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CHAPTER 3   METHOD

3.1 STATEMENT OF THE PROBLEM

Physical actvity is defined as any body movement produced by the contraction of skeletal muscles that substantially increases energy expenditure. In simpler terms, physical activity is defined as moving, whereas physical fitness is defined as the ability to move. Fitness tests are being used to assess physical fitness. With the recent recognition of the importance of life-long, health-enhancing physical activity conducted as a regular regimen in people's daily lives, health benefits such as lower cholesterol, decreased blood pressure, and decreased body fat have been documented in adults who regularly participate in such physical activity. In addition, studies have shown that physical activity reduces the risk of diseases such as CHD, hypertension, diabetes mellitus and colon cancer (USDHHS, 1996).

Recently, the field of physical fitness testing has placed more emphasis on assessing health-related physical fitness and health-enhancing physical activity, as opposed to traditional school-based physical education program emphasis on gymnastic skills and/or sports programs. Aerobic exercise is a health-enhancing physical activity that has numerous health benefits and is very popular among adult populations. But to date, aerobic exercise has not been widely used in school physical education programs.

In order to strengthen the case for the inclusion of aerobic exercise in school physical education programs, the knowledge base of the health benefits of school-based aerobic exercise needs to be expended.

3.2 PURPOSE OF THE STUDY

This study has a fourfold purpose:

1) To determine the effects of school-based aerobic exercise intervention on children's health-related physical fitness.

2) To determine the Portuguese middle school children's health-related physical fitness.

3) To determine the Portuguese middle school children's physical activity levels during school physical education, recess and leisure time.

4) To determine the relationship between the children's physical activity levels and health-related physical fitness.

3.3 RESEARCH QUESTIONS

1) What are the current levels of the children's health-related physical fitness?

2) What are the children's body compositions?

3) What are the children's physical activity levels during leisure time, as estimated by a self-reported questionnaire?

4) What are the children's physical activity levels during school physical education classes, as measured by the heart rate monitoring?

5) What is the relationship between the children's physical activity levels and health-related physical fitness?

6) What do the children know about health-related physical fitness and aerobic exercise?

7) Do the children have opportunities to participate aerobic exercise during physical education?

8) What are the effects of school-based aerobic exercise intervention on children's health-related physical fitness?

3.4 EXPECTATIONS

1) Children's health-related physical fitness can be improved by aerobic exercise intervention in school physical education programs;

2) Aerobic exercise intervention in a school physical education programs improve children's knowledge, skill, physical activity levels, and health-related physical fitness;

3) Aerobic exercise can be incorporated into school physical education programs and accepted
   by school physical education teachers as an important component of their programs.

3.5 ASSUMPTIONS

1) Children gave their maximum effort on all trials of each test item.

2) Children answered all the questions in the questionnaire honestly.

3) The sample size was sufficient for each gender and age group to statistical comparison.

4) The testers were well-trained in test administration.

5) The children practiced the test items sufficiently and performance reflected true ability.

3.6 DELIMITATIONS

1) Children were recruited via convenience sampling from a public school in Braga, Portugal.

2) Measurement of health-related physical fitness was delimited to the protocols and tests governed by FITNESSGRAM.

3) Only school children in grades 6th, 7th, 9th was selected to participate in school physical education aerobic exercise intervention study.

4) For the purposes of this study, only middle school children (ages 10-15), were selected.

3.7 RESEARCH DESIGN

This study is a trial of an aerobic exercise intervention in school-based physical education programs for Portuguese middle school children. The subjects were recruited from middle schools in northern Portugal from September 2001 to October 2002.

264 children ages from 10-15 from the different middle schools were selected participating in a physical examination (FITNESSGRAM) and completing a questionnaire during physical education classes. 141 children ages from 10-15 were selected to continue the experimental study for one-school year. Their physical education classes were all taught by the same teacher. The researcher directs the intervention in the experimental groups. The students were assigned to an aerobic experimental group (70 children) and a control group

(71 children) by random. After the one year intervention, we compared the children's health-related physical fitness through the battery FITNESSGRAM to determine the effects of school-based aerobic exercise on children's health-related physical fitness.

3.8 SAMPLES

3.8.1 Sample of study 1

Study 1 was designed to determine the children's health-related physical fitness and physical activity levels and the relationship between the two.

A total of 264 children, ages 10-15, were selected from four public middle schools (Braga, Aveiro, Barcelos and Guimarães). We thoroughly explained to all subjects (264 eligible completions, 5 absent) the health-related physical fitness test (FITNESSGRAM) and questionnaire during physical education classes. All subjects did their tests and questionnaire in their school physical education classes (survey procedures were designed to protect students' privacy by allowing for anonymous participation in the questionnaire.).

3.8.2 Sample of study 2

Study 2 was designed to determine the effects of school-based aerobic exercise intervention on children's health-related physical fitness.

A total of 141 children, ages 10-15, at Real Middle School in Braga, agreed to continue the interventional study of school-based aerobic exercise.

70 students from 6th, 7th and 9th grade classes were randomly assigned to experimental groups and 71 students from three different classes of the same grades were randomly assigned to control groups. (One participant in the experimental group withdrew prior to completing the study due to an injury).

3.8.3 Sample of study 3

Study 3 was designed to determine the children's physical activity levels (moderate-to-vigorous physical activity) during their school physical education classes.

14 7th grade boys (mean age 12.5 years) and 14 7th grade girls (mean age 12.1 years), were randomly selected from the sample of 264 children. The children's heart rates were

measured during fourteen indoor physical education classes (seven 45-minute classes and seven 90-minute classes). The classes consisted of training in football, basketball, handball, volleyball, gymnastics, and skill evaluation.

3.9 MEASUREMENT(S)

3.9.1 Health-related physical fitness---FITNESSGRAM

FITNESSGRAM, a relatively new health-related physical fitness test battery, was used in our study. While other test batteries, such as Physical Best and EUROFIT, include tests for either health-related physical fitness or skill-related physical fitness, FITNESSGRAM includes all components of health-related physical fitness. It utilizes criterion-referenced standards for performance, rather than norm-referenced standards, which classify individuals as either healthy or unhealthy on a particular test item by different age and gender. A healthy classification indicates that an individual meets the criterion-referenced standard on all test items. An individual who does not meet FITNESSGRAM standards is classified as unhealthy. The FITNESSGRAM was chosen because of its ease of administration to large numbers of subjects, its reliability and the validity of its fitness measures (Bono et al., 1991; Marshall et al., 1998).

Four components of health-related fitness were evaluated: body composition, cardiorespiratory endurance, muscle strength and endurance, and flexibility. The One-mile walk/run, Curl-up (Cadence), Push-up (Cadence), Skinfolds measurement, Trunk Lift, and Back-Saver Sit & Reach were chosen for this study. Participants were tested at two different locations: the one-mile run testing occurred at a school outdoor 200m track and field facility; the remaining tests were conducted in a school indoor gym. At both locations, testing occurred in temperatures ranging from 15-30 ºC with no more than 50% relative humidity.

On testing day, participants were required to avoid any vigorous exercise. During the exercise testing, each participant was requested to wear running shoes and shorts. Testing procedures were fully explained to the participants before testing. To ensure reliability and validity, the one-mile run was separated from other exercise testing in order to avoid muscular fatigue and at the same time provide maximum power potential.

All tests were conducted according to the FITNESSGRAM measurement procedures (Appendix-04). Passing or not passing the test depended on the FITNESSGRAM Standards for Healthy Fitness Zone (Appendix-05). We kept detailed records on report sheets (Appendix-06). All data were analysed by the Excel and SPSS11.0.

3.9.2 Body Mass Index ---BMI

There are many practical methods of assessing body composition such as skinfolds, bioelectrical impedance analysis (BIA), and hydrostatic weighing. The Body Mass Index is widely used in adult populations; a cut-off point of 25 and 30 kg/m^2 is recognized internationally as a definition of adult overweight and obesity respectively (WHO, 2002c). BMI provides information on appropriateness of weight relative to height. BMI is a simple measure of the lean and fat weight components. It is used in epidemiological research and has a moderately high correlation ($r = 0.69$). But the BMI in childhood changes substantially with age (Cole et al., 1995). In the United States, the 85th and 95th centiles of body mass index for age and sex, based on U.S. nationally representative survey data, have been recommended as cut-off points to identify overweight and obesity (Barlow & Dietz, 1998). The Childhood Obesity Working Group of the International Obesity Task Force-IOTF (Cole et al., 2000) obtained data on body mass index for children from six large nationally representative cross-sectional surveys on growth from Brazil, Great Britain, Hong Kong (china), the Netherlands, Singapore and the United States. Each survey had over 10 000 subjects, ages 6-18 years. IOTF has developed cut-off criteria with relative (age-specific) BMI centile charts for children (2-18 yrs). The IOTF authors point out that although these cut-off points were less arbitrary; they were more internationally acceptable than others that had been used (Cole et al., 2000). By using this international standard definition (BMI) for child overweight and obesity, we can compare the trend of child overweight and obesity in different countries.

In the BMI test, weight is measured twice, to the nearest 0.1 kg (the average was used), with subjects wearing light clothes and no shoes, using a medical beam balance. Height is measured twice to the near 0.1cm (the average was used). BMI is easily calculated as weight (kilograms) divided by height (meters) squared, BMI=Weight/Height^2 (kg/m^2) (see Appendix-07 & Appendix-08).

3.9.3 Leisure Physical Activity Level--- IPAQ, YRBS, PYLQ

There are many methods to assess physical activity levels, including Doubly Labelled Water, Direct Observation (Criterion Standards); Heart Rate Monitor (Objective Measures); Accelerometers, Pedometers (Motion Sensors); Self-Report Questionnaire, Interview, Proxy-Report, and Diary (Subjective Measures). For the purpose of population surveys, self-report measures of participation in physical activity represent the best compromise between acceptability and accuracy (Booth et al 1996).

In 1978, The ACSM published guidelines on the frequency (3 to 5 days per week), intensity (60% to 90% MHRR), duration (15- to 90-minutes per session), and type of exercise needed for cardiorespiratory fitness and optimal body composition. In 1991, The ACSM exercise prescription guidelines are similar except the target heart rate (THR) is set at 55% to 90% of MHR (Maximal Heart Rate) and the duration of continuous activity is 15 to 60 minutes (ACSM, 1991). The specific duration and intensity of exercise necessary for the development of cardiorespiratory endurance in children is not well documented. However, ACSM recommended that children participate in vigorous exercise each day for 20 to 30 minutes. New scientific evidence and the desire to provide recommendations that could be realistically achieved by the general public resulted in a new CDC–ACSM recommendation that "every U.S. adult should accumulate 30 minutes or more of moderate intensity physical activity on most, preferably all, days of the week"(Pate, 1995).

The International Physical Activity Questionnaire (IPAQ) is a recently proposed set of questionnaires for the assessment of health-enhancing physical activity. It assesses the total amount of moderate-to-vigorous physical activity covering all domains, for example, work/education, transport, domestic chores and recreation during the last seven days or a usual week. It was tested and subsequently vetted for feasibility, reliability and validity (Craig et al., 2003).

The items in the IPAQ short version (Appendix-09) and the 2001 Youth Risk Behaviour Survey-YRBS (Appendix-10) were selected for this study and translated into Portuguese. All participants completed the Children's Lifestyle Questionnaire (Appendix-11).

During physical education classes, the children were asked about their leisure time physical activities in the last seven days, which include the recreation, exercises or sports at school, at home, and walk from place to place. The researchers explained all questions very carefully (vigorous physical activities refer to activity that take hard physical effort and

make them breathe harder than normal; moderate physical activities refer to activity that take moderate physical effort and make them breathe somewhat harder than normal). The students completed the questionnaire and wrote down the time in minutes spent in physical activity in last 7 days.

To assess instrument reliability, the two-week test-retest assessment was assessed with a random sub-sample of 28 9th grade students. The reliability was 0.84. Survey procedures were designed to protect students' privacy by allowing for anonymous participation in the questionnaire.

To determine children's physical activity levels and its relationship with other parameters, we divided children's physical activity levels (MVPA) into four categories (sedentary: 0-2 times/week, low: 3-4 times /week, moderate: 5-6 times/week, vigorous: 7+ times/week).

3.9.4 Heart Rate Monitor (HRM)

To assess children's physical activity levels, the Heart Rate Monitor is probably the most common objective method, due to its validity and reliability (DuRant et al., 1993), relatively low cost and ability to record value over time (Louie et al., 1999). The HRM is also a good tool for assessing moderate-to-vigorous physical activity (Riddoch & Boreham, 1995).

Stratton (1996) suggested that, in children around the age of puberty, heart rate above 139 beats/min have been used as a threshold for moderate physical activity, and above 159 beats/min for vigorous physical activity. Stratton (1996) also suggested that the percentage of maximal heart rate reserve (%MHRR) might be the most appropriate way to represent relative intensities. Moderate-to-vigorous physical activity intensity at least 60% MHRR is considered appropriate for physical education curriculum goals for promoting physical activity; vigorous physical activity intensity above 75% MHRR may stimulate an increased cardiorespiratory.

We used 140bpm and 160bpm cut-points and %MHRR to assess children's physical activity levels (MVPA) during physical education classes, and assessed the different kinds of school physical education programs in control groups. We also used HRM as a tool to know and control children's physical activity levels in experimental groups during classes.

In our study study, professional physical educators, ages 25 to 45, taught classes. Contents included football, basketball, handball, volleyball, gymnastics, and skills evaluation. The total area of the school indoor gym is 900m^2, which can be divided into

three equal parts (how big a playground the students have depends on how many classes there are at the same time). Actual physical education class time was calculated depending on heart rate monitor measurement. The Polar S810 HRM, which we selected, consists of a chest strap with wireless electrodes and a watch receiver-microcomputer. The HRMs were preset to record and store heart rate data every five- seconds during the duration of a class.

Each time, we selected one boy and one girl randomly from the different physical education class. The subjects were asked to wear HRMs (Appendix-12) and lie still on a bench for approximately three minutes to record their resting heart rate before the class. The subjects were then instructed to join the class and participate in the schedule program. Teachers were instructed to maintain their class schedule. All students were asked to do everything as normal. The researcher reminded the HRM students to start and stop the HRMs when their teachers began and finished classes.

The subjects' heart rate data in HRM memory were then transferred to computer by a POLAR infrared interface. Polar Precision Performance 3.0 software was used to check and correct errors in all HR files. EXCEL and SPSS11.0 were used to calculate and analyze all the data. The T-test was used to test the heart rate difference between different genders in different indoor PE. Statistical significance was set at $p < 0.05$.

3.9.5 Biological maturation

Some studies indicate that children could be advantaged or disadvantaged in physical fitness tests by being more or less physically mature than their counterparts of the same chronological age (Jones et al., 2000). Malina & Bouchard (1991, p.274) indicate that early-maturing children of both sexes are taller and heavier than average, late maturing peers from about age 6 onward. Armstrong & Welsman (2001) indicate that VO_2 peak increased with age and maturation in both sexes.

Mota et al. (2002) also suggest that many studies do not ordinarily consider physiological changes and biological maturation in adolescents. Although it is widely believed that physical maturity influences physical performance, relatively few studies have attempted to quantify differences between children groups by maturity status (Beunen et al., 1992, 1997).

Since it is important for us to know the role of maturation in children's health-related physical fitness, we chose Tanner's criteria to assess children's sexual maturation for this

study. But we did not succeed in testing all children without the permission of the Minister of Education of Portugal. Only 28 8th grades were tested.

During physical education class and physical examinations, each student was assessed in a private room by comparing his body (genital and pubic hair) or her body (genital and breast) to drawings of the Tanner stages (Appendix-13). The drawings depict five successive stages of genital development, breast and pubic hair growth. The first stage is pre-adolescence and the fifth stage is the mature adult according to Tanner's criteria (1962).

3.10 INTERVENTION

3.10.1 Physical education contents in experimental and control groups

According to the schedule of the school, students in all grades have physical education twice a week at school. Total class time per student is 135 minutes (one 90-minute class, one 45-minute class).

Design of Control Group

During the course of this study, students in control groups participating their traditional physical education classes as usual, according to the physical education plan as prescribed by the Portugal Ministry of Education (Appendix-14), and the physical education program guidelines (5th-9th grade) of the Real Middle School (2001/2002) (Appendix-15). Students receive a physical education grade depending on the level of their class participation and their physical fitness (more on skill-related).

Design of Experimental Group

Students in experimental groups were asked to participate in aerobic exercise twice a week during their physical education classes. Physical activity levels were monitored by the heart rate monitor, which was supervised by an experienced aerobic instructor. In the 90-minute class, each student had 30 to 45 minutes continuous moderate-to-vigorous aerobic exercise, which included warm-up (5 minutes), exercise (30-45 minutes), resistance training (10 minutes) and cool down (5 minutes); In the 45-minute class, each student had 20 to 30 minutes continuous moderate-to-vigorous aerobic exercise, which included

warm-up (3-5 minutes), main exercise (20 minutes), resistance training (5 minutes) and cool down (3-5 minutes).

The children in experimental groups were also given a health education intervention for about five minutes to motivate the children to adopt a healthier lifestyle during the 90-minute class. "Health Education (for students ages 11 to 16)", a handbook for teachers, was selected as the main reference book for instruction (Davies & Williams, 1994). Instructors relayed to students information about health, health-related physical fitness, aerobic exercise, and the importance of a healthy diet. They also introduced the students to information on how to test, evaluate and improve health-related physical fitness, and how to monitor and record daily activity. The behaviour reinforce methods were also been used in our intervention.

Since extracurricular physical activity programs are always very popular with students, we organized an aerobic school team; most girls (mainly the 7th and 9th grades) in the experimental groups took part in this school team and practiced for two hours per week. Because of the incentive of possible performances at the school and elsewhere, the girls became very enthusiastic about the team and also practiced their aerobic routines at home in their leisure time.

3.10.2 School physical education intervention on aerobic exercise model

The intervention was carried out according to the timetable of the intervention in school physical education (Appendix-16).

(1) We modified some sports or skill-related programs with health-related programs.
 ✧ Some sports or skill-related programs (such as high jumping, skill of relay race) were replaced by health-related programs (such as aerobic dance) to give the students more health-enhancing exercise programs.
 ✧ We retained some sports programs (such as football, basketball and badminton), but changed the organization so as to give the students more time to be physically active during the classes. We combined some basic skills of these sports into aerobic routines, teaching the motor skills in moving rather than in sedentary ways.

(2) We modified the rules of student evaluation for grades.

✧   We announced at the beginning that high grades would be given to children who are fit, and who make a substantial improvement in their health-related physical fitness.

✧   We also announced at the beginning that high grades will be given to those children who are more active during physical education classes and leisure physical activities.

(3)   We provided children more sports facilities, playgrounds and equipment (balls, mats, etc.) during physical education classes.

   ✧ We organized the facilities and playgrounds to allow more children to be continually active during class, instead of standing still and waiting for their turn on the field or gym floor and/ or waiting to use the balls and/or mats, and

   ✧ We modified some programs when the school did not have enough sports facilities and/or equipment (such as bars for pull up and dip).

(4) We motivated children to be more active during physical education by:

   ✧   Exercising aerobically at least 20-30 minutes twice a week during their physical education classes, as monitored by the HRM;

   ✧   Exercising continuously, moving from moderate-to-higher intensity levels;

   ✧   Performing health-related resistance exercises.

(5) We improved exercise intensity step-by-step during classes to:

   ✧   Encourage every one to participate in fun walking or jogging under the music in the classes;

   ✧   Increase children's exercise intensity, which needs music, step-by-step, by selecting different music (low, moderate, high speed) as monitored by the HRM;

   ✧   Increase children's exercise intensity, which does not need music, step-by-step, by increasing time in MVPA as monitored by HRM;

   ✧   Motivate some sedentary individuals and others with some illness or disease to be more active gradually.

3.10.3 Improve children's knowledge, skills, attitudes, and behaviors on active lifestyle

(1)   We improved children's knowledge about healthy and active lifestyle by providing the following information (see also Appendix-17):

✧   Health, health-related and skill-related physical fitness, diseases, and the benefits of physical activity, and health-enhancing physical activity;

✧   Overweight and obesity as a rapidly-growing world-wide problem, especially among young people;

✧   Physical inactivity as a risk factor for several chronic diseases;

✧   Regular physical activity improves cardiorespiratory endurance, flexibility, muscular strength and endurance; builds bone mass density, reduces depression and anxiety and improves mental health.

(2)   We improved children's skills and attitudes about health and active lifestyle by introducing and mastering the following information:

✧   Physical activity pyramid (Appendix-18);

✧   International physical activity recommendations;

✧   Methods of testing pulse to measure physical activity intensity;

✧   Method of measuring physical activity intensity by using a HRM;

✧   Method of estimating body composition by testing BMI and skinfolds (Appendix-19);

✧   Methods of testing health-related physical fitness by ages and gender (Appendix-19);

✧   The standards of FITNESSGRAM by ages and gender (Appendix-19);

✧   Different kinds of aerobic exercises (Appendix-17);

✧   Some exercise techniques, such as proper walking skill (how to breathe, how to control pace and intensity by heart rate), and skills for doing warm up, cool down, stretching, and resistance exercise (Appendix-17).

(3)   We motivated children to be active in leisure by suggesting the following (Appendix-18):

✧   More active in their structured physical education classes;

✧   Increase their lifestyle physical activity through some change in their daily routine, such as walking to school instead of going by car, using stairs instead of elevators or escalators;

✧   Use consistently accurate methods to monitor their leisure physical activity;

✧   Participate in leisure sports, such as swimming, tennis, stationary ergometers at home or in a sports club;

✧   Engage in vigorous physical activity three or more days per week for 20 minutes or more per occasion, and to engage in regular, preferably daily, moderate physical activity at least 30 minutes per occasion;

✧   Reduce the amount of time they watch television.

(4) We improved children's self-monitor their fitness and activity by following:

✧   Understand the details of each procedure of health-related physical fitness testing, to know how to evaluate their fitness;

✧   Self-monitor their daily activity with the use of logs, spreadsheets, and other tools to record their daily physical activity and begin to meet recommended physical fitness and activity levels;

✧   Generally monitor physical activity level themselves and keep it in the target zone.

(5) We reinforced children's behaviour changes related to the adoption and adherence of exercise and physical activity behaviour by following ways:

✧   To increase exercise self-efficacy (e.g., sharing testimonials from successful individuals under similar circumstances);

✧   To suggest that children establish realistic and attainable expectations and short- and long- term goals, using different forms of physical activities that are enjoyable and can be maintained for a lifetime;

✧   To analyze and remove typical barriers and resistance to exercise (lack of time, fear of injury or pain of muscle, bad weather, lack of space, lack of knowledge and skill, fear of extreme exertion, special situations (e.g. holiday, visitors, travelling, and fatigue);

✧   To promote contingency plans for situations likely to affect exercise compliance such as an injury;

✧   To encourage children to seek regular support by engaging others in one's exercise plans;

✧   To encourage children to deal positively and constructively with interruptions in habitual exercise routine known to have negative effects on the maintenance of behaviour;

✧   To teach children to build a personal rewards system that consistently acknowledges success and achievement of individual goals.

3.10.4 Improve children's knowledge, skills on healthy eating

(1) We improved children's knowledge on healthy eating and diet by including emphasis on:

✧   The importance of the six types of nutrients for healthy eating (carbohydrates, fats, protein, vitamins, minerals and water);

✧   The four components of healthy food intake (hydration, variety, balance, and moderation);

✧   The composition of sugar, simple sugars (cake, candy, table sugar, honey) and complex carbohydrate, (whole grain, fruits, vegetables, legumes), know the difference between refined and natural sugars, artificial sweeteners, and the recommended guidelines for sugar intake;

✧   The role of sugar in diet by introducing the functions of sugar, how sugar operates in our metabolism, our bodies (brain, muscle) and how it impacts energy supply during exercise;

✧   The functions of water in the body, how to determine hydration, how to increase fluid intake, how to add more fruits and vegetables and less fat food in their diets;

✧   The negative health consequences of fat diets, more especially high protein, low carbohydrate diets.

(2) We improved children's skills on healthy eating and diet by teaching them the following:

✧   How to read food labels to identify different types of fats and to find hidden fats in foods, in order to improve overall food intake quality;

✦   How to reduce more calorie intake and improve the overall quality of food intake by using a modified version of the USDA food guide pyramid (Appendix-18);

✦   How to plan ahead for holiday/seasonal parties in order to make them healthier, to assist the subjects in making healthy food choices when dining out and to avoid the overeating and fast-foods.

3.11 STATISTICAL ANALYSIS

Statistics analyses were completed using the Statistical Package for the Social Sciences (SPSS, version 11.0). Analyses were conducted with the data from all subjects who took participate in the FITNESSGRAM, Questionnaire, Heart Rate Monitoring and both experimental and control groups.

We used the Independent Samples T-Test to compare the difference between the experimental groups and control groups by different gender and age groups. We used the Independent Samples T test to compare the difference before and one-school-year after the aerobic exercise intervention. We also used the Pair-Sample T-Test to compare the same people's characteristics at different time (before and one-school-year after the aerobic exercise intervention). The T-test was used also to test the heart rate difference between different genders in different indoor physical education exercises. Correlation analysis was used to estimate the relationships between independent and dependent measures. Pearson correlation coefficients were also used. Statistical significance was set at $p < 0.05$.

Data collection
We collected all data, character of samples, the results of FITNESSGRAM and Questionnaire, sent them to computer analysis using SPSS10.0 software. We analyzed heart rate using Polar Precision Performance SW 3.0 software.

To calculate VO$_2$max
In FITNESSGRAM, aerobic capacity is predicted from a statistical (regression) equation that relates performance on or responses to the test to VO_2max. Conversion of field test

performances to VO$_2$max allows comparison of scores on the three field tests and permits changes in the relation of the test performance to VO$_2$max that occur with age. Details on the prediction equations used for the various aerobic capacity assessments are provided below:

The equation used to predict VO$_2$ max (ml×kg^{-1}×min^{-1}) from the one-mile run was based on work by Cureton et al. (1995). The equation was based on a sample of 753 males and females, 8-25 years of age and uses age (years), sex (coded 0=F and 1=M), BMI (kg×m^{-2}) and one mile run time (minutes) for the prediction (R = .72, SEE = 4.8 ml×kg^{-1}×min^{-1}).

VO$_2$max =0 .21 (Age× Sex) -0 .84 (BMI) - 8.41 (Time) +0 .34 (Time^2) + 108.94 (B=1, G=0)
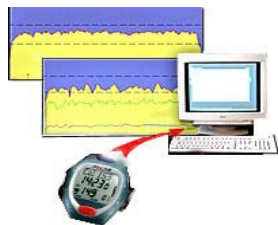
To calculate % Body Fat

To estimate the percentage of body fat, we used the formula by testing skinfolds of triceps and calf in children 8 to 17 year old (Slaughter, et al., 1988).

Body Fat = 0.735(SSKF) +1.0 (boy);

Body Fat = 0.610(SSKF) +5.1, (girl).

(SSKF = Sum of skinfolds (mm) = Triceps + Calf)

To download and analysis heart rate data

Children's heart rate data from HRM memory were transferred to PC through a POLAR infrared interface. The Polar Precision Performance 3.0 software was used to check and correct the errors in all HR files. EXCEL and SPSS11.0 had been used to calculate and analyze all the data.