

CHAPTER 5 DISCUSSION

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CHAPTER 5 DISCUSSION

5.1 CHILDREN'S HEALTH AND HEALTH-RELATED PHYSICAL FITNESS

World health in transition, non-communicable diseases (NCDs) are increasingly significant causes of disability and premature death in both developing and newly developed countries, adult and youth people, placing additional burdens on already overtaxed national health budgets (WHO, 2003b, p1). Obesity is a major risk factor for NCDs, such as coronary heart disease, diabetes, hypertension and certain types of cancer. Obesity in childhood is also associated with high prevalence of blood pressure, diabetes, respiratory diseases, orthopedic and psychosocial disorders. The most significant long-term consequence of childhood obesity is its persistence into adulthood, along with all the associated health risks (Luo & Hu, 2002).

Marked increases in the prevalence of overweight and obesity have been observed in recent decades in both adults and children worldwide (Luo & Hu, 2002). In the United States, 15.3% of children aged 6 to 11 years and 15.5% of adolescents aged 12 to 19 years were overweight in 1999-2000 (National Health and Nutrition Examination Survey). These figures have doubled for children and nearly tripled for adolescents in the past two decades. In Portugal, a recent large-scale study finds that while in 1998, 36.1% of the Portuguese children and adolescents (boys: 25.0% vs. girls: 45.7%) are overweight, data was 31.9% (boys: 23.9% vs. girls: 39.5%) in 2002 (Matos et al., 2003). Our study confirmed that 27.3% (boys: 29.8% vs. girls: 24.8%) of the 264 Portuguese middle children suffered from either overweight or obesity.

Though children and young adults have very low rates of CHD, cancer and stroke, which are leading causes of death, it is true that these diseases develop over time and quite often begin with habits and behaviours developed earlier in life (Gilliam, 1977; Malina, 2001). The major problems associated with child obesity are its persistence into adult life;

obese children will most likely become obese adults and carry all the extra risks for diseases such as heart attacks, strokes, high blood pressure and diabetes (Wright et al., 2001). A recent study strengthens reports of a link between childhood obesity and the increased risk of adult cardiovascular disease (Chu et al., 1998).

Physical inactivity besides unhealthy diet and smoking is a major cause of common noncommunicable diseases. The scientific evidence is clear—regular physical activity has powerful positive effects on both physical and psychological health. Conversely, physical inactivity has a high human cost in terms of health. It shortens years of life, decreases quality of life and limits functional independence. These health effects arise from physical inactivity’s contribution to obesity, cardiovascular disease, diabetes, osteoporosis, mental health disorders and some cancers (USDHHS, 1996).

Savage and Scott (1998) indicated that it was widely believed that the aerobic test performance of children and adolescents had declined over the last few decades. A recent meta-analysis compared the results of 55 reports of the performance of children and adolescents aged 6-19 years who used the 20m shuttle run test. All data (129,882 children and adolescents) were collected in the period 1981-2000. It confirmed children and adolescent’s aerobic fitness was declining (Tomkinson et al., 2003).

Table 5-01 Comparing FITNESSGRAM results between Portuguese and American children in 2001-2002.

	Portugal*	US**	Portugal*	US**	Portugal*	US**	Portugal*	US**
	10-15yrs	All	10-11yrs	5 th Grade	12-13yrs	7 th grade	14-15yrs	9 th grade
Number	264	1172329	104	439858	66	393728	94	338743
Aerobic Capacity	83.3%	54.5%	88.5%	55.7%	74.2%	57.4%	81.9%	47.5%
Body Composition	82.6%	66.5%	75.0%	65.4%	81.8%	66.3%	91.5%	64.7%
Abdominal Strength	76.5%	79.4%	73.1%	78.2%	74.3%	80.7%	81.9%	77.7%
Trunk Extension Strength	89.4%	83.9%	87.5%	84.0%	87.9%	86.4%	92.6%	79.7%
Upper Body Strength	29.8%	67.2%	29.8%	62.0%	21.2%	62.2%	33.0%	61.1%
Flexibility	57.2%	66.5%	53.9%	63.8%	48.5%	69.3%	67.0%	65.5%
All fitness standards	17.4%	22.9%	19.2%	21.3%	13.6%	24.9%	18.1%	22.6%

Source: * Wang and Pereira (2003); **California Department of Education (2001)

We did not do the longitudinal comparing in this study for the reason of some limitations of the Ph.D. study. We used the FITNRSSGRAM to determine children's health-related physical fitness level. we also compared our results with a comparative study in California (Table 5-1). Totally, we found that 17.4% of Portuguese children and 22.9 % of California children met all six minimum standards in FITNESSGRAM to be considered physically fit. The Portuguese children and the California children had almost similar results in 3 items (Trunk Extensive Strength, Abdominal Strength and Overall Flexibility). In Aerobic Capacity and Body Composition, Portuguese children did better than the California children. While in Upper Body Strength, Portuguese children did worse than the California children. We found that the result of FITNESSGRAM among the Portuguese children were skewed by the fact of the lower passing rate (28.8%) in upper body strength criterion, whereas the percentage that passed the other component criteria ranged from 52.1% to 90.9%. The result of upper body strength maybe because we only use the Push-Up test rather than use the more selections (such as Modified Pull-Up and Flexed-Arm Hang). But it is also true that many children could not do a single Push-up. These two recent studies confirmed that most students were not fit when compared to standards established by the Cooper Institute for the FITNESSGRAM, a measurement of fitness levels which is used nationally in the United States. There is still much work to do to ensure high levels of fitness for all students. The physical fitness test results also provided physical educators with considerable information to make program changes to promote physical activity and over-all fitness in the daily lives of their students.

5.2 CHILDREN'S PHYSICAL FITNESS AND PHYSICAL ACTIVITY LEVELS

Participating in regular physical activity can reduce the risk of diseases, enhanced health and reduced risk for all-cause mortality (Blair, 1995). Appropriate physical activity

during youth also has been shown to promote skeletal health, reduce body fatness, increase aspects of health-related fitness and enhance psychological well-being (Armstrong & Welsman, 1997).

Sallis and McKenzie (1993) studied the relationship between the children's habitual physical activity and components of health-related physical fitness in 528 healthy fourth-grade children. They found that the children's physical activity index was significantly associated (0.29, $r < 0.01$) with all five fitness components (the mile run, skin-fold tests, pull-ups, sit-ups and the sit-and-reach test). Huang and Malina (1996) studied the relationship between children's MVPA and their health-related physical fitness among the 282 Taiwanese children aged 12-14 years. They found that the children's estimated daily energy expenditure and energy expenditure in MVPA was significantly related to the one-mile run and sit and reach, but was not related to sit-ups and subcutaneous fatness.

Our study concentrates on children's moderate-to-vigorous physical activity (MVPA) and health-related physical fitness (HRPF). It confirmed that children participating in MVPA regularly could significantly improve their health-related physical fitness ($r_{all}=0.30$, $p < 0.001$; $r_{boy}=0.26$, $p < 0.05$; $r_{girl}=0.31$, $p < 0.05$), passed more health-related physical fitness items in FITNESSGRAM ($r_{boy}=0.26$, $p < 0.05$; $r_{girl}=0.31$, $p < 0.05$) and improved many health-related physical fitness items in FITNESSGRAM. We also found that children's MVPA levels were significant correlated with children's VO_2 max ($r_{boy}=0.30$, $p < 0.05$; $r_{girl}=0.41$, $p < 0.01$), upper body strength ($r_{boy}=0.31$, $p < 0.01$; $r_{girl}=0.29$, $p < 0.01$), boys' flexibility ($r_{boy} = 0.24$, $p < 0.01$), girls' abdominal strength ($r_{girl}=0.31$, $p < 0.01$) and trunk extensive strength ($r_{girl} = 0.18$, $p < 0.05$). But our results did not confirm the correlation between children's MVPA and their body composition (BMI and percentage of body fat).

Our study agreed with the results of Sallis and his colleagues (1993) and Huang and Malina (1996), which showed a low-to-moderate relationship between children's physical activity and their health-related physical fitness.

5.3 CHILDREN'S PHYSICAL ACTIVITY RECOMMENDATIONS

Current international recommendations for health-enhancing physical activity suggest that 30 minutes of moderate-intensity activities, which causes a person to be slightly out of breath, on most, or preferably all, days of the week, can have significant positive health effects and that the activities can be accumulated by shorter bouts each lasting for around 10 minutes (USDHHS, 1996; Corbin & Pangrazi, 2000).

Although, many people know the benefits of regular physical activity, it is estimated that world-wide over 60% of adults are simply not active enough to benefit their health. Among children and adolescents, physical activity declines significantly with age from adolescence on and girls are less active than boys (WHO, 2003).

In the United States and in European countries, adolescent habitual physical activity levels also are declining dramatically (UDSHHS, 1996; Freedson & Rowland, 1992). There are same worrisome trends among Portuguese children, a large-scale investigation among the Portuguese children and adolescents in grades 6, 8 and 10 (6903 subjects) found that 36.1% participated in physical activity four or more times a week in 1998. This activity level declined dramatically in all gender and age groups in 2002, when only 31.9% of the subjects (6131 subjects) of the same ages participated in physical activity four or more times a week (Matos, et al., 2003, p 470-472).

According to our study, among the sample of the 264 Portuguese middle school children, ages 10 to 15, including subjects' school physical education class activity twice a week, 55.6% of the children did not have enough MVPA; 19.2% (boys: 10.3% vs. girls: 27.6%) did not participate in any kinds of MVPA beyond school physical education (Wang & Pereira, 2003). 'How to improve our children's habitual physical activity?' is the fundamental question.

5.4 SCHOOL IN PROMOTING CHILDREN'S ACTIVITY FOR HEALTH

Schools can provide physical and social environments that have the potential to improve the health of young people by providing instruction, programs and services that promote enjoyable, lifelong physical activity (American Heart Association, 1995; Iverson et al, 1985; King, 1994; Owen & Lee, 1989; McGinnis et al., 1991).

Due to the fact that some chronic conditions and diseases are often the results of a lifestyle of inactive behaviours which begin as early as childhood and adolescence, adoption of a regular physically active lifestyle during youth may be vital to sustaining such behaviour in adulthood (Corbin & Pangrazi, 1998). Meanwhile, many young people already have risk factors for chronic diseases associated with adult morbidity and mortality (Nicklas et al., 1995), and the prevalence of overweight is at an all-time high among children and adolescents (Troiano et al., 1995). In our study, which showed 27.3% of the Portuguese children were either overweight or obese and a large-scale investigation indicated that more than 30% of Portuguese children were fat (Matos, et al, 2003).

Schools are an efficient vehicle for providing physical activity instruction and programs because they reach most children and adolescents (Kolbe, 1993; McGinnis et al., 1991; Kann et al., 1995). Schools might allow access to facilities before and after school hours and during vacation periods. Almost all school children are required to take some physical education. Children spent a large portion of their day in school. The primary opportunities for children to be active at school are physical education classes. Physical activity has a beneficial effect on the physical and mental health of young people (USDHHS, 1996). In addition, people begin to acquire and establish patterns of health-related behaviors during childhood and adolescence (Kelder et al., 1994). For all of these reasons, schools are the ideal venue to establish a comprehensive intervention to begin to education and train young people in health awareness and physical activities that become life-long healthy lifestyle habits.

The Youth Risk Behavior Survey in the United States in 1999 reported that 60% of high school females and 23% of high school males were attempting to lose weight. Students reported their most commonly used method when attempting to lose or control weight was exercise (51.5%), followed by dieting (30.4%). Integrating the teaching of nutrition and physical activity in school classes makes good sense and could be an important contributor to decreasing obesity and helping adolescents who are attempting to lose weight, but are using ineffective techniques. The importance of weight-related issues in school-age children was recently documented by Freedman, Dietz, Srinivasan, & Berenson (1999).

Data from the large population studies also indicate that activity levels peak at around 13 to 14 years, and then decline markedly (Riddoch & Boreham, 1995). According to our investigation on children's MVPA by self-reported questionnaire, we did not find that decline among the middle school children aged from 10 to 15. Malina (1990) indicated that this decline probably related to the social demands of adolescence, changing interests and transition from school to work or school to college. This decline is an important issue that merits further study. Riddoch & Boreham, (1995) indicated that since a drastic decline in habitual physical activity had been observed during adolescence, especially after the ages of 15 years, it was important to motivate children to be physical active during childhood and adolescence, which might continue into adulthood. The Coronary Prevention Group (1988) also suggested that childhood was an important time for the development of an active lifestyle.

There is also great concern about differences in physical activity between the genders. Some studies have reported not only the dramatic decline of leisure-time physical activity during adolescence but also those girls were not as active as boys (Mota & Esculcas, 2002; Sallis & Saelens, 2000). Our study also showed that boys were more active than girls ($r = -0.36, p < 0.001$) in participating in MVPA. It agreed with some previous studies (Mota & Esculcas, 2002; Sarkin, 1997; Sallis, 1993; Sallis et al., 2000) on children physical activity survey between different genders. Other studies also reported that boys even spent more time than girls in higher-intensity activities (Aaron et al., 1993; Faucette et al., 1995;

MacConnie et al., 1982; Shephard et al., 1980). Shephard et al. (1980) reported that boys spent 20 minutes more per day in vigorous physical activity than did girls.

Sallis and Saelens (2000) suggested that special interventions are needed to provide girls with adequate levels of physical activity. Though community programs and opportunities to be at home are part of a comprehensive approach (Sallis et al., 1992), a careful examination of school's role in promoting physical activity is needed, particularly in relation to girls' activity.

To add to these concerns, we notice that school physical education programs are declining dramatically. In United States, daily, high quality physical education is advocated for children and adolescent from kindergarten through secondary school graduation. But daily participation in physical education classes by U.S. high school students dropped from 42% in 1991 to 29% in 1999 (USDHHS, 2000b). Only 27 % of students in grades 9 through 12 engaged in moderate physical activity for at least 30 minutes on five or more of the previous seven days in 1999 (USDHHS; 2000a). In Portugal, before 2001, middle school children had 180 minutes physical education weekly, but now the school physical education program has been reduced to 135 minutes per week. In Portuguese primary schools, physical education classes are taught by classroom teachers, who are not "specialists" in physical education.

Some studies indicate that school physical education programs is not effective in promoting children's health and children in school physical education classes spend large amounts of class time being inactive (Metzler, 1989; Silverman, 1991; USDHHS, 1996). Reports also indicate that the amount of physical activity in physical education classes is often below the levels suggested in national health objectives (50% of class time) (Simons-Morton et al., 1993; Simons-Morton, et al. 1994; Simons-Morton et al., 1997).

Mckenzie, Marshall, Sallis & Conway (2000) indicated that even in American schools with daily physical education classes, students were not receiving adequate amounts of physical activity. This situation was likely to be worse in many other schools, where the physical education was not offered daily. The comprehensive survey in 25 European

countries revealed that no European country offers a daily period of physical education (Armstrong & Astrand, 1997).

Moderate-to-vigorous physical activity (MVPA) is known to provide multiple health benefits for young people (Sallis & Patrick, 1994; USDHHS, 1991). According to our study, we found that the 7th grade Portuguese students spent 49.8% (boys: 51.6% vs. girls: 48.0%) of actual class time in their 45-minute indoor class with their heart rates above 139 bpm. This result is close to a comparable study 10 years before, which showed 5th grade Portuguese boys and girls spent 60.2% and 46.5% of lesson time, respectively, with heart rates above 139 bpm (Mota, 1994). Our results are similar to a recent study in United States, which showed students in grades 3 through 12, spent 51% of physical education class time in their heart rate zones (Kulinna et al., 2003). Our study has better results than a recent study in Hong Kong that found that primary school children spent 32.4% of actual class time with children's heart rates above 139 bpm (Macfarlane & Kwong, 2003). Our study also shows that students spent 42.6% (boys: 44.5%; girls: 40.7%) of actual class time in their 90-minute class with their heart rates above 139 bpm.

Stratton (1996) reviewed levels of school physical education and concluded that the majority of school physical education lessons failed to provide sufficient MVPA and VPA. However it is difficult to directly compare studies due to inconsistent methodologies and analyses. We also noticed that many studies use actual class time to express the percentage of class time been spent in physically active. For example a recent study in Hong Kong showed that 35-minute class time was reduced to only 22 minutes of actual class time and children spent 32.4% of actual (or 19.7% of scheduled) time at recommended activity levels (Macfarlane & Kwong, 2003). We found that the percentages are higher when we use actual class time. But actual class time is changeable and incomparable; it does not count the real time spent in classes changing clothes and taking showers. If we use the scheduled class time, we found only 32.0% of (or 49.8% of actual) class time in 45-minute indoor classes and 31.0% of (42.6% of actual) class time in 90-minute indoor classes being spent at recommended activity levels. So we can see the intensity objective of 50%

class time is still far from being met in both 45-minute and 90-minute school physical education classes. Totally, during an uninterrupted week, on average, our study subjects spent 43.3 minutes (27.9 min in 90-minute classes and 14.4 min in 45-minute classes) at recommended activity levels. If the children were sedentary in their leisure time, the current international recommendations for health enhancing physical activity, which stresses on 30-60 minutes of moderate-intensity activities daily (Corbin & Pangrazi, 1998), would be clearly far from being achieved.

Heart rate above 159 bpm (or 75% MHRR) have been used as a threshold for vigorous physical activity and may stimulate an increased cardiorespiratory fitness (Stratton, 1996). We found that on average the subjects spent 23.4 minutes (15.7 minutes in 90-minute classes and 6.7 minutes in 45-minute classes) with their heart rates above 159 bpm, or 12.7 minutes (10.1 minutes in 90-minute classes and 2.6 minutes in 45-minute classes) with their heart rates $\geq 75\%$ MHRR, which were all far from the recommended amount (3 or more days per week for 20 or more minutes per occasion) (Sallis & Pattricket, 1994).

Researchers found that young people's physical activity's patterns were characterized by short, rather than sustained, bouts of activity (Armstrong et al., 1990). Recent recommendations on physical activity for children and adolescence did not include a component of sustained exercise (USDHHS, 2000a; Corbin, 1994; Sallis & Patrick, 1994). Simons-Morton et al. (1990) used the 10-minute criterion in a self-report study. Debusk et al. (1990) found 10-minute continuous bouts that accumulated 30 min were effective in improving aerobic capacity. Blair et al. (1992) also recommended 10-minute continuous bouts of exercise. In a study of daily physical activity of Singapore school children, 18% of boys and 6.3% of girls experienced daily 10-minute periods of continuous activity with their heart rates above 139 bpm (Gilbey & Gilbey, 1995). Armstrong et al. (1991) indicated that 36% of boys and 48% of girls, ages 11-16, did not experience a single 10-minute period with their heart rate above 139 bpm during three days of monitoring. Only 3.9% of boys and 0.6% of girls experienced 20-minute periods of continuous activity daily at an arbitrary criterion of 70% of the age-predicted maximum heart rate (70%MHR,

MHR=220-age). There are not too many studies on continuous bouts of physical activity in school physical education classes. According to our investigation, we found children in 90-minutes indoor classes had more chance to achieve the 10-minutes and 20-minutes continuous periods of physical activity with heart rates above 139 bpm than in their 45-minutes indoor classes. They even had opportunities to achieve 20- minutes continuous periods of physical activity with heart rates above 159 bpm. But still, 30 to 50% of the sample did not achieve even a 5-minute continuous periods of physical activity with heart rates above 139 bpm in both 90-minute and 45-minute indoor classes. In 45-minute indoor classes, children seldom had the chance to achieve a 20-minute continuous period of physical activity with heart rates above 139 bpm. Only 42.9% of the boys achieved a 10-minute continuous period of physical activity with heart rates above 139 bpm. A total of 35.7% (boys: 28.6% vs. girls: 42.9) of children had no chance to achieve a 5-minute continuous period of physical activity with heart rates above 139 bpm.

We also noticed the big time difference in children physical education classes with children's time spending in MVPA and VPA by the compositive reasons of playground, facilities, management, discipline, contents, instruction methods and etc. During the 90-min PE classes, the maximal time that children's heart rate above 139 bpm was 73.9 minutes, the minimal time was 4.5 minutes and the difference was 69.4 minutes. During the 45-min PE classes, the maximal time that children's heart rate above 139 bpm was 20.7 minutes, the minimal time was 7.8 minutes and the difference was 12.9 minutes. These results also indicated we could improve children's physical activity levels during physical education classes through the comprehensive management.

Macfarlane & Kwong, (2003) indicated that it was uncertain whether school physical education classes were designed to promote physical activity or specific motor skills, which might not place as much stress on the cardiovascular system. Our current study shows that children's physical activity levels (MVPA and VPA) are still far from recommended levels. To meet the international objectives to improve health, children need to engage in substantial amounts of physical activity both inside and outside school.

Physical education teachers need to maximize the class time spent in MVPA, VPA and continuous periods of MVPA and VPA. Students also need to be encouraged to participate in regular extracurricular physical activity.

Sallis & McKenzie (1991) indicated that school physical education had not historically been viewed as a public health program. Traditional physical education programs were heavily influenced by Swedish gymnastics and military drill, which were not popular with students. Moreover, studies indicated that students adopt very sedentary lifestyles immediately after leaving school (Ilmarinen & Rutenfranz, 1980).

At the turn of the last century, the physical fitness philosophy emphasized athletics and sports, which were referred to as the motor fitness philosophy (Pate, 1983). These programs also have a high dropout rate during adolescence and early adult life. Defections begin with students who fail to develop an appropriate body build for their chosen sport at adolescence (Shephard, et al. 1978). Recently, physical educators have shifted their emphasis to teaching health-enhancing physical activities, such as walking, cycling and swimming that are likely to improve immediate health and to carry over into adult life: (Shephard 1982, Bouchard & Shephard, 1994).

In 1987, the Cooper Institute for Aerobics Research developed the health-related fitness test battery, Prudential FITNESSGRAM, which places a primary emphasis on healthy physical activity levels. With a new emphasis on moderate-to-vigorous physical activity, some physical education programs have shifted from skill-related to health-related fitness activities theoretically, but the actual implementation of appropriate physical activities has been slow and/or inconsistent. The traditional form of exercising to improve athletics or sports skills has continued and physical education programs have not changed significantly (Pate, 1983). Although national health agencies and national organizations are promoting a greater emphasis upon health-related fitness, physical educators have not yet implemented the appropriate curriculum into their programs (Pate, 1983).

According to our investigation, we found the experimental school physical education programs still more contained more skill-related and sports-related programs (see

Appendix-14: PE-plan of teaching-learning organization by the Ministry of Education) and Appendix-15: the Guideline of PE in Middle School of Real)

Blair and Meredith (1994) reported that what usually occurs in physical education is an emphasis on sports skills rather than fitness promotion. It appears that physical education programs are not providing enough vigorous exercise to enhance children's cardiovascular endurance. Sports-focused physical education programs and interscholastic athletics are increasingly being questioned by health and physical education professionals (Malina, 1987).

The American Academy of Physical Education, the American Academy of Pediatrics Committees on Sports Medicine and School Health (1987), and the American College of Sports Medicine (1988) have recently issued strongly worded statements highlighting the need for school physical education programs that adopt health-related physical activity goals. In a society in which adult sedentary behavior contributes substantially to the epidemic of cardiovascular and other chronic diseases, there is a rationale for shift of orientation in physical education programs to a health focus. Moreover, school physical education is the only major institution that can address the health-related physical activity needs of virtually all children.

Health promotion professionals have recognized the important role that school physical education programs play in providing physical activity. Recommendations for increasing both the quantity and quality of school physical education are included in Health People 2000 (USDHHS, 1991) and Health People 2010 (USDHHS, 2000a). Health People 2010, recommends that physical education be provided daily and calls for an increase in the proportion of adolescents who spend at least 50% of school physical education class time being physically active (USDHHS, 2000a). Other experts also suggested that students need to spend more class time being physical active (Pate & Hohn, 1994; USDHHS, 2000b) and recommended that physical education programs should be taught by physical education specialists. Most important, studies stress that more physical education

programs should promote lifetime physical activity (Nader, 1999; Sallis et al., 1992; USDHHS, 2000a).

In recent years school-based physical education programs have placed greater emphasis upon health-related exercise or conceptual physical education, focused upon the knowledge, skill and attitudes required to promote health and well-being and to encourage active lifestyles (Harris, 1994).

There are many factors that could influence physical activity levels during physical education classes, McKenzie et al. (1993) reported that activity levels varied according to the content of physical education classes. Research also showed that intervention with teachers could increase the amount of time student spend performing physical activity in classes (Sallies, 1992). Programs such as SPARK (Sallis et al., 1997) also have shown that physical education taught by qualified teachers increases the amount of activity children experience and those educational interventions for classroom teachers can result in increased activity levels of students taught by trained teachers. In addition, studies show that by changing physical education class content (Sallis & McKenzie, 1991), school physical education programs could provide more MVPA and VPA through modifying the activity selection and instruction methods (McKenzie, 2001). Health-related physical education curricula could increase physical activity (Simons-Morton et al., 1988) and prevent risk factors of the cardiovascular diseases (Dwyer, 1983). Simons-Morton et al. (1991) provided evidence that quality programs could result in increased physical activity in physical education classes. Dale, Corbin, and Cuddihy (1998) have demonstrated that a conceptual physical education program focusing on lifestyle physical activity promotion can effectively reduce sedentary behaviors among adolescent years after program completion. Some evidence suggests that quality physical education programs can assist in the adoption of important lifestyle behaviors and are particularly important concerning weight control (Guo et al., 1994; Must et al., 1992). A sound physical education program, coupled with nutritional guidance, can help maintain caloric balance (Morrow et al., 1999).

McKenzie et al. (2000) found that 31% of 45-minute scheduled class time was spent in clothes changing etc. Only 69% of scheduled time ($M=34\text{min}$, $SD=5.1$) was used for actual physical education. According to our investigation by heart rate monitor in different indoor school physical education classes, we found that more than 30% of indoor class time was in clothes changing and showering (Wang, Pereira, Mota, in press). We also found that lesson contents, class size, playground size, facilities, discipline, and management all affected the quality of indoor classes. It seemed students engaged in more MVPA ($r=0.64$, $p<0.05$) in their favourite programs, such as football, than others, such as volleyball. In gymnastic classes, students were often instructed while standing or waiting in queues for practice because of lack of facilities. We found that students exercising on bigger playgrounds spent more time in MVPA ($r=0.55$, $p<0.05$) and VPA ($r=0.67$, $p<0.001$).

5.5 EFFECTS OF SCHOOL-BASED PHYSICAL ACTIVITY INTERVENTION

According to the review of school-based interventions on diseases treatment and risks prevention (details in Chapter 2), most intervention length ranged from nine weeks to six months, with session frequencies ranging from once a week to five times a week; treatment included modified physical education, outside school physical activity education, diet and nutrition education, modified lunch, parental involvement and behaviour modification. Overall, school-based treatments for obesity child and adolescent appear to be effective, especially when multi-component obesity treatment is used. Ewart, Young and Hagberg (1998) suggested that aerobic exercise in school physical education was a feasible and effective health promotion strategy for high-risk adolescent girls whose blood pressures were above the 67th percentile. School-based preventive intervention also showed the potential to prevent obesity in children and adolescents. Many studies included aerobic exercise intervention showed significant improvement in children's BP or LDL, HDL and TC, which may be beneficial in the long term in preventing atherosclerosis or

coronary artery disease in adulthood. Some studies found a significant improvement in children's VO_2 max levels, but others did not (details in Chapter 2). Mandigout et al. (2002) indicated that "it appeared only a program with continuous activity, organized on the basis of three sessions per week, with 25-35 minute at intensity higher than 80% of maximal heart rate at each session, enhanced VO_2 max in pre-pubertal boys and girls." One study showed that aerobic exercise could produce significant changes in girls' physical self-perceptions (Daley & Buchanan 1999); Daley and Buchanan (1999) suggested that aerobics might be one activity, which can help prevent girls from adopting a lifetime sedentary lifestyle. Aerobic exercise may also facilitate a rise in the physical activity rates for girls - a major aim for educators and researchers into the new millennium.

There were three main expectations included in our study before the intervention: (1) Can aerobic exercise can be included into our physical education programs? (2) Does aerobic exercise intervention improve children's knowledge, skill, and attitude about physical activity and health? (3) Does aerobic exercise intervention improve children's health-related physical fitness and physical activity levels?

Our aerobic exercise intervention in school physical education programs was a school-based intervention in co-educated physical education classes for one school year, with a session frequency of twice in a week for a total of 135 minutes per week. We tried to use multi-interventions by combining daily physical education, modified lunch, health education programs and parental involvement that are the more successful ways in school-based interventions (according to the review of literature). Actually, we found most ways could not be put into practice because of limitation of actual school environment. Comparing with others ways, school physical education can be reached more easily. Considering the merits of the Comprehensive School Health Program, we included some of its health education programs in our intervention.

Our study concentrates on children's health-enhancing physical activity and health-related physical fitness. That because health-related physical fitness, which includes cardiorespiratory endurance, body composition, muscular strength/endurance and flexibility, can prevent disease and/or improve health (Pate, 1983). The fitness component of health-related physical fitness that is the focus in the current study is cardiorespiratory endurance. In order for youth to achieve fitness in aerobic endurance, guidelines have been set forth to assist educators in planning the exercises and activities which must be designed to address four training variables: (a) frequency of activities, which should be at least 3 to 5 times per week; (b) frequency of activities, which should be 60% MHRR; (c) duration of continuous activity, which should be 20 to 60 minutes; and (d) mode of exercise or activity, which should use the large muscle groups and be maintained for the required amount of time and intensity (AAPERD, 1989; Ross & Gilbert, 1985). These are the main characters of our school-based aerobic exercises intervention.

We tried to provide children an extra physical education class who had school physical education classes twice in a week. But we were not successful in that because of low attendance. Nevertheless, we did succeed in organizing a school aerobic team, which gave performances in school and interscholastic events. Most girls in experimental groups (especially the older girls) took part in this team. These girls who had an extra 90 minutes of aerobic training weekly were also instructed to practice the aerobic routine regularly at home.

According to our experience, the aerobic exercise programs selection is very important. Some aerobic programs are popular with girls, but not popular with boys, such as aerobic dance. Some aerobic programs are popular with boys, but not with girls, such as football. In order to motivate the children to be physically active with fun, we also considered the gender differences in our co-educated physical education intervention, we adjusted the boys' aerobic programs by using the model "aerobic football" and "aerobic basketball" instead of "aerobic dance" when they did not like dance. We also found that some aerobic programs, such as long distance running, are not popular to all. So we tried to let children

have fun in running under the popular music. Our findings generally agreed with Daley and Buchanan (1999). Daley and Buchanan (1999) also indicated that most sports in school physical education programs are sports geared to boys; aerobics might be one activity which meets objective of helping girls avoid a lifetime sedentary lifestyle. Aerobics can also improve their physical self-perceptions and contribute to their being more active during and after school physical education classes. To improve children's activity levels during the classes, same-gender physical education might be the right choice in middle school.

Some aerobic programs, such as swimming, are popular to all, but we did not choose these programs because of the limited school sports facilities. Most Portuguese middle school only have a small playground, we found it is really hard to let children run around the small racetrack (200-meter) circle by circle for a long time. If government and schools can provide sufficient playground space and enough sports facilities in the future, aerobic exercise programs could be more effectively integrated into school physical education programs. Children can conduct their aerobic exercise in different forms at a bigger indoor gym with a mirror, outdoor playground spaces or even a swimming pool.

But integration of aerobic exercise into school-based physical education programs requires a comprehensive commitment to aerobic exercise concepts and practice. School physical educators need to be well-versed in the concepts of health, physical activity, nutrition, specific aerobic exercises and comprehensive aerobic teaching methods. This commitment to fully integrate aerobic exercise in physical education and to stress aerobic exercise as important as sports training can translate aerobics exercise from the level of short-term primary and secondary school physical classes to a commitment to life-long physical activity.

Before the intervention, we found most children did not know very well about health, health-related and skill-related physical fitness. They did not know very well how to exercise aerobically; they did not know if their body composition were belong to healthy,

overweight or obesity; they did not know very well how to organize their habitual physical activity. Our intervention included modified physical education, health education (including instruction in the knowledge, skills and attitudes about physical activity and nutrition) and some behavior modification in physical education classes (see Appendix-17:Health Education on Physical Activity, Nutrition And Health); We also provided the children with their results of FITNESSGRAM (see Appendix- 19: The Sample Sheet of FITNESSGRAM Test Result to Students), so the children could know their health-related physical fitness and target in future; We also provided children and their parents the useful knowledge about exercise and food (A- 18: Exercise and Food Pyramid Recommendations to Children and Parents).

We modified some programs in traditional school physical education (see Appendix-15: PE Intervention Schedule for The Experimental Groups and Appendix-21 Comparing the Two Different Model in School Physical Education Classes), improved some teaching methods, class discipline and supplied children with sufficient playground and facilities. These intervention and modification in school physical education were useful to improve children's knowledge, skill, and attitude about physical activity and health. These kinds of interventions and modification can be reached in most schools and cost not much.

According to the results of our aerobic exercise intervention in school physical education, we found that experimental group students, both boys and girls, improved their health-related physical fitness greatly as compared to the children in control groups (details in Chapter 4). More children in the experimental groups achieved a healthy level and/or passed more items in the health-related physical fitness test (aerobic exercise is especially effective for older girls in experimental groups).

VO2 max is an important health index. We found that but girls in the 12-13 and 14-15 age groups improved their VO2 max significantly as compared with their control groups, but all boys in experimental groups did not significantly improve their VO2 max. This improvement in VO2 max may come from the successful interventions both in physical

education classes and extracurricular aerobic programs. Some studies indicated that it is hard to train children to alter VO_2 max significantly before the age of 12 years (Mirwald et al.,1981; Kobayashi et al.,1978). Our study could not confirm that.

According to other results in FITNESSGRAM, we found boys in the experimental groups made some significant improvement compared to their pre-test results. For example, boys ages 14-15 in the experimental group made a significant improvement in the curl-up test, as compared to the control group. Girls made even more improvement. Not only did the girls in experimental groups make significant improvement in FITNESSGRAM compared to their results one school year ago; the girls ages 12-13 made a significant improvement in curl-up, skinfold and 1-mile run tests compared to control groups. In addition, girls ages 14-15 made significant improvement in curl-up, push-up and 1-mile run tests, as compared to those in control groups.

Although the scores in all components of the FITNESSGRAM did not improve totally because of the limitations of time (one school year) and conditions, our results at least prove that the aerobic exercise model can be successfully implemented in school physical education programs. Our aerobic exercise intervention results point to the potential for aerobic exercise to improve children's health-related physical fitness. The aerobic model may also be able to improve children's habitual physical activity.

In traditional school physical education, in order to teach motor skills, most teachers tend to emphasize sports skills. Students are often asked to stand or sit down and listen to their teacher carefully. Children's physical activity levels are lower during most of classes (see also the figure in Appendix 21). Children also been found have less chance to exercise aerobically during the traditional school physical education classes in our study (see also some figures in Appendix 20). Ilmarinen and Rutenfranz (1980) indicated that traditional physical education programs fail to develop a healthy attitude toward exercise and could be adopt to very sedentary lifestyles immediately after leaving school. In our intervention, we modified the program content by combining some motor skills (traditional, athletics-oriented) into the aerobics routine accompanied by attractive aerobic

music. We used HRM to monitor children's physical activity levels during the classes so as to keep their physical activity levels in target healthy zone as well. We found that the intervention did make the experimental groups more active and exercise aerobically during the classes. More important, we also improved children's knowledge, skills, attitudes and behavior on active lifestyle.

5.6 CHILDREN'S PHYSICAL ACTIVITY AND BEHAVIORS

Some experts suggest that current public health campaigns have focused largely on increasing exercise levels, but have paid little attention to reduction of sedentary behaviours, such as watching television. Some studies have found that the amount of time children and adolescents watch television is associated with increased obesity, less physical activity and lower physical fitness (Dietz & Gortmarker, 1993; Durant et al, 1996). But, there have been conflicting findings concerning the relationship among the time of TV viewing, leisure physical activity and body composition of children and adolescents (Dietz & Gortmarker, 1993; Robinson et al., 1993). Goran et al. (1998) reported a significant association between television watching and body composition and no relationship between physical activity and body composition.

Our study confirmed that many children spent their leisure time on watching television. We did not confirm the significant correlations among the time of television watching, physical activity levels, sum of skinfolds and BMI. Stouffer & Dorman (1999) posit that childhood obesity is a complex problem with a multifaceted etiology. It was not merely a simple question of physical activity levels or television viewing time, but could be also associated with excess caloric intake, high fat diet, genes, parental influences, psychosocial contributors and eating patterns. A current large population study in the United States provided strong evidence that sedentary behaviors, especially prolonged periods of watching television, are directly related to risks of obesity and diabetes (Hu et al., 2003).

Although the partial correlations among television viewing time, BMI and the sum of two skinfold thicknesses controlled by MVPA were low (ranging from +0.08 to +0.10), we did find that these girls who watch television more than 4 hours per school day have a higher BMI than the girls who watch television less than 2 hours per school day.

Physical activity is a behavior, whereas physical fitness is an attribute. Inadequate physical activity is a behaviour pattern that is typically established during youth, persists into a sedentary adulthood and contributes to poor health status (Nader, 1999). As we enter the 21st century, the importance and value of regular physical activity has been recognized as never before. Accompanying this recognition is the awareness that childhood is the time to begin the development of active and healthy lifestyles. But children do not automatically develop the skills, knowledge, attitudes and behaviors that lead to regular and enjoyable participation in physical activity. They must be taught. The responsibility for this instruction is vested primarily in school health and physical education programs. The habit of maintaining a healthy lifestyle, including regular exercise and a nutritious diet ideally begins in childhood. Promoting health and physical activity early for children can perhaps double the effect. As most children are enrolled in school and spend a large amount of their time in school, this venue can play a key role in encouraging physical activity and promoting health education among children and adolescents.

Meanwhile, governments and policy makers also can create a supportive environment for children. School, community and family could encourage children and adolescents to be active early; health care professionals and physical education teachers all can play a key role in encouraging sedentary children to adopt more active lifestyle.

Health promotion professionals have long recognized the important role physical education plays in encouraging physical activity. In order to combat the decline in physical activity during adolescence, health professionals are calling upon physical education to equip students with the skills and knowledge to maintain a physically active lifestyle. The U.S. National Center for Chronic Disease Prevention and Health Promotion

-NCCDPHP (1997) recommends that physical education implement "curricula and instruction that emphasize enjoyable participation in physical activity" and "help students develop the knowledge, attitudes, motor skills, behavioral skills and confidence needed to adopt and maintain physically active lifestyles" (p.205). Sallis and McKenzie (1991) share this view when they write "the public health goal for physical education is to prepare children for a lifetime of regular physical activity" (p. 133).

Recognizing the enormous potential physical education can have in the promotion of lifelong physical activity, several nationally acclaimed documents were recently developed to assist middle school physical education programs in meeting the needs of the early adolescent. These documents for the first time give physical education a platform on which to proclaim its goals and purposes. A report of the U. S. surgeon general (1996) has also contributed greatly to the promotion of quality physical education. This first-ever report documents the health benefits that derive from adopting a physically active lifestyle. In recognizing the importance of physical activity to the health of young adolescents, the report recommended that the amount of K-12 physical education be increased. Recommendations for increasing both the quantity and quality of school physical education are included in Health People 2010 (USDHHS, 2000a). Experts also suggest that students need to spend more class time being physical active (Pate & Hohn, 1994; CDC, 2000), physical education programs should be taught by physical education specialists and more physical education programs should promote lifetime physical activity (Nader et al., 1999; Sallis et al., 1992; USDHHS, 2000a). In recent years school physical education programs have put greater emphasis upon health-related exercise or conceptual physical education, focused upon the knowledge, skill and attitudes required to promote health and well-being and to encourage active lifestyles (Harris, 1994). Research has showed that interventions with teachers can increase the amount of time within physical education classes spent in physical activity (Silverman, 1991).