).

Table 99. Physical activity scores in the study sample by social class and sex, age groups combined.

	Physical activity score[a]			
Social class	Mean	SE	F value	*p*
	Males			
Middle class	2.3	0.2	1.69	ns
Lower middle class	2.5	0.1		
Lower class	2.2	0.1		
	Females			
Middle class	1.8	0.1	3.78	0.03*
Lower middle class	2.3	0.1		
Lower class	2.0	0.1		

[a] ANCOVA adjusting for chronological age, scores vary from 1 to 5.

*$p < 0.05$, ns=not significant.

Table 100. Physical activity score and self-activity rating in the study sample by sex, age groups combined.

	Physical activity score[a]	
Activity rating	Mean	SD
	Males	
Less active than peers	1.9 [b]	0.5
As active as peers	2.3 [b]	0.5
More active than peers	2.6 [b]	0.6
	Females	
Less active than peers	1.7 [c]	0.5
As active as peers	2.1	0.6
More active than peers	2.3	0.5

[a] scores vary from 1 to 5, adjusted by chronological age

[b] differences among the 3 groups ($p<0.01$)

[c] difference between the less active group and the other groups ($p<0.001$)

Table 101. Physical activity scores by social class and sex.

Social class	Physical activity score[a] Mean	SE	F value	*p*
	Males			
Middle class	2.3	0.2	1.69	ns
Lower middle class	2.5	0.1		
Lower class	2.2	0.1		
	Females			
Middle class	1.8	0.1	3.78	0.03*
Lower middle class	2.3	0.1		
Lower class	2.0	0.1		

[a] ANCOVA adjusting for chronological age, scores vary from 1 to 5.

*$p < 0.05$. ns=not significant.

FIGURES

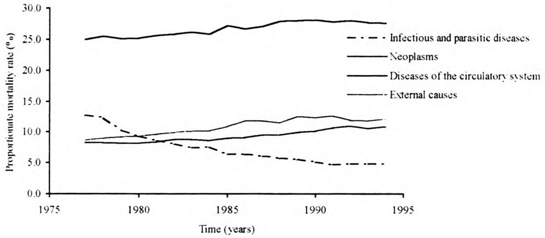


Figure 1. Proportionate mortality rates for several conditions in Brazil from 1977 through 1994. Drawn from data reported by IBGE (1992) and DATASUS on-line (1997). External causes combined include motor accidents, homicides, suicides, drowning, etc.

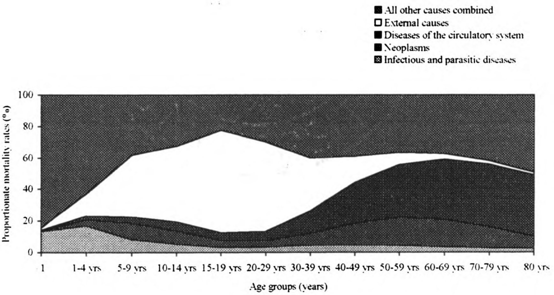


Figure 2. Variation in proportionate mortality rates through the life span in Brazil. Drawn from data reported in DATASUS on-line (1996).

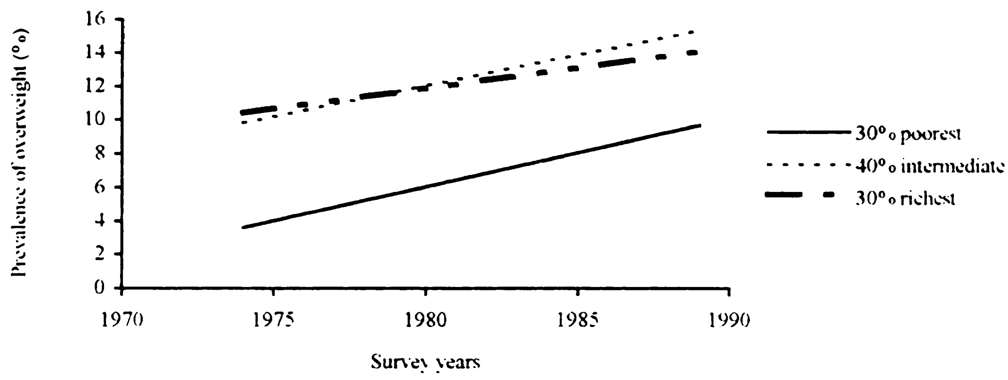


Figure 3. Prevalence of overweight (BMI > 30 kg/m^2) in adults 25-64 years (sexes combined) by socioeconomic status. Drawn from data reported by Monteiro et al. (1995).

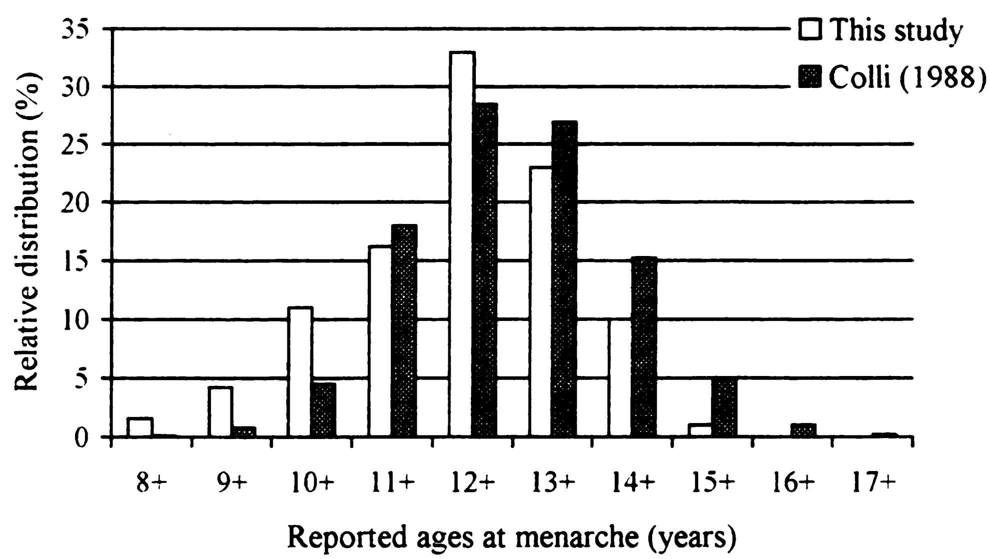


Figure 4. Relative distribution of reported ages at menarche in the present study and that of Colli (1988).

APPENDICES

APPENDIX A

APPROVAL OF THE UNIVERSITY COMMITTEE ON RESEARCH INVOLVING HUMAN SUBJECTS

MICHIGAN STATE
UNIVERSITY

August 5, 1997

TO: Robert M. Malina
213 IM Sports Circle

RE:
IRB#: 97-491
TITLE: CORONARY HEART DISEASE RISK FACTORS AND HEALTH RELATED PHYSICAL FITNESS OF ADOLESCENTS IN NITEROI, RIO DE JANEIRO, BRAZIL
REVISION REQUESTED: N/A
CATEGORY: FULL REVIEW
APPROVAL DATE: 08/04/97

The University Committee on Research Involving Human Subjects'(UCRIHS) review of this project is complete. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the UCRIHS approved this project and any revisions listed above.

RENEWAL: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB # and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

PROBLEMS/ CHANGES: Should either of the following arise during the course of the work, investigators must notify UCRIHS promptly: (1) problems (unexpected side effects, complaints, etc.) involving human subjects or (2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of any future help, please do not hesitate to contact us at (517)355-2180 or FAX (517)432-1171.

Sincerely,

David E. Wright, Ph.D.
UCRIHS Chair

DEW:bed

cc: Rosane C. Rosendo da Silva

OFFICE OF
RESEARCH AND GRADUATE STUDIES

ersity Committee on Research Involving Human Subjects (UCRIHS)

Michigan State University
Administration Building
East Lansing, Michigan
48824-1046

517/355-2180
FAX 517/432-1171

APPENDIX B

APPENDIX B

MAP OF BRAZIL

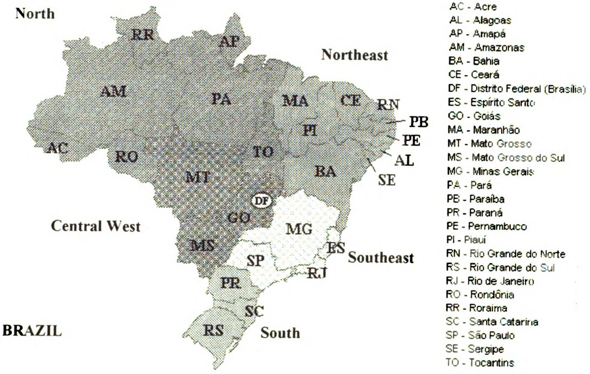


Figure 5. Map of Brazil. Adapted from University of Whales (1997, on-line).

APPENDIX C

APPENDIX C

MAPS OF NITERÓI, RIO DE JANEIRO

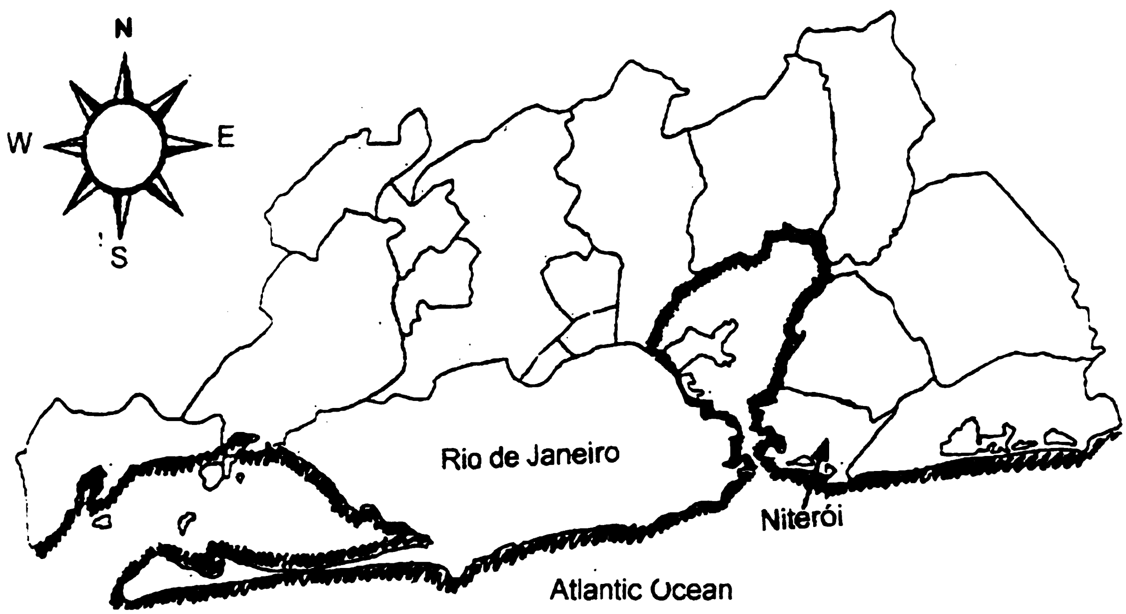


Figure 6. Map of the state of Rio de Janeiro, showing the location of Niterói. Adapted from PMN/CECITEC (1996a).

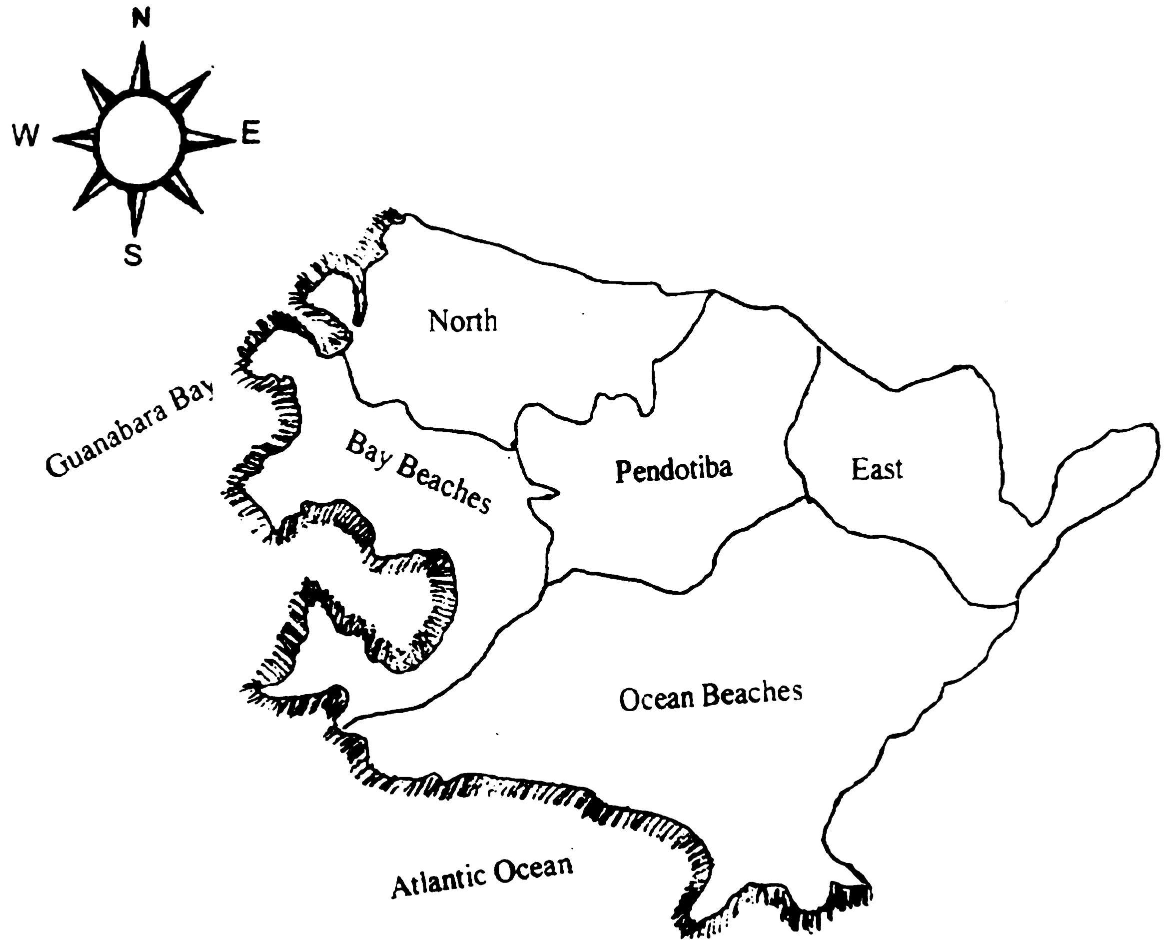


Figure 7. Map of the administrative regions of Niterói. Adapted from PMN/CECITEC (1996a).

APPENDIX D

APPENDIX D

LETTERS OF CONSENT FROM STATE AND MUNICIPAL DEPARTMENTS OF EDUCATION IN NITERÓI

GOVERNO DO ESTADO DO RIO DE JANEIRO
SECRETARIA DE ESTADO DE EDUCAÇÃO
COORDENADORIA REGIONAL METROPOLITANA II

COMUNICADO

Niterói, 24 de março de 1998.

Comunicamos que a Professora ROSANE CARLA ROSENDO DA SILVA, está AUTORIZADA a continuar a coleta de dados sobre "FATORES DE RISCO PARA A DOENÇA CORANARIANA E A APTIDÃO FÍSICA relacionado à saúde em adolescentes da Rede Pública de Ensino de Niterói.

Atenciosamente,

Regina Celia Correa Maciel
Coordenadora Regional
E/CRO5.R
Mat. 291.422-4

It is a consent for Rosane C Rosendo da Silva to collect the data for the research *CHD risk factors and health related physical fitness of adolescents* in the State public schools in Niterói.

Sincerely,

PREFEITURA DE NITERÓI

Fundação Municipal de Educação
SUPERINTENDÊNCIA DE DESENVOLVIMENTO DE ENSINO

OFÍCIO FSDE Nº 70 /98

Niterói, 05 de fevereiro de 1998.

Sr.ª Diretora,

Apresentamos a Professora Rosane Carla Rosendo da Silva, assistente da Universidade Federal Fluminense que prepara seu doutoramento pela MICHIGAN STATE UNIVERSITY, na área de Educação Física. Para tanto necessitará avaliar estudantes da 8ª série, motivo pelo qual solicitou esta autorização. Contando com sua colaboração,

Atenciosamente

Nelson Ricardo da Costa e Silva

Nelson Ricardo da Costa e Silva
Gerente de Planejamento Escolar e
Desenvolvimento Curricular - FSDE/FME
Mat. 231.595-0

Dear Principal:

We introduce Rosane C Rosendo da Silva, Assistant Professor at Universidade Federal Fluminense, who is conducting a research for her doctoral degree in Kinesiology at Michigan State University. We agree that she will be measuring the 8th graders in your school, and we ask for your cooperation.

Sincerely,

APPENDIX E

APPENDIX E

PARENTAL CONSENT

Coronary heart disease risk factors and health-related physical fitness of adolescents in Niterói, Rio de Janeiro, Brazil

Consent Form

I am conducting a study to assess risk factors for coronary heart disease and components of health-related physical fitness in adolescents 14 to 16 years of age, as part of the requirements for the doctoral degree at Michigan State University, East Lansing, Michigan, USA.

I am inviting your son/daughter/ward to participate in the study, which is being conducted in the physical education program at his/her school. In order to participate in the study your child has to have your written approval.

If you permit your child to participate, he/she will be tested on several activities. None of the tests offer any physical or psychological risk, except the 12 minute walk/run which involves minimal risk. To minimize the risk, this test will be performed after an appropriate warm-up and will be supervised by both the researcher and the physical education teacher. The child will be instructed to stop the test if he/she feel too tired to continue, or if she/he feels dizziness. Please let us know if your child has any respiratory disease such as asthma, diabetes or any other condition for which physical exercise is not recommended.

Other tests include measures of height, weight, body circumferences, and body fatness. Questionnaires on the habitual physical activity, sexual maturity status, cigarette smoking and sociodemographic data, such as age and parental occupation, will be completed. The approximate time for participation is about one hour. Control of data collection will be performed during the study and some of the adolescents will be re-evaluated for a second time, and in this case another hour will be spent. Since the tests will be conducted during the physical education class, every effort to minimize the loss of academic teaching time will be made.

All of the information gathered for this study will be strictly confidential. Only the researcher will have the access to the data. Individual data may be shared with you, the parent or guardian, should your adolescent wish.

The study does not involve any financial costs to the subject or to the family. All materials needed for testing will be provided; however, the adolescent needs to be appropriately dressed for physical education class on the test day.

If you have any question regarding this study, you can contact Rosane Rosendo da Silva at Univ. Federal Fluminense, Dep. de Educação Física, Campus do Valonguinho, Niterói, Rio de Janeiro, tel 620-8080, ramal 371 or Dr. Robert M. Malina at the Institute for the Study of Youth Sports, Michigan State University, East Lansing, Michigan, 48825, phone 001-517-355-7620.

You may keep the above portion of the form and return only the signed portion. Please return this form as soon as possible. Your cooperation is greatly appreciated.

Sincerely,

Rosane C Rosendo da Silva

Consent Form

Coronary heart disease risk factors and health-related physical fitness of adolescents in Niterói, Rio de Janeiro, Brazil

I have decided to allow my son/daughter/ward ___________________________ to participate in a study to assess the risk factors for coronary heart disease and components of health-related physical fitness in adolescents 14 to 16 years of age that will be conducted in regularly scheduled school day in the physical education class. My signature indicates that I have read the above information, or have had someone read the above information to me, and have given permission for my son/daughter/ward to participate in the study. I understand that my child may withdraw at any time (I can choose to discontinue his/her participation in the study) without any negative consequences to me or my family in my present or future relations with Michigan State University.

___________________________________ ____________________

Signature of parent/guardian Date

___________________________________ ____________________

Signature of investigator Date

Current occupation of father____________________

( ) employed ( ) self-employed

Current occupation of mother___________________

( ) employed ( ) self-employed

Please sign and return this page.

Autorização dos Pais

Fatores de risco para a doença coronariana e aptidão física relacionada à saúde em adolescentes de Niterói, Rio de Janeiro, Brasil

Sr. Responsável, estou conduzindo um estudo que avalia os fatores de risco de doença coronariana e a aptidão física de adolescentes de 14 e 15 anos de idade, como trabalho de final de curso de pós-graduação na Universidade do Estado de Michigan, Estados Unidos. Por isso, estou convidando o (a) seu (sua) filho(a) para participar do estudo, que será realizado na escola que ele(a) freqüenta . Para participar no estudo o seu filho(a) precisa de sua autorização, de acordo com o procedimento solicitado pelo Comitê de Ética de Pesquisa da universidade.

A participação no estudo envolve várias medidas. Nenhuma delas oferece risco de lesões físicas. O teste de corrida em 12 minutos é o único que envolve risco mínimo de lesões. Para diminuir esse risco o teste será realizado após uma sessão de aquecimento, e será supervisionado por um professor de Educação Física. Seu/sua filho(a) será orientado(a) a parar o teste se sentir cansaço para continuar o teste, ou se sentir algum tipo de mal-estar. Por favor nos notifique se seu/sua filho(a) tiver alguma doença em que a atividade física intensa não seja recomendada, tal como asma ou diabetes.

Outros testes incluem medidas de altura, peso, circunferências e dobras de gordura subcutânea. Questionários sobre a atividade física habitual, nível de desenvolvimento dos caracteres sexuais secundários, uso de cigarros e dados sócio-demográficos tais como idade e ocupação dos pais serão preenchidos. A tempo aproximado para esses testes é de 1 hora. Alguns adolescentes serão medidos em duas ocasiões para controle de qualidade das medidas.

Todas as informações coletadas nesse estudo são estritamente confidenciais. Apenas a pesquisadora terá acesso aos dados, que poderão ser requisitados pelo responsável através do adolescente. Em caso de publicação do trabalho, a anonimidade será também garantida.

O estudo não envolve nenhum gasto para o participante ou sua família. Todos os materiais necessários para os testes serão providenciados, porém o adolescente deverá utilizar roupas apropriadas para a aula de Educação física no dia do teste.

Se você tiver qualquer pergunta sobre o estudo, você pode entrar em contato com uma das seguintes pessoas:

Prof ª Rosane Rosendo
Univ. Federal Fluminense
Dep. de Educação Física
Campus do Valonguinho
Niterói, Rio de Janeiro
tel 620-8080, ramal 371

Prof. Dr. Robert Malina
Director
Intitute for the Study of Youth Sports
Michigan State University
East Lansing, MI 48825
tel. (001517) 355-7620

Dr. David Wright
Chair
Universtity Committee on Research involving Human Subjects
Michigan State University
East Lansing, MI 48825
tel (001517) 355-2180

A folha que contem a sua permissão deverá ser devolvida a fim de que seu/sua filha possa participar do estudo. Desde já agradeço a sua colaboração.

Atenciosamente,

Rosane Rosendo

Formulário de Consentimento

Eu permito que meu/minha filho(a) ___________________________________

participe do estudo *Fatores de risco para a doença coronariana e aptidão física relacionada à saúde em adolescentes de Niterói, Rio de Janeiro, Brasil,* que avalia fatores de risco de doença coronariana e aptidão física de adolescentes de 14 e 15 anos de idade e que será realizado na escola em que ele(a) estuda. Entendo que meu/minha filho(a) pode sair do estudo em qualquer momento que eu ou ele(a) decidir não mais participar, sem que haja nenhuma conseqüência negativa para ele(a) ou para mim, em minha relações com a UFF ou com a Universidade do Estado de Michigan, no presente ou futuro.

________________________________ ________________

Assinatura do pai, mãe ou responsável Data

________________________________ ________________

Assinatura da pesquisadora Data

Profissão atual do pai: ________________________________

( ) empregado ( ) trabalho por conta própria

Profissão atual da mãe: ________________________________

( ) empregado ( ) trabalho por conta própria

Por favor devolva esta página para a pesquisadora.

APPENDIX F

APPENDIX F

SUBJECT ASSENT

Coronary heart disease risk factors and health-related physical fitness of adolescents in Niterói, Rio de Janeiro, Brazil

Assent Form For The Subjects

I, ______________________, understand that my parents have given permission for me to participate in the study concerning coronary heart disease risk factors and health-related physical fitness of adolescents, under the direction of Rosane Rosendo da Silva.

I understand that measures of my body will be taken, that I will give information about my physical activity habits and sexual maturity status, and that I will have to perform a 12 minute walk/run. I also understand that any information about what I say or do will not be given to anybody else, and will only be used for the purpose of this study.

My involvement in this study is voluntary, and I have been told that I may withdraw from participation at any time without penalty and loss of benefit to myself. When I sign this page, I am indicating that I am agreeing to participate in this study and that I understand what will be required of me.

_________________________________ ______________________

Signature of the subject Date

_________________________________ ______________________

Signature of principal investigator Date

Please sign and return this page.

Formulário de Concordância na Participação do Estudo

Fatores de risco para a doença coronariana e aptidão física relacionada à saúde em adolescentes de Niterói, Rio de Janeiro, Brasil

Eu, ______________________________, compreendo que meus pais consentiram a minha participação no estudo que avalia fatores de risco de doença coronariana e aptidão física de adolescentes de 14 e 15 anos de idade, sob direção da Prof ª Rosane Rosendo.

Compreendo que medidas do meu corpo que serão realizadas e que eu informarei sobre minha atividade física regular e o estágio de maturação sexual, além de executar o teste de 12 minutos. Eu também entendo que qualquer das informações sobre aos meus resultados não serão divulgados a ninguém, e que serão utilizados apenas nesse estudo.

Minha participação nesse estudo é voluntária, e eu fui informado que posso desistir de participar a qualquer momento, sem nenhum prejuízo a minha pessoa. Assinando este documento eu indico que concordo em participar do estudo e que entendo o que me será solicitado.

______________________________ ________________
Assinatura do participante Data

______________________________ ________________
Assinatura da pesquisadora Data

Por favor devolva esta página para a pesquisadora.

APPENDIX G

APPENDIX G

IDENTIFICATION FORM

Sociodemographic data

Name:__________________________________ Sex: ( ) Male ( )

Female

Date of birth: ___/___/_____ Date of testing ___/___/_____

Race: ( ) White ( ) Black ( ) Pardo

How many people live in your household? _________

How many brothers and sister do you have? __________

Do you work outside your home? ( ) yes ( ) no

If yes, what is your occupation? _________________

Health status

Do you have any disease that prevents you from exercising? ( ) yes ( ) no

If yes, what is the disease? _______________

Do you have any orthopedic problem that limits your running ability? ( ) yes ( )no

If yes, what is the problem? ______________

Do you smoke cigarettes frequently? ( ) yes ( ) no

If yes, what is the average number of cigarettes per day?

( ) <1 ( ) 2-5 ( ) 6-10 ( ) 11-20 ( ) ≥ 20

FICHA DE IDENTIFICAÇÃO

Dados sócio-demográficos

Escola:____ Turma:___________

Sexo: ( ) masculino ( ) feminino Data de nascimento: ___/___/___

Cor: ( ) Branca ( ) Preta ( ) Parda

Quantos irmãos e irmãs você tem? ______________

Quantas pessoas moram na sua casa? _____________

Você trabalha fora de casa? ( ) sim ( ) não

Se *sim*, qual é a sua ocupação? ______________

Na sua casa, quantas pessoas trabalham fora? ___________

Dados de saúde

Você tem alguma doença que impeça a prática regular de exercícios físicos?

( ) sim ( ) não Se *sim*, qual é a doença? ______________________

Você tem algum problema ortopédico que limita a sua capacidade de correr?

( ) sim ( ) não Se *sim*, qual é o problema? ____________________

Você fuma regularmente?

( ) sim ( ) não

Se *sim*, qual é a média de cigarros fumados por dia?

( ) <1 ( ) 2-5 ( ) 6-10 ( ) 11-20 ( ) ≥ 20

Data do teste: ____/____/____

APPENDIX H

APPENDIX H

CLASSIFICATION OF SOCIAL CLASS BY HEAD OF HOUSEHOLD OCCUPATION

A. High class:

Owners and shareholders of large enterprises

B. Middle class:

Owners and shareholders of medium and small enterprises

Executive, administrative and managerial

Accountants and auditors

Administrators, education

Administrators, protective services

Financial managers

Management-related occupations

Managers, medicine and health

Managers, real state

Marketing, advertising, and public relations managers

Personnel and labor relations managers

Public officials and administrators

Purchasing managers

Professional

Architects

College and university teachers

Computer systems analysts

Dentists

Educational and vocational counselors

Elementary and secondary school teachers

Engineers

Lawyers and judges

Librarians

Mathematical and computer scientists

Natural scientists

Physicians

Physicians' assistants

Registered nurses

Social scientists and urban planners

Therapists

C. Working Class

Atypical (Lower middle class)

Technicians and related support

Clinical laboratory technologists and technicians

Computer programmers

Dental technicians

Drafting occupations

Electrical and electronic technicians

Engineering technologists and technicians

Health technologists and technicians

Licensed practical nurses

Sales occupations

Cashiers

Insurance sales

Real state sales

Sales counter clerks

Sales representatives, except retail

Administrative support, including clerical

Bank tellers

Bookkeepers, accounting and auditing clerks

Computer operators

Data entry keyers

Duplicating, mail and other office machine operators

File clerks

General office clerks

Postal clerks

Receptionists

Secretaries

Supervisors

Teacher's aides

Telephone operators

Typists

Typical (Lower class)

Precision production, craft, and repair

Automobile body repairers

Bakers

Carpenters

Construction trades

Electricians

Locksmith and safe repairers

Mechanics and repairers

Painters

Plumbers

Precision production occupations

Tile setters

Typesetters

Operators, fabricators, and laborers

Freight, stock, and material handlers

Laborers, except construction

Machine operators, assemblers, and inspectors

Motor vehicle operators

Solderers and brazers

Stevedores

Farming, forestry, and fishing

Animal caretakers

Farm operators and managers

Fishers, hunters, and trappers

Forestry and logging

Gardeners

Other agricultural and related occupations

Service Occupations

Child care, not private household

Cooks

Doorkeepers

Dressmakers

Elevator operators

Firefighters

Food preparation and service

Garbage collectors

Guards and private police

Hairdressers and cosmetologists

Housekeepers

Janitors and cleaners

Launderers and ironers

Maids

Nursing aides, orderlies, and attendants

Police and detectives

Police officers

Porters

Private household cleaners and servants

Private household, child care

Street vendors

Vehicle washer

Waiters and waitresses

APPENDIX I

APPENDIX I

THE SELF-ASSESSMENT OF SEXUAL MATURITY - MALES

General Instructions

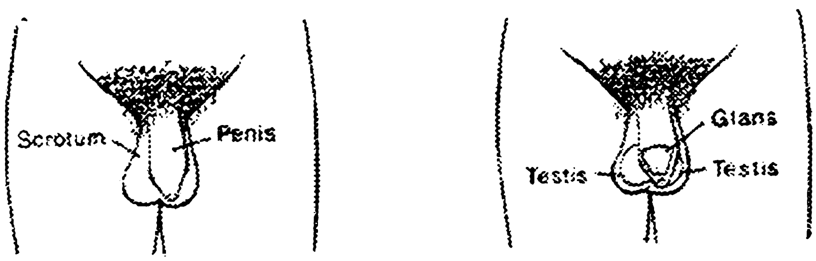
Please read each description of a stage and compare it with the corresponding drawing and photograph opposite. Then assign a stage to yourself. Most will be easily able to decide that the correct stage is one of a possible two or three. Read the descriptions for these again and check the photographs and drawings again before making a decision.

Most of the drawings and photographs are for boys who are not circumcised. Try not to let this difference affect your choice of stages. You may wish to used a mirror to help assign the correct stages.

BOYS

Grades of genital development

The genitalia to be graded are the penis and the scrotum and the testes which can be felt within the scrotum. If you consider there are differences from one side of your body to the other, which is not unusual, assign a stage based on the average of the two sides.



STAGE 1: The penis, scrotum, and testes are of the same size and proportion as in early childhood.

STAGE 2: The scrotum and testes have enlarged. The size of each testis can be judged by looking at the scrotum and also by feeling each testis through the skin of the scrotum. The skin of the scrotum becomes thinner, wrinkled and slightly red, but this is difficult to see in a photograph. There is little or no change in the penis.

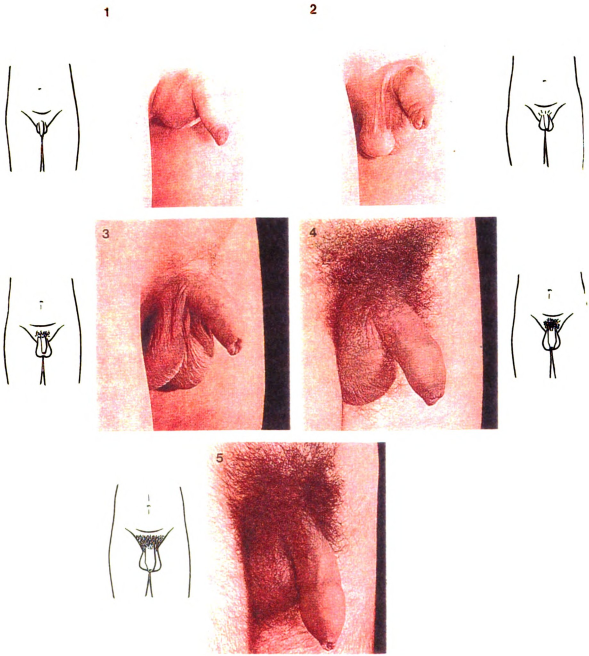
STAGE 3: The penis is longer than in early childhood but there is little change in thickness. The scrotum and testes are larger than in STAGE 2. The scrotum now hangs down further below the base of the penis.

STAGE 4: The penis is further enlarged in length and breadth. The end of the penis becomes conical and there is an enlargement where this part (the glans) joins the rest of the penis. The scrotum and testes are further enlarged and the skin of the scrotum is darker.

STAGE 5: The penis, scrotum and testes are adult in size and shape.

STAGES OF GENITAL DEVELOPMENT

BOYS

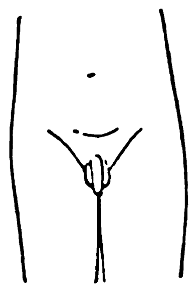


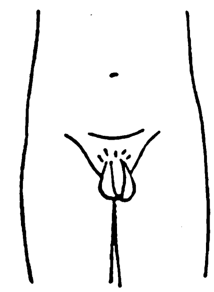
STAGES IN GENITAL DEVELOPMENT

BOYS

Check the stage that best represents your development

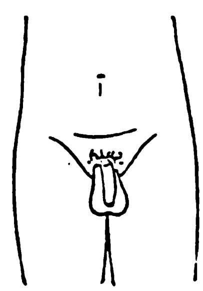
____ 1

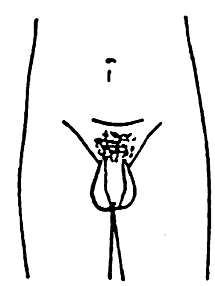




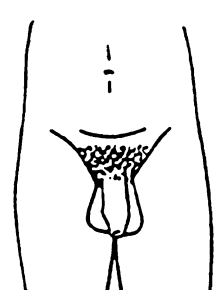
2 ____

____ 3





4 ____



5 ____

BOYS

Stages in development of pubic hair

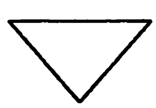
Pubic hair grows near the middle where the thighs meet the stomach. It develops during pubescence and becomes colored and curly.

STAGE 1: No pubic hair. The hair in this region does not differ from that over the front of the stomach.

STAGE 2: There is sparse, long, slightly colored hair that is straight or only slightly curled. It is at base of the penis or on the scrotum. This stage is difficult to see in a photograph, particularly if the person has fair hair. Therefore, rely more on the written description and the drawing than on the photograph.

STAGE 3: The pubic hair is considerably darker, coarser, and more curled. The hair is around the base of the penis.

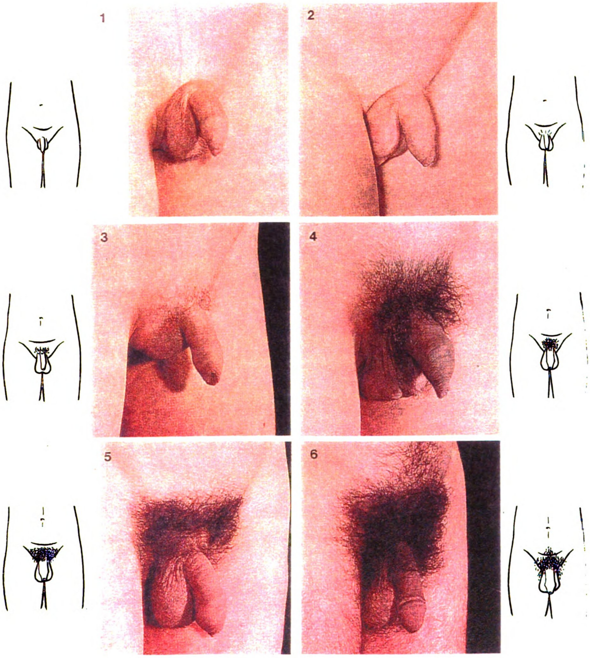
STAGE 4: The pubic hair is now adult in type (colored similarly to cranial hair, coarse, curled), but the area covered is considerably smaller than in most adults. The pubic hair does not spread to the inner surface of the thighs; that is. It is not extend over the folds where the thighs join the stomach.

STAGE 5: The pubic hair is adults in type and quantity. It covers a triangular area with a straight upper margin (). The pubic hair spreads to the inner surfaces of the thighs across the folds where the thighs join the stomach, but it does not extend up onto the front of the stomach beyond a straight line.

STAGE 6: The pubic hair is not restricted to a triangular area but extends up to the front of the stomach so that the area covered is no longer triangular.

STAGES IN DEVELOPMENT OF PUBIC HAIR

BOYS

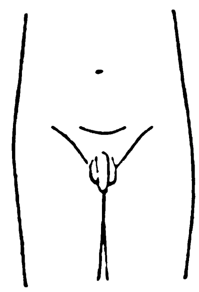


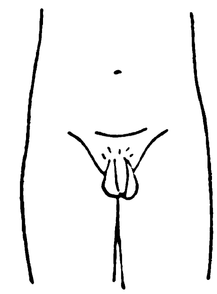
STAGES IN DEVELOPMENT OF PUBIC HAIR

BOYS

Check the stage that best represents your development

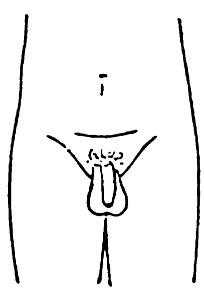
___ 1

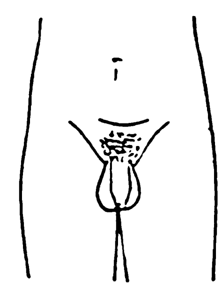




2 ___

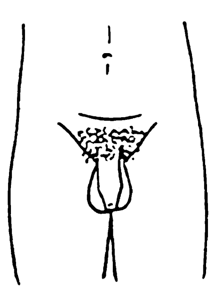
___ 3

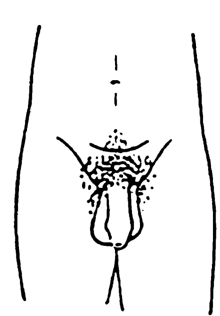




4 ___

___ 5





6 ___

APPENDIX J

APPENDIX J

THE SELF-ASSESSMENT OF SEXUAL MATURITY - FEMALES

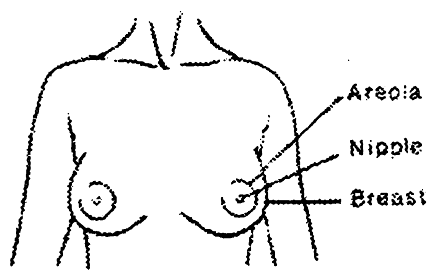
GENERAL INSTRUCTIONS

Please read each description of a stage and compare it with the corresponding drawing and photograph opposite. Then assign a stage to yourself. Most will be easily able to decide that the correct stage is one of a possible two or three. Read the description for these again and check the photographs and drawings again before making a decision.

GIRLS

Stages of breast development

Please use the mirror to help assign the correct stages. In many girls, one breast is more developed than the other. If this is so for you, record an average stage for the two breasts. The parts of the breast you need to examine are shown in the drawing below.



STAGE 1: Only the nipple is higher than the general level of the chest wall in this area, as in a child.

STAGE 2: There is an elevation of the areola, which is the colored area around the nipple. The areola is larger than in childhood and fairly hard tissue can be felt deep to it.

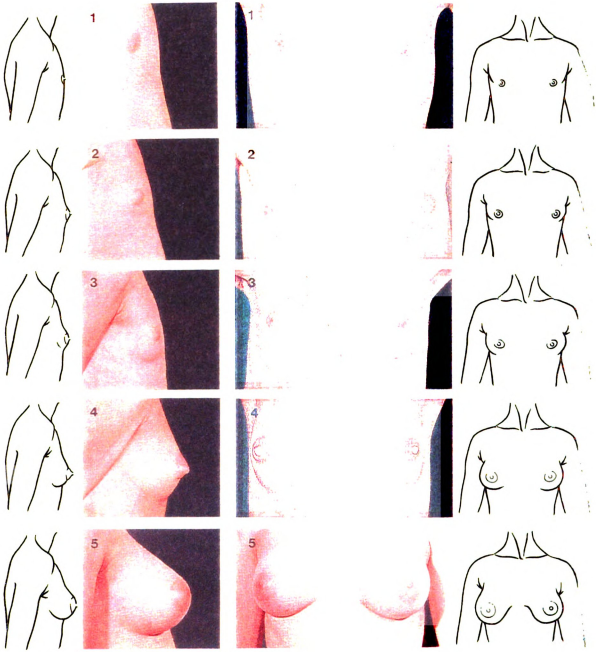
STAGE 3: There is further enlargement of the breast and the areola, without any separation of their contours. The breast is now clearly feminine in appearance.

STAGE 4: The nipple and the areola project from the general level of the breast to form a mound.

STAGE 5: The breast is now adult. The nipple projects from the general contour but the areola does not. The areola is markedly colored.

STAGES OF BREAST DEVELOPMENT

GIRLS



GIRLS

Stages of development f pubic hair

Public hair grows near the middle where the thighs meet the stomach. It develops during pubescence and becomes colored and curly.

STAGE 1: No public hair. The hair in this region does not differ from tat on the front of the stomach.

STAGE 2: There is sparse, long, slightly colored hair in the public area that is straight or only slightly curled. It is mainly along the labia. The labia are the rounded folds of the opening of the vagina. This stage is difficult to see in a photograph, particularly if the person has fair hair. Therefore, rely on the written description and the drawing than on the photograph.

STAGE 3: The pubic hair is considerably darker, coarser, and more curled than in Stage 2. The public hair spreads sparsely over the pubic area beyond the labia.

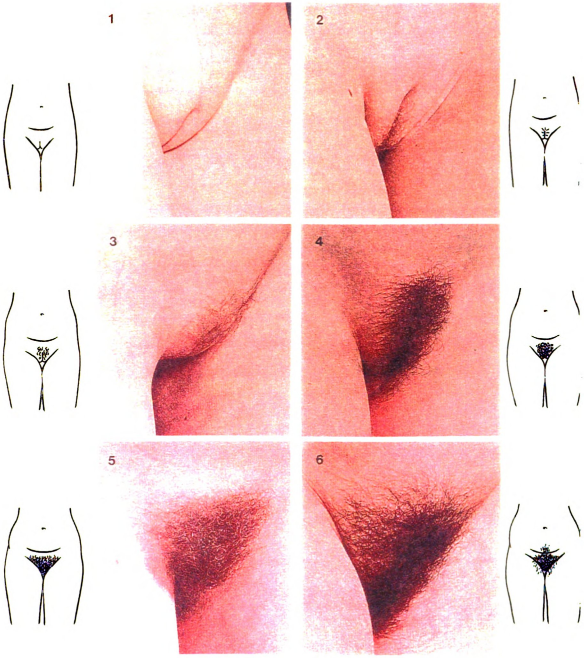
STAGE 4: The pubic hair is now adult in type (colored similarly to cranial hair, coarse, curled), but the area covered is considerably smaller than in most adults. There is spread to the inner surfaces of the thighs, that is, the pubic hair does not extend over the folds where the thighs join the stomach.

STAGE 5: The pubic hair is adult in quantity and type. The area covered is an inverted triangle (▽). The pubic hair extends to the inner surfaces of the thighs. In some girls, the pubic hair extends up the front of the stomach in Stage 5.

STAGE 6: In about 10 percent of adults there is further extension of pubic hair to the sides or up onto the front of the stomach.

STAGES IN DEVELOPMENT OG PUBIC HAIR

GIRLS

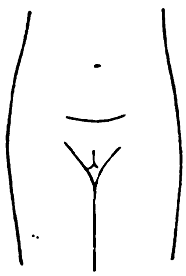


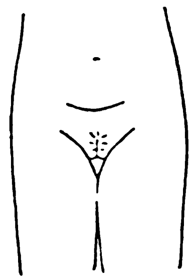
STAGES IN DEVELOPMENT OF PUBIC HAIR

GIRLS

Check the stage that best represents your development

___ 1





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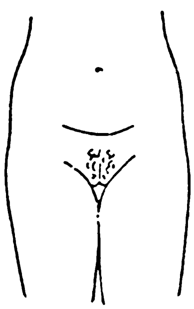
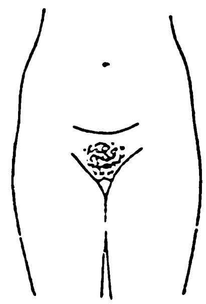
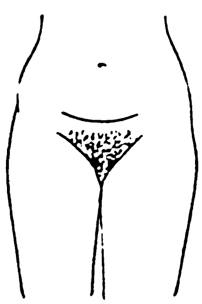
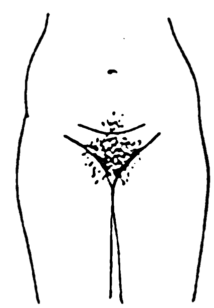




4 ___

___ 5





6 ___

APPENDIX K

APPENDIX K

PHYSICAL ACTIVITY QUESTIONNAIRE

Name: ______________________________ Age: ________ Sex : M ___ F ___

Date: __________________

We are trying to find out about your physical activity levels that you have done IN THE LAST 7 DAYS (in the last week). This includes sports or dance that make you sweat or make your legs feel tired. or games that make you breathe harder, like tag, skipping, running, climbing and others.

REMEMBER:

A. There are no right or wrong answers-- this is not a test.

B. Please answer all the questions as honestly and accurately as you can -- this is very important.

---

1. PHYSICAL ACTIVITY

Have you done any of the following activities in the PAST 7 DAYS (last week)? If yes, how many time?

** Tick Only One Box Per Row **

	No	1-2	3-4	5-6	7 times or more
Skipping	☐	☐	☐	☐	☐
Creative Playground	☐	☐	☐	☐	☐
Tag	☐	☐	☐	☐	☐
Walking for exercise	☐	☐	☐	☐	☐
Bicycling	☐	☐	☐	☐	☐
Jogging or running	☐	☐	☐	☐	☐
Aerobics	☐	☐	☐	☐	☐
Swimming	☐	☐	☐	☐	☐
Dance	☐	☐	☐	☐	☐
Skateboarding	☐	☐	☐	☐	☐
Soccer	☐	☐	☐	☐	☐
Volleyball	☐	☐	☐	☐	☐
Basketball	☐	☐	☐	☐	☐
Dodgeball	☐	☐	☐	☐	☐
Other					
__________	☐	☐	☐	☐	☐
__________	☐	☐	☐	☐	☐

2. In the last 7 days, during your physical education (PE)classes, how often were you very active (playing hard, running, jumping, throwing)?

I don't do PE.	....	☐	
Hardly ever	....	☐	check
Sometimes	....	☐	one
Quite often	....	☐	only
Always	....	☐	

3. In the last 7 days, what did you do most of the time <u>AT RECESS</u>?

Sat down (talking, reading, doing school work)	....	☐	
Stood around or walked around	....	☐	check
Ran or played a little bit	....	☐	one
Ran around and played quite a bit	....	☐	only
Ran and played hard most of the time	....	☐	

4. In the last 7 days, what did you normally do <u>AT LUNCH</u> (besides eating lunch)?

Sat down (talking, reading, doing school work)	....	☐	
Stood around or walked around	....	☐	check
Ran or played a little bit	....	☐	one
Ran around and played quite a bit	....	☐	only
Ran and played hard most of the time	....	☐	

5. In the last 7 days, on how many days <u>RIGHT AFTER SCHOOL</u>, did you do sports, dance, or play games in which you were very active?

None	....	☐	
1 time last week	....	☐	check
2 or 3 times last week	....	☐	one
4 times last week	....	☐	only
5 times last week	....	☐	

6. In the last 7 days, on how many <u>EVENINGS</u> did you do sports, dance, or play games in which you were very active?

None	....	☐	
1 time last week	....	☐	check
2-3 times last week	....	☐	one
4-5 times last week	....	☐	only
6-7 times last week	....	☐	

7. <u>ON THE LAST WEEKEND</u>, how many times did you do sports, dance, or play games in which you were very active?

None	....	☐	
1 time	....	☐	check
2-3 times	....	☐	one
4-5 times	....	☐	only
6 or more times	....	☐	

8. On the average, about how many hours per day do you watch television? _______ hours.

9. Which <u>ONE</u> of the following describes you best for the last 7 days?

** Read ALL FIVE statements before deciding on the one answer that describes you **

A). All or most of my free time was spent doing things that involve little physical effort (e.g., watching TV, doing homework, playing computer games or Nintendo)	....	☐	
B) I sometimes (1 - 2 times last week) did physical things in my free time (e.g., played sports, went running, swimming, bike riding, did aerobics).	....	☐	check
C) I often (3 - 4 times last week) did physical things in my free time	....	☐	one only
D) I quite often (5 - 6 times last week) did physical things in my free time	....	☐	
E) I very often (7 or more times last week) did physical things in my free time	....	☐	

10. How fit (in good shape) do you think you are compared to others your age and sex?

Very fit	....	☐	
Fitter than most	....	☐	check
About average	....	☐	one
Less fit than most	....	☐	only
Very unfit	....	☐	

11. Were you sick last week, or did anything prevent you from doing your normal physical activities?

Yes .... ☐

No .... ☐

If yes, what prevented you? ______________________________

12. Compared to other children your age and sex, how would you rate yourself as to how physically active you were in the last 7 days?

A) I was <u>much less</u> active than others	....	☐	
B) I was <u>a little less</u> active than others	....	☐	check
C) I was <u>about the same</u> as others	....	☐	one
D) I was <u>a little more</u> active than others	....	☐	only
E) I was <u>much more</u> active than others	....	☐	

13. Mark how often you did physical activity (like playing sports, games, doing dance or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
A) Monday	☐	☐	☐	☐	☐
B) Tuesday	☐	☐	☐	☐	☐
C) Wednesday	☐	☐	☐	☐	☐
D) Thursday	☐	☐	☐	☐	☐
E) Friday	☐	☐	☐	☐	☐
F) Saturday	☐	☐	☐	☐	☐
G) Sunday	☐	☐	☐	☐	☐

Questionário sobre atividade física regular

Nome: ____________________________ Idade: ________ Sexo: M ___ F ___

Data: __________________

Gostaria de saber que tipos de atividade física você praticou NOS ÚLTIMOS SETE DIAS (nessa última semana). Essas atividades incluem esporte e dança que façam você suar ou que façam você sentir suas pernas cansadas, ou ainda jogos (tais como pique), saltos, corrida e outros, que façam você se sentir ofegante.

LEMBRE-SE:

A. Não existe certo ou errado - este questionário não é um teste.

B. Por favor responda a todas as questões de forma sincera e precisa - é muito importante para o resultado.

---

1. ATIVIDADE FÍSICA

Você fez alguma das seguintes atividades nos ÚLTIMOS 7 DIAS (na semana passada)? Se sim, quantas vezes?

** Marque apenas um X por atividade **

	Nenhuma	1-2	3-4	5-6	7 vezes ou mais
Saltos	☐	☐	☐	☐	☐
Atividade no parque ou playground	☐	☐	☐	☐	☐
Pique	☐	☐	☐	☐	☐
Caminhada	☐	☐	☐	☐	☐
Andar de bicicleta	☐	☐	☐	☐	☐
Correr ou trotar	☐	☐	☐	☐	☐
Ginástica aeróbica	☐	☐	☐	☐	☐
Natação	☐	☐	☐	☐	☐
Dança	☐	☐	☐	☐	☐
Andar de skate	☐	☐	☐	☐	☐
Futebol	☐	☐	☐	☐	☐
Voleibol	☐	☐	☐	☐	☐
Basquete	☐	☐	☐	☐	☐
"Queimado"	☐	☐	☐	☐	☐
Outros (liste no espaço)					
__________	☐	☐	☐	☐	☐
__________	☐	☐	☐	☐	☐

2. Nos últimos 7 dias, durante as aulas de Educação Física, o quanto você foi ativo (jogou intensamente, correu, saltou e arremessou)?

Eu não faço as aulas	☐	
Raramente	☐	marque
Algumas vezes	☐	apenas
Freqüentemente	☐	uma
Sempre	☐	

3. Nos últimos 7 dias, o que você fez na maior parte do <u>RECREIO</u>?

Ficou sentado (conversando, lendo, ou fazendo trabalho de casa)	....	☐	
Ficou em pé, parado ou andou	....	☐	marque
Correu ou jogou um pouco	....	☐	apenas
Correu ou jogou um bocado	....	☐	uma
Correu ou jogou intensamente a maior parte do tempo	....	☐	opção

4. Nos últimos 7 dias, o que você fez normalmente durante o horário do almoço (além de almoçar)?

Ficou sentado (conversando, lendo, ou fazendo trabalho de casa)	....	☐	
Ficou em pé, parado ou andou	....	☐	marque
Correu ou jogou um pouco	....	☐	apenas
Correu ou jogou um bocado	....	☐	uma
Correu ou jogou intensamente a maior parte do tempo	....	☐	opção

5. Nos últimos 7 dias, quantos dias da semana você praticou algum esporte, dança, ou jogos em que você foi muito ativo, <u>LOGO DEPOIS DA ESCOLA</u>?

Nenhum dia	....	☐	
1 vez na semana passada	....	☐	marque
2 ou 3 vezes na semana passada	....	☐	apenas
4 vezes na semana passada	....	☐	uma
5 vezes na semana passada	....	☐	opção

6. Nos últimos 7 dias, quantas vezes você praticou algum esporte, dança, ou jogos em que você foi muito ativo, <u>A NOITE</u>?

Nenhum dia	....	☐	
1 vez na semana passada	....	☐	marque
2-3 vezes na semana passada	....	☐	apenas
4-5 vezes na semana passada	....	☐	uma
6-7 vezes na semana passada	....	☐	opção

7. <u>NO ÚLTIMO FINAL DE SEMANA</u> quantas vezes você praticou algum esporte, dança, ou jogos em que você foi muito ativo?

Nenhum dia	....	☐	
1 vez	....	☐	marque
2-3 vezes	....	☐	apenas
4-5 vezes	....	☐	uma
6 ou mais vezes	....	☐	opção

8. Em média quantas horas você assiste televisão por dia? _______ horas.

9. Qual das opções abaixo melhor representa você nos últimos 7 dias?
** Leia TODAS AS 5 afirmativas antes de decidir qual é a melhor opção**

A). Todo ou quase todo o meu tempo livre eu utilizei fazendo coisas que envolvem pouco esforço fisico (assistir TV, fazer trabalho de casa, jogar videogames)	....	☐	
B) Eu pratiquei alguma atividade fisica (1-2 vezes na última semana) durante o meu tempo livre (ex. Praticou esporte, correu, nadou, andou de bicicleta, fez ginástica aeróbica)	....	☐	marque
C) Eu pratiquei atividade fisica no meu tempo livre (3-4 vezes na semana passada)	....	☐	apenas uma
D) Eu geralmente pratiquei atividade fisica no meu tempo livre (5-6 vezes na semana passada)	....	☐	opção
E) Eu pratiquei atividade fisica regularmente no meu tempo livre na semana passada (7 ou mais vezes)	....	☐	

10. Comparando você com outras pessoas do mesma idade e sexo, como você se considera?

Muito mais em forma	....	☐	
Mais em forma	....	☐	marque
Igualmente em forma	....	☐	apenas
Menos em forma	....	☐	uma
Completamente fora de forma	....	☐	opção

11. Você teve alguma problema de saúde na semana passada que impediu que você fosse normalmente ativo?

Sim	....	☐
Não	....	☐

Se sim, o que impediu você de ser normalmente ativo? ______________________________

12. Comparando você com outras pessoas da mesma idade e sexo, como você se classifica em função da sua atividade fisica nos últimos 7 dias?

A) Eu fui muito menos ativo que os outros	....	☐	
B) Eu fui um pouco menos ativo que os outros	....	☐	marque
C) Eu fui igualmente ativo	....	☐	apenas
D) Eu fui um pouco mais ativo que os outros	....	☐	uma
E) Eu fui muito mais ativo que os outros	....	☐	opção

13. Marque a freqüência em que você praticou atividade fisica (esporte. jogos. dança ou outra atividade fisica) na semana passada.

	Nenhuma vez	Algumas vezes	Poucas vezes	Diversas vezes	Muitas vezes
Segunda	☐	☐	☐	☐	☐
Terça	☐	☐	☐	☐	☐
Quarta	☐	☐	☐	☐	☐
Quinta	☐	☐	☐	☐	☐
Sexta	☐	☐	☐	☐	☐
Sábado	☐	☐	☐	☐	☐
Domingo	☐	☐	☐	☐	☐

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