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EVALUATION OF THE CURRENT STATUS AND ASSESSMENT
OF PROGRAM EFFECTIVENESS WITH REGARD TO STUDENTS'
MOTOR PERFORMANCE AND ACADEMIC ACHIEVEMENT
IN THE NATIONAL SPORTS SCHOOL, MALAYSIA

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Saidon Amri

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EVALUATION OF THE CURRENT STATUS AND ASSESSMENT OF PROGRAM EFFECTIVENESS WITH REGARD TO STUDENTS' MOTOR PERFORMANCE AND ACADEMIC ACHIEVEMENT IN THE NATIONAL SPORTS SCHOOL, MALAYSIA

By

Saidon Amri

A DISSERTATION

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2001

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ABSTRACT

EVALUATION OF THE CURRENT STATUS AND ASSESSMENT OF PROGRAM EFFECTIVENESS WITH REGARD TO STUDENTS' MOTOR PERFORMANCE AND ACADEMIC ACHIEVEMENT IN THE NATIONAL SPORTS SCHOOL, MALAYSIA

By

Saidon Amri

The purposes of this study were to determine the current status of the sports component of a sports school in Malaysia, and to assess the effectiveness of the sports school program with regard to motor performance and academic achievement.

Using information submitted by the administrator and 37 coaches of the sports school, and from record and reports of the sports school, the current status of three main areas of the program; namely, the program content and policy, privilege and opportunities, and training and facilities, was compared to its original plan. Additionally, the level of adequacy for each program areas was determined. The program effectiveness was determined by comparing motor performance scores (flexed arm hang, jump and reach, thirty-yard dash, sit and reach, agility shuttle run, 800-meter run) and academic achievement attained over one school year between students of the sports school and ordinary schools. One hundred sixty boys and 66 girls in the sports school from three age groups; 13-year-olds, 14-year-olds and the 16- year-olds, and a similar number of students from two ordinary schools participated in the study. In addition other variables (stature, body mass, sitting height, skinfolds-boys only, arm and calf circumferences, sexual maturity status-boys only, arm and calf musculatures-boys only, family income, body mass index, place of residence) were measured or constructed to control for pre-existing differences among the subjects in the statistical analyses.

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The extent to which the current status of the sports school program met its original plan varied according to the areas being evaluated. Among the three program areas assessed, privileges and opportunities provided to teacher-coaches and students had the least conformity with the original plan. The overall adequacy of the program was rated as moderately adequate. The most adequate area of the program is training and facilities, followed by program content and policy, while the privileges and opportunities area is the least adequate.

There were significant effects of the sports school program on motor performance for boys and girls for all age groups. However, the motor performance tasks affected were not consistent across age groups. The sports school boys had better performance than their counterparts in the ordinary schools on the FAH, SR, ASR, and ER for the 13-year-olds; on the TYD, SLJ, ASR, and ER for the 14-year-olds; and, on the FAH, TYD, and ER for the 16-year-olds. For girls, the sports school students had better performance than their counterparts in the ordinary schools on the FAH, ASR, and ER for the 13-year-olds; on the FAH, SLJ, ASR, and ER for the 14-year-olds; and, on the JR, SLJ, and ER for the 16-year-olds. Among the sports school students themselves, the effect of the program varied among the boys only. The boys in the oldest group had better performance in the FAH and TYD than the two younger groups.

Overall, there was no significant effect of the sports school program on academic achievement. However, for specific age groups, the sports school program had negative effect on academic achievement among the 14-year-olds. The sports school students in this age group had poorer academic achievement than their counterparts in the ordinary schools.

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I am indebted to University Putra Malaysia which provided the funding for my graduate studies and for the data collection of this research. Sincere appreciation to the principals, coaches, and physical educators of the schools involved for giving all the assistance and cooperation in data collection. Thanks are also due to Mr. Sam Shor Nahar Yaakob, lecturer at University Putra Malaysia for providing me a place to stay and helped me in various ways during my data collection.

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CHAPTER 1

INTRODUCTION

Youth sports have continued to flourish during the past decade. Today, youth have more opportunities to play a greater variety of sports and to get involved in more highly competitive sport programs than youth in prior decades. The most common motives for taking part in sports are intrinsic values like enjoyment and social reasons, and for investment values of success and prestige (DeKnop, Engstrom, & Skirstad, 1996; De Knop, Skirstad, Engstrom, Theeboom, & Wittcock, 1996). In the United States, development in the social and cultural milieu of the society provided the most direct influence on the rise and growth of competitive sports program (Berryman, 1996). The rise of sports itself in all parts of the country and the subsequent desire to participate and spectate by large numbers of the population were the most influential factors to the rise and growth of competitive sport programs. In contrast, in many nations, especially the developing ones, sport in general and competitive sport in particular are highly regarded as means for building national image and assisting national integration (Ren, 1996). As a result, development of sport has been accelerated with greater focus on youth sport activities.

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In the United States, the greater focus on youth sport has led to a growing trend for sport specialization at high school levels (Hill, 1991). The primary reasons cited for this increase are encouragement from coaches and parents, and the athletes' desire to win a state championship and receive a collegiate scholarship. In some countries, special institutions have been set up to groom young athletes to be future champions. In Poland, sports schools were established for the athletically gifted children with the idea of developing the sports careers of students while also developing their complete personality (Sulisz, 1996). The sport schools were organized at two different levels and known as sport schools and sports championship schools. Conceptually, the sports championship schools had fewer sports departments and had a lower student-department ratio than the sports schools because of their heavy emphasis on individual teaching. In Israel, youth aged 11 to 16, gifted in gymnastics, swimming, tennis, and table tennis are invited to attend a boarding school at Wingate Institute and are provided with the most advanced conditions available in the country (Simri, Tenenbaum, & Bar-Eli, 1996). China has it's "competitive sports schools" which are secondary educational institutions oriented toward professional sports (Ren, 1996). The students of these schools are provided with the best sport training facilities, and receive instruction from high-quality coaches.

In Malaysia, the rise of youth sports can be primarily attributed to the establishment of the National Sports Policy in 1988. Since the inception of this policy, various programs are being implemented to promote youth participation in sports, as well as to identify athletes who can be groomed for international competition. Moreover, sport is recognized as one of the important factors for the development of the country. It is being u

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being used as a means to foster national unity and to create a healthy and productive society. Like many other developing countries, sport is also being used to project the country's image internationally.

In coping with the need for international achievement in sport, various strategies are being adopted to produce world class athletes. One of the strategies is to nurture and promote excellence of youth in sport through identification and subsequent training of young athletes with potential for success in national and international competition. These selected athletes are trained in special sports schools where they are provided with training opportunities and facilities so they can be a sport champion of the future.

The first sports school in Malaysia was set up in 1996. The goal of the school program is to provide potential young athletes between the ages of 12 to 17 years with systematic and scientific training without neglecting their studies. Young athletes are selected into the sports school based on their performance in age group competition, on recommendation from national sports bodies and State Sports Councils, and through talent scouting by the school's coach.

Parallel to its objective, the program of the school has two main components, sports and academic. The sports component was designed to develop the sport potential of these young school athletes to form a pool from which potential international champions can emerge. For such purpose, the students are to receive an in-depth instruction from highly qualified coaches, practice with adequate quality equipment, and have many competitive opportunities. Adequate funding is also to be made available for the program to run smoothly and to achieve the desired outcome.

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The program of the sports school also places a strong emphasis on academic achievement. In the academic pact of the program, students of the sports school are provided with qualified teachers, financial aids, and academic tuition in subjects where they find difficulties. Their academic lessons follow a flexible schedule to accommodate time for training and sports competition. These measures are taken so that the students of the schools have the required academic qualifications for university education. Additionally, a Memorandum of Understanding was signed by the Ministry of Youth and Sports with University Putra Malaysia, to allow athletes with minimum required academic qualifications to be given a place at the university. With such assurance, parents are encouraged to allow their students to be enrolled at the sports school.

It is apparent that students selected into the sports school are different from their peers in that they are successful in sport. Moreover, they are also provided with regular physical training and are more actively involved in sports activities than those in the ordinary school. Regular physical training is known to speed up the rate of development of physical performance in adolescents (Meszaros, Mohacsi, Frekl, Szabo, & Szmodis, 1985). Athletes aged 13 were found to have similar performance in the 30-meter dash, standing long jump, fistball throw, and better performance in 1200-meter run than non-athletes 15 years of age. Increase in physical performance, in turn, can be consistent with success in many sport activities, particularly when children are grouped according to chronological age. For example, competitive-level performance may require that high forces be generated rapidly in order to achieve sufficiently high velocity in movements such as throwing, jumping, kicking, or sprinting (Thorland, Johnson, Tharp, & Housh, 1988).

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Training can also cause significant changes in strength, aerobic, and anaerobic performance in adolescents. Both children and adolescents can increase muscular strength as a consequence of strength training (Micheli, 1988; Guy & Micheli, 2001). Maximal aerobic power of adolescents can be significantly increased in response to a vigorous, intensive training program (Krahenbuhl, Skinner & Kohrt, 1985). Trained young wrestlers were found to have higher anaerobic performance than non-athletes with similar pubertal development (Sady, Thomson, Berg & Savage, 1984).

Physical training, however, is not the only factor that has an effect on the physical or athletic performance of adolescents. Generally, at these ages, motor performance capacity will continue to increase even if they do not participate in physical activity because of the influence of growth and maturation processes. Although human beings generally follow similar growth patterns, some variations occur between individuals of the same chronological age (Tanner, 1962; Shephard, 1982; Malina, 1988a). Many of these variations are due to timing of the pubertal growth spurt and maturity status. Youngsters advanced in maturity status are generally taller and heavier than their peers. They also differ in physique, body composition, and physical performance compared to those delayed in maturity (Malina, 1996). These differences are especially marked during the circumpubertal years, 9 to 14 in girls, and 11 to 16 in boys.

Size, build, body composition and motor performance vary considerably with the maturity status, suggesting an interrelationship between growth, maturation, and performance (Malina, 1975; Ellis, Carron, & Bailey, 1975). Given the association between the anthropometric characteristics and strength and motor performance, any consideration of the relationship between maturity status and performance must include the inter

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the interrelationships among size, physique, composition, and maturity status (Malina & Bouchard, 1991). Boys who are maturationally advanced generally are stronger and perform better on motor tasks requiring speed and power than boys delayed in maturity status (Malina, 1996). On the other hand, the motor performance of adolescent girls is poorly related to maturity status (Malina, 1996). Although the early maturing girls are stronger at early puberty, it is often the later-maturing girls who attain better performance in later adolescence.

Maturity associated variation in size and body composition is a significant factor in comparing motor performance among adolescents, especially between young athletes and non-athletes. Young athletes are a highly selected group, ordinarily based on their skill and physical performance, but sometimes size and physique may also be the criteria (Malina, Meleski, & Shoup, 1982; Malina, 1988a; Malina & Bouchard, 1991). Male athletes tend to be advanced maturationally compared to non-athletes especially in sports or positions where size is important (Osterback & Viitasalo, 1985; Malina, 1996). Female athletes, in general, are late maturing especially in ballet, figure skating, and gymnastics (Malina et al., 1982; Malina, 1998). Except for gymnasts, figure skaters, and ballet dancers, athletes of both sexes in other sports are equal to or exceed the reference median in stature (Malina, 1994a).

It should also be noted that growth and maturation cannot be treated in isolation from the cultural and social conditions into which an individual is born and under which he or she is reared (Malina & Bouchard, 1991). Biological factors are most likely to interact with cultural and social factors in determining level of performance and, in turn, influence the opportunities and experiences of individuals in sport (Malina, 1996). Social

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conditions such as socioeconomic and nutritional status are significant factors that can affect growth, maturation, and performance. Children in high and middle socioeconomic groups in nearly all countries are, on average, larger in body size than their peers in the lower socioeconomic group (Eveleth & Tanner, 1990). Reduction in body size and wasting of muscle mass are the main contributors to low motor performance and low physical fitness in undernourished children (Malina & Buschang, 1985).

The interrelationships between growth, maturation, performance and other environmental factors warranted several methodological considerations when studying the effect of a program on young athletes. This has to do with the fact that physical training may induce changes in the same direction and approximately the same magnitude as expected growth changes (Bailey, Malina, & Mirwald, 1988; Bar-O, 1989). To correctly evaluate training-induced changes during growth, one must therefore include a carefully selected control group. Matching the groups by chronological age alone may not be adequate. One must consider also the biologic age and spontaneous development of the subjects such as body height and body mass (Bar-Or, 1989; Meszaros et al., 1985). Additionally, other related factors such as socioeconomic and nutritional status should also be considered.

Need for the Study

The first sports school in Malaysia was set up to provide young Malaysian athletes the opportunity to train under a systematic and scientific training program without neglecting their studies. With the facilities and privileges provided, they are expected to achieve strong academic achievement and greatly improve their motor performance. However, since its establishment in 1996, the effect of the school program on motor performance and academic achievement has never been fully evaluated. The degree of implementation, as compared to what has been planned, has yet to be determined. The morphological, motor performance, and academic achievement characteristics of students enrolled in the sports school should be determined, and the influence of the school program on academic achievement and motor performance should be investigated.

Little is known about the interrelationships among growth, maturation, and motor performance of students enrolled in this school. The selection of the students is based mainly on their success in age group competitions. On the other hand, successful young athletes usually are superior in size and performance as a result of more advanced maturity status than their peers. It is also noted that, besides training, the motor performance of adolescents is also influenced by other factors such as socioeconomic status, nutritional status, and more importantly, their growth and maturity status. Therefore, evaluation of the effectiveness of the training program on the motor performance of these young athletes has to take these various factors into consideration. Similarly, the academic achievement of the sports school students should be assessed with consideration of other influencing factors.

Purpose of the Study

The purposes of this study are: 1) to determine the current status of the sports component of the sports school, and 2) to assess the effectiveness of the sports school program with regard to motor performance and academic achievement. The current status of the sports program is determined by comparing the present status to its original plan. The program effectiveness is determined by comparing the motor performance and academic achieve

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Research Questions

On the basis of the purposes of this study, the investigation will seek answers to the following questions:

1. To what extent does the current status of the sports school meet the original plan of the program?
2. Are there differences in motor performance between students enrolled in the sports school and in the ordinary schools?
3. Is there an effect of the sports school program on the motor performance of secondary school students in Malaysia?
4. Which motor performance tasks, if any, distinguished between students enrolled in the sports school and those attending ordinary schools?
5. Does the effect of the sports school program on motor performance vary by age group among students of the sports school?
6. Are there differences in academic achievement between students enrolled in the sports school and the ordinary schools?
7. Is there an effect of the sports school program on the academic achievement of secondary school students in Malaysia?

Significance of the Study

This study examines the current status and the effectiveness of the sports school program. It will provide a profile of the present status of the program, its strength and weaknesses, a

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weaknesses, and its effectiveness in enhancing students' motor performance and academic achievement. Being the first sports school in Malaysia, it is essential for implementers to know whether the program is properly implemented, to what extent the outcome is successfully met, and problems associated with the implementation process. Only with such information can relevant changes, if necessary, be made. Being the first school of its kind, information about the strengths and weaknesses of the program could be used in setting up similar schools in the country.

Findings of the study will also improve the knowledge for training young athletes and provide guidelines for talent identification and predisposition for future success. Relationships between the physical performance and physical characteristics of young Malaysian athletes will be more clearly understood. This information can be used as guidelines for more accurate selection, training and prediction for future success. The effects of training on athletes of different age groups will reflect training response behavior among adolescents in Malaysia. In addition, motor performance of the sports school athletes can be used as a reference by coaches throughout the country to evaluate the effectiveness of their youth training programs.

Limitations of the Study

The results of the study of this investigation are subject to the following limitations:

1. Students of the ordinary schools are selected from two urban schools only. Although all ordinary schools in Malaysia follow similar guidelines in their physical education curriculum and sports program, the degree of implementation may vary from school

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to school. Generalizations may therefore be limited to students with similar school characteristics only.

2. Maturity status for boys is determined through self-assessment of sexual maturity based on figure drawings depicting Tanner's five stages of pubic hair development (Tanner, 1962). Biological maturation is most accurately assessed by measuring skeletal age, however, with limited resources (i.e. physician, funds), this is not possible. It should be noted that this method of maturity assessment has its limitations, namely superimposing a discrete series of stages onto a continuous process and being limited to the pubertal years only.
3. Reliability coefficient for subjects' rating on this maturity indicator will only be calculated for students of the sports school by comparing them to a physician's assessment. It is assumed that students of the ordinary school also have similar ability in rating their stage of sexual maturity.
4. Motivation of subjects is difficult to control when testing for motor performance, although all subjects are urged to perform with maximum effort on all of the tests.
5. Index of SES can be accurately derived from occupational prestige rating, years of education, and income. However, this study only uses household monthly income as the indicator for SES due to the unavailability of occupational prestige rating and lack of reference to rate years of education based on Malaysian population. Based on numerous studies describing socioeconomic status in Malaysia, it is assumed that those with high income also have high occupational prestige rating and longer years of education.

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Definition of terms

Ordinary school - school where students' enrollment is not based on sports performance (i.e success in age group sports competition, talent identification).

Urban school - school located in urban area as defined and listed by the Department of Statistics, Malaysia.

Growth - an increase in the size of the body as a whole or the size attained by specific parts of the body (Malina & Bouchard, 1991)

Maturation - the tempo and timing of progress toward the mature biological state (Malina & Bouchard, 1991).

Adolescent - encompasses all individuals between 10 to 19 years of age (World Health Organization, 1995).

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CHAPTER 2

REVIEW OF LITERATURE

This chapter is divided into three main parts. The first part contains a general background of Malaysia, the development of sports, and the origin and characteristics of the National Sports School. The second part presents a review of literature related to growth, maturation, and performance of adolescents. This includes interrelationships between growth, maturation, and performance and factors influencing them. Finally, characteristics of young athletes with regard to growth, maturation, and performance are presented.

Malaysia: geographical and sociocultural background

Malaysia is located in the heart of South East Asia. Consisting of 127,316 sq. miles (329,749 sq. km), Malaysia is divided into two main regions: Peninsular Malaysia, which lies just south of Thailand, and East Malaysia, which can be found north of Indonesia on the Island of Borneo. These two regions are divided into thirteen states, eleven in Peninsular Malaysia and two states in East Malaysia.

Malaysia has a multiracial and multicultural population consisting of Malays, Chinese, Indians and numerous indigenous peoples. It's total population is about 21.41

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million people (WHO, 1999). On the basis of ethnic classification used in the 1991 census, 61.7 percent of Malaysian citizens are Bumiputera (son of the soil-comprised of the Malays and numerous indigenous groups), while Chinese and Indians make up 27.3 and 7.7 percent, respectively (Malaysia, 1996). About 4 percent of the total population are non-citizens. The Malays are all Muslim, the Chinese mostly Buddhist and the Indians mostly Hindu. Sabah and Sarawak in East Malaysia are home to many indigenous groups such as Dusun, Kadazan, Bajau, Iban, and Bidayuh.

Socioeconomic divisions have often been along ethnic lines, which in turn related to rural-urban differentials in ethnic divisions. The urban populations who are predominantly Chinese have better socioeconomic conditions than rural populations which are largely comprised of Malays and Indians. Historically, these divisions are deeply rooted in the economic structure that was built during the colonial occupation. The majority of the Chinese and Indian immigrants were brought in to work as laborers in the tin and rubber estates. Along with the laborers, Chinese businessman also came, hence there is a thriving Chinese business sector. The Malays remained largely in peasantry sector while a very small upper class forms the administrative elite.

Over the years, Malaysia has experienced both rapid economic growth and profound social and demographic changes. The New Economic Policy (NEP) which was introduced in 1971 has substantially reduced economic imbalance between ethnic groups (Ghosh, 1998). With a Gross National Product of RM 6,716 per head in 1991, it is now classified as an upper middle income country by the World Bank. Due to the rapid transformation of the economic and social structure, Malaysia is now one of the newly industrializing countries and hopes to attain the status of a fully developed nation by the year 2020. Mala

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Malaysian Education System

The organization and management of education is the responsibility of the Ministry of Education which consists of Professional and Administrative Departments, Divisions, State Education Departments, and Statutory Bodies. This centralized system of educational administration is organized at four hierarchical levels; namely, national, state, district and school. The Ministry of Education is headed by a Minister who is assisted by two deputy ministers. Directly responsible to the Minister is the Secretary-General of Education who is concerned with professional matters.

Decision making at the Ministry is through a system of committees which facilitates interdepartmental and interdivisional cooperation and cohesion. The Educational Planning Committee, chaired by the Minister, is the highest decision making body at the federal level. The implementation of policies and plans at the school level is via the State Education Department and the District Education Office.

The national education system encompasses education beginning from pre-school to higher education. Children generally begin their education at the pre-school level, between four and five years of age. The aim of pre-school education is to provide a firm foundation for formal education. Pre-schools are run by government agencies, non-governmental agencies as well as private institutions. However, all pre-schools have to abide by the curriculum guidelines set by the Ministry of Education.

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Primary school begins at six years of age, and may be completed within five to seven years. At this level, the emphasis is on acquiring strong reading and writing skills as well as building a solid foundation in mathematics and the basic sciences. Two assessment examinations at years three and six are used to evaluate the performance of students.

Secondary school covers a period of five to seven years, three years at the lower secondary level and two to four years at the upper secondary level. Following the Lower Secondary Assessment examination (PMR) at year three, students move into more specialized fields of study at the upper secondary level, based on choice and aptitude, and are re-evaluated at year five via the Malaysian Certificate of Education (SPM) assessment examination. At the upper secondary level, several technical and vocational schools have been set up to provide technically-based academic education and pre-employment skills. Some secondary schools offer the Malaysian Higher School Certificate (STPM) program which qualifies students for entry into the national universities, colleges, and teacher training institutions.

A post-secondary level includes matriculation, certificate, and diploma programs. The matriculation program is an alternative to STPM program which qualifies students for entry to undergraduate programs at the national universities. The certificate program is a one to two year vocational training program offered by polytechnics and colleges. These institutions also offer a two to four year diploma program for vocation training and preparation for further studies.

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Factors influencing academic achievement of Malaysian students

A consistent finding in several studies regarding factors influencing academic achievement of Malaysian students is the negative effect of low socioeconomic status (Razikin, 1986; Zainal, 1989; Educational Planning & Research Division, 1989; Letchumanan, 1995). Students from low socioeconomic status, either rural or urban, had lower academic achievement than did students from higher status. The strong influence of socioeconomic advantage on academic achievement status was due to its influence on mediating variables such as parents' support, home environment, and students' academic aspirations (Zainal, 1989). Students from low economic status had less parental support, a less conducive learning environment, and lower academic aspiration, which in turn resulted in lower academic achievement.

Various other factors have also been identified to influence Malaysian school students' academic achievement. Among the factors are: type of school, teacher's experience, students' prior achievement, student self-motivation, and supportive family relationships (Razikin, 1986). Average teaching experience was found to be associated in a curvilinear fashion with academic achievement, implying that the optimal level of teacher efficiency occurred in the early years of the teaching career. Prior achievement, self -motivation, and supportive family relationships were positively and significantly associated with achievement.

School characteristics such as location of the schools and availability of resources were also found to influence Malaysian students' academic achievement (Sarjit, 1989; Educational Planning & Research Division, 1994; Letchumanan, 1995). Rural students tended to complete fewer years of schooling and had lower achievement in public examin

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Sports in Malaysia

The government of Malaysia has recognized sports as one of the important factors for the development of the country. This recognition was comprehensively manifested in the National Sports Policy, which was amended by the ministers' cabinet in 1988 (Ministry of Youth and Sport, 1988). This policy provides guidelines for the development of sports through the "Sports For All" and "Towards Sports Excellence" concepts. Strategies and plans of action were outlined for the purpose of improving achievement in high performance sports and providing scope for mass participation in physical activities. Through the implementation of these concepts, it is the aim of the government to promote a healthy, integrated and productive society, and at the same time be capable of producing distinguished athletes to project the country's image internationally.

History of sports in Malaysia can be traced back as early as the 15th century. Sepak Takraw, which was originally known as "Sepak Raga" was recorded as being played in Melaka in 1477 (Adam, 1991). Raga was the rattan ball used in the game which involved the players standing in a circle keeping the ball in the air with not just the feet but various parts of the body except the hands. The arrival of the Europeans beginning with the Portuguese in 1511, followed by the Dutch and the British, and the

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migration of the Chinese and Indians in the early 20th century, brought new sports to the country. The Europeans brought with them sports such as soccer, cricket, and badminton while the Chinese and Indian immigrants came in with their table tennis, basketball, hockey, etc.

The founding of Perak Club in 1881 and the Royal Selangor Club in 1884 by the British signified the beginning of organized sports activity in Malaysia, especially tennis and cricket. However, it was limited to Europeans. Only after the first World War, individuals other than Europeans began to pay more attention to various types of sports such as hockey, soccer, volleyball, rugby, and badminton. Nevertheless, because of the sports' origin, ethnic links with particular sport were apparent during the early phases of sports development in Malaysia (Salman, 1997). Basketball, badminton, and table tennis are often associated with the Chinese, hockey and cricket with the Indians, while Malays tend to play soccer and sepak takraw. These affinities however have decreased as sports associations have become multi-ethnic.

After World War II, sports in Malaysia (Malaya at that time) became more organized and Malaysia began to participate at international events. Although at that time Malaya was not yet independent, the British government in Malaya allowed four weightlifters to participate for the first time in the 1950 British Empire Games (now known as the Commonwealth Games), and won two gold medals, one silver, and one bronze in the games. The same year Malaysia also won the Thomas Cup for badminton. During this time, the Federation of Malaya Olympic Council and many national sports associations were formed in preparation for the 1956 Olympics: Malaya Hockey Federation (1948); Malaya Swimming Association (1956); Malaya Weightlifting

Association (1956); and, Malaya Women Hockey Association (1956). Since then the Olympic Council of Malaysia, as it is known since 1964, has been participating in all the Olympic Games, except the 1980 Moscow Olympic Games.

The development and success of Malaysian sport led to the establishment of the Ministry of Youth and Sport in 1964 and the National Sports Council in 1972. However, despite the establishment of these two government bodies, Malaysia's international sports achievement saw a decline in 1980's. Thus, a complete restructuring of the sports system was needed, and in 1986, the First national Sports Convention was held in Kuala Lumpur to discuss the agenda of formulating the National Sports Policy. Consequently, the National Sport Policy was formulated in 1988.

Thereafter, the development of sport in Malaysia has been guided by the National Sport Policy. This comprehensive document introduced a two-concept approach, "Sports For All" and "Towards Sports Excellence" to revitalize sports development in the country. The two sport related government agencies, the Ministry of Youth and Sports and the National Sports Council are held responsible to carry out these duties. The Sport Division of the ministry is to encourage sports activities for the mass population, while the National Sports Council has responsibility for competitive and high performance sports.

Physical education and school sports

Sport has long been considered one of the important components in the centralized Malaysian education system. This is reflected in the country's educational philosophy, which places a great deal of emphasis on sport activities as means to produce a well-balanced individual and to achieve national integration (Ministry of

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Education, 1989). In the effort to accomplish this philosophy, physical education and sports are regarded as an integral part of education and the curriculum in the school system. The sports program is to provide the students with educational experiences not otherwise provided in the curriculum that will develop learning outcomes in knowledge, skills, and emotional patterns that will contribute to the development of a better person. Physical education is compulsory for all primary and secondary school students and usually lasts about 11 years. Sports, especially ball games (soccer, volleyball, basketball, netball, etc.), hockey, and track and field are the essential components of the physical education curriculum. It is through physical education classes that many children first come in contact with sports.

Besides the National Education Philosophy, the National Sports Policy also provides for the role of education and school sports in Malaysian sport. This policy developed by the Ministry of Youth and Sports, Malaysia (1988) encompasses both mass and high performance sports. It has been formulated on the rationale that sports activities form an integral part of the government's overall development efforts towards the entire population. In this context, implementation of sports programs in secondary schools is also expected to produce athletes for higher level sports competition. The program, besides being able to develop a "whole person", must also be able to produce elite athletes to represent the nation in future national and international competitions.

The management and administration of school sports in Malaysia is under the responsibility of the Sports Division, Ministry of Education. This division, headed by a director, is responsible in implementing sports policies developed by the ministry. In addition, it functions as the secretariat to the Malaysian Schools' Sports Council which is responsible for the development and enhancement of sports and for organizing competition at district, national, and international levels. Empowerment and delegation of responsibilities is channeled through the various State Schools Sports Councils to the schools.

Origin of the National Sports School

Under the "Towards Excellence" concept of the National Sports Policy, the Malaysian Government through the National Sports Council (NSC) has initiated all sport movements to obtain international achievement and to strive towards producing world class athletes. One of the various strategies adopted to achieve this objective is to nurture and promote excellence in youth sports. Athletes are to be selected and trained systematically from an early age. Programs such as "Junior" and "Talent" have been undertaken to nurture and promote excellence in sports. Along with this idea came the rationale for setting up a special sports school where young athletes could be groomed to be world class athletes (Malaysia, 1991). The needs became more urgent when Malaysia was selected as the host for 1998 Commonwealth Games. The sports school was to prepare athletes for the Commonwealth Games and other international competition thereafter.

So, in January 1996, the Ministry of Education with the cooperation of the National Sports Council set up a National Sports School at Bukit Jalil in the capital city, Kuala Lumpur. A site within the vicinity of the National Sports Complex was selected for the location of the school. The complex built in preparation for organizing the Commonwealth Games provides adequate sports facilities of international standard. This ba

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location was selected with the consideration that students of the sports school could use the facilities for their training.

The choice of setting up a special sports institution in a school setting is largely based on the development of sports in the country. Sport associations which have traditionally been administered by voluntary organizations are lacking in facilities and personnel where athletes can be groomed and trained under a systematic program. Additionally, school sports, which form the roots of the entire sport system of the country, have also been the primary avenue for producing national athletes. However, the existing school structure has several constraints to producing excellent athletes. Cocurricular school sports have traditionally been provided by teachers before or after schools, and sometimes on weekends. Teachers give their time voluntarily and much depends on the interest and enthusiasm of individual teachers. Some schools also lack facilities and equipment for training. As a result, students fail to receive in-depth instruction from highly qualified coaches, practice with inadequate quality equipment, and have limited competitive opportunities in order to be successful athletes. Thus, the establishment of the sports school was to provide solution to all these problems.

Another component of the sports school program is the academic program. Under this component, the responsibility of the sports school is to provide sufficient academic resources and assistance to the athletes. For athletes selected to attend the school, besides the pressure of increasing demands for sports success as a justification for government spending, they are also expected by their parents to achieve academically. Entry to tertiary education depends greatly on achievement in school level public examinations. On the contrary, sports achievement has been given very little

consideration for tertiary education and job placement. Parents, as much as they like their children to excel in sports, want their children to have strong academic achievement for university entrance. For that matter, parents must be assured that their children will receive adequate academic assistance and only then they will allow their children to be enrolled in the sports school.

Including the academic component in the sports school program has several advantages. First, it encourages the parents to allow their students to be enrolled in the sports school. Second, the school has the opportunity to adopt a flexible daily schedule to accommodate the sports and academic needs of the students. During the competitive season, more time is allocated for training, while during examination seasons more time is allocated for academic study. In contrast, ordinary schools can not take such measures for their student athletes. As such, lack of time due to studies may act as the main barrier for sports participation (Salman, 1997). A study conducted by Donnelly (1993) on student athletes reported academic difficulties were usually attributed to the time committed to sports. Forty percent of the athletes had to attend school on a modified schedule. To a certain extent, students drop out of sport in the later years of school to concentrate on their studies (Oldenhove, 1996). Although no such studies have been done in Malaysia, student athletes in ordinary schools may face a similar problem. School athletes in ordinary schools who are selected to represent their state are more likely to miss academic classes to attend centralized training. Moreover, the current school system in Malaysia does not accommodate a modified schooling schedule for elite student athletes in ordinary school.

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Characteristics of the Program

The sports school, which was initially known as National Sport School was later named Bukit Jalil Sports School because more sport schools will be set up in the country. The program, although running in a school format, functions at the national level because its athletes will only be competing at national and international levels. Therefore, school progress has to be reported directly to the nation's highest sport and education governing bodies; the Ministry of Education and the National Sports Council.

The school's program was also designed to produce student athletes with strong academic achievement. For that reason, an academic component was included in the sports school program. Through this component, academic assistance can be appropriately channeled to these athletes, while at the same time they have the opportunity to excel in sports.

A prominent approach taken by the sports school to ensure strong academic achievement and excellent sports performance among its students is the adoption of a flexible daily schedule for the students. This flexible schedule is designed to accommodate the training and academic needs of the students at different school seasons. More training times are allocated during the competitive season, while academic times are extended during the examination season.

Goal of the program

Through the two main components; academic and sports, the goal of the program is to produce athletes who not only excel in sports but also have strong academic achievement. This goal is to be accomplished through the following objectives:

1. To improve athlete's performance in their respective games by providing them with well-equipped sports facilities, highly qualified sports personnel, and systematic training programs.
2. To create a balance between the need for sports and academic excellence by providing them with a conducive learning environment and sufficient academic assistance.
3. To instill and encourage the development of positive moral values through their involvement in sports activities and competition.
4. To impart knowledge about careers in the sports industry such as sports administrators, sports psychologist, fitness instructors, sports medical officers, coaches, trainers, and other sports related experts.

Individuals Involved in the Program.

Administrative arrangements

The school is under the authority and direct supervision of the Sports Department of the School Division, Ministry of Education, Malaysia. At the school level, the administration is headed by a principal and assisted by three vice-principals. These three vice-principals are assigned to different departments; namely, Academic, Student Affairs, and Sports department. The administrative arrangements at the sports school are somewhat different from those of the ordinary schools. Ordinary schools are not directly supervised by the School Division, but under respective State Education Department where the schools are located. In ordinary schools of a similar category, there a

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there are only two vice-principals, Academic and Students Affairs. Sports related activities in the ordinary schools are the responsibility of the Student Affairs department.

Student athletes

The school was planned to accommodate a total of about 600 students; 400 boys and 200 girls between the ages 13 and 17 years. The selection of students is based on their sports performance in the Under-12, and Under-16 age group competitions held by the Malaysian Schools Sports Council, talent scouting by the school's coaches, and recommendations from the State Sports Council. Besides their sports performance, the entry of students is also based on their academic qualification. For Form One (13 years old) entry, the students must score at least 2A's and 2B's (from 5 subjects) in their Primary School Assessment Test. Students selected for Form Four (16 years old) are required to obtain at least 4A's (from 8 subjects) in their Lower Secondary Assessment Test. However, special considerations are given to students with outstanding sports performance who have lower academic achievement.

The talent identification process is conducted by the National Sports Council and the sports school with the cooperation of respective state school sports councils. The process is mainly administered on primary six school students aged 12 years old with sports potential, at three levels; district, state, and national. Shortlist students from the district level are directed to the state level for further screening. Students selected from the state level screening are then referred to the national level panel comprised of officers from the National Sports Council and teacher-coaches of the sports school for the final selection.

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Administration of the process includes anthropometric measurements and motor performance/fitness tests (National Sports Council 1998, National Sports Council, 1999). The anthropometric measurements and fitness tests administered at each level are summarized in Table 1.

Table 1. Anthropometric measurements and motor performance tests included in the Talent Identification process of the sports school

Level	Fitness test	Anthropometry
1 - District	Standing triple jump 40-meter dash 800-meter run Overhead ball throw Vertical jump	Stature Body mass Arm span Sitting height
2- State	10-meter shuttle run Vertical jump Standing broad jump 3-kg ball throw 40-meter dash 800-meter run	
3- National	Basketball dribbling 40-meter dash Quadrant jump Sit-up	

Basically, selection is based on the motor performance of the students. The students' motor performance scores are compared to normative motor performance data of Malaysian children. Students' performance for motor performance tests administered at the state level must at least equal the 70^{th} percentile score of the normative data in order to be selected into the sports school. The performance tests administered at the national level are conducted on a competitive basis. Additionally, for team sports, game sessions a

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sessions are conducted to determine the skills of the candidates. For certain sports such as volleyball and basketball, the student's stature is also given due considerations.

Teacher and teacher-coaches

The number of teachers allocated to this school is based on a teacher-class ratio of 2:1, with each class having an average of 25 students. According to the teacher-class ratio, the number of teachers allocated would be 40. However, the number of teachers allocated in the original plan was 43. The allocation of three extra teachers could be due to consideration of the small number of teaching periods assigned to the principal and the vice-principals of the school. Selection of teachers is based on academic qualifications, a bachelor's degree and substantial teaching experience in their related subjects. Some of the teachers selected are also responsible coaching sports. These teacher-coaches must not only have the required academic qualifications, but also must be a certified coach and have substantial coaching experience in their related games. They must have at least three years of coaching experience at the state or national levels. However, teacher-coaches without the required academic qualifications will be given due consideration based on their experience and the needs of the sports school. Selection of teachers and teacher-coaches is made through application, and the decision is made through an interview by a selection committee headed by the Director of School Division, Ministry of Education.

For some sports, coaches who are not teachers of the school are appointed to conduct the training program. These coaches are assigned by the National Sports Council and receive an allowance of RM 250.00 a month.

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Non-academic staff

As in ordinary schools, this school is provided with non-academic personnel: clerical and maintenance staff, a hostel supervisor, and a fitness instructor. However, the two latter positions are more directly involved with the school sports program. The fitness instructor is responsible for monitoring conditioning activities, while the hostel supervisor is responsible for the residential and nutritional needs of the students.

Privileges and Opportunities

The school is managed on a full boarding concept based on the National Full Boarding School status. With this status, students are provided with hostels, food, health insurance, and a monthly allowance of MR 50 (USD 15) a month. Traveling expenses for going back home and coming to school are also provided three times a year. Additionally, the students are to be provided with personal sports equipment and medical insurance.

Apart from the school's training programs, students of the sports school are to be exposed to sports camps, seminars, dialogs and workshops with experienced local and overseas coaches and sports-related experts. In the academic program, assistance will be given to students having academic difficulties and to those who will be sitting for the national public examination.

Students of the school are also exposed to high level sports competition. This is done by giving the school the status of a "state" team in the national age group competition. With this status, athletes of this school compete with the best athletes from various state teams of the country. Additionally, all athletes are to be given the opportunity

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opportunity to compete overseas at least twice a year for them to gain experience at the international level. Athletes with outstanding performances are also given the opportunity to represent the country in international competition.

Teacher-coaches and administrators are provided with apartments and houses within the school compound. In addition, teacher-coaches of the school will be given opportunities to attend courses to improve their knowledge and skills in sports administration and training.

Training and Facilities

Training schedule

Student athletes selected and trained in this school are from various types of games. The games are:

1. Track and field - boys and girls
2. Artistic gymnastic - boys and girls
3. Rhythmic gymnastic - girls only
4. Squash - boys and girls
5. Archery - boys and girls
6. Swimming - boys and girls
7. Sepak Takraw - boys only
8. Netball - girls only
9. Field Hockey - boys and girls
10. Soccer - boys only
11. Volleyball - boys and girls
12. Basketball - boys and girls

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The curriculum content of the academic program of the school follows the national curriculum set by the Ministry of Education. In general, the courses offered are similar to those of the ordinary schools, except for Physical Education which is substituted by a Sport Science course.

Class schedules are also tailored to suit the sports training program. In ordinary schools, academic classes are a one-half day commitment, running from 7:30 a.m. to 1:00 p.m. for the morning session, or from 1:00 p.m. to 6:00 p.m. for the afternoon session.

In general, daily schedules for the students of the sports school are as follows;

6:30 - 7:30 A.M	- Physical Fitness Activities
9:00 - 4:20 P.M	- Academic Classes
5:00 - 7:00 P.M	- Sports Training
8:30 - 10:30 P.M	- Academic Activities/Tuition
Saturday	- Cocurricular activities

Besides the general daily schedules, the sports school also adopted a flexible daily schedule which is designed to accommodate the sports competitive season and the examination season. More training time is allocated during the competitive season, while academic time is extended during the examination season.

Sport facilities

Sports facilities of the school consist of a multipurpose hall, squash courts, a demonstration room, and a fitness training room. However, since the school is located within the National Sports Complex, most of the athletes' training is expected to be carried c

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carried out using the facilities in the complex. The complex is fully equipped with international standard playing venues and advanced training facilities.

Athletes' treatment for injury and rehabilitation will be provided by physicians at the National Sports Council which is located in the vicinity of the school, and by physicians at the National University hospital located in the capital city.

Summary

The development of sports and its important role in Malaysia has led to the establishment of Bukit Jalil Sports School. The goal of the program is to produce student-athletes with excellent sports performance and strong academic achievement.

Several processes have been identified to achieve this goal. First, there should be a very selective strategy for entry to this school. Students have to be selected based not only on their sports performance but also on their academic achievement. However, under special circumstances, students with very outstanding sports performance are also given the opportunity to be in the program. Second, students selected are to be given the greatest opportunities to improve their sports performance and academic achievement. In sports, they are to be provided with well-equipped sports facilities, and systematic training under the supervision of qualified coaches. In academics, they are to be provided with qualified teachers, adequate educational resources, and adequate academic assistance. It is assumed that through these processes, the students' physical performance will improve, and their strong academic performance can be maintained. Consequently, these students will come out winners in high level sports competition and perform successfully in their academic commitments.

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For most parts of the program, the implementation is carried out by the administrators, teachers, and teacher-coaches of the school. The academic component of the program is solely the responsible of these personnel. However, there is involvement of personnel from the National Sports Council and the Malaysian Institute of Sports in the sports component of the program. Involvement of personnel from National Sports Council is in the form of advanced training programs that their coaches provide to the student-athletes during school holidays, while physicians and trainers from the Malaysian Sports Institute are responsible for the rehabilitation programs of the athletes. In addition, there is collaboration between the Sports Division, Ministry of Education and the National Sports Council regarding the standard of the students' performances in sports competition.

Normal Human Growth

Growth refers to increase in the size of the body or its part, while biological maturation refers to the tempo and timing of progress to the mature state (Malina & Bouchard, 1991). Human beings generally follow a similar growth and maturation pattern with regard to age. Growth accelerates just before and during puberty. Body size, body composition, and physiology are basically similar in boys and girls before puberty (Sanborn & Jankowski, 1994). The adolescent growth spurt and puberty mark the period in life when sex differences in development become evident. Peak rates for height or peak height velocity (PHV) are observed in girls at about 12 years and in boys at 14 years of age (Tanner, 1962; Marshall & Tanner, 1986; Lindgren, 1976; Shephard, 1982). Due to the earlier growth spurt in girls, they become both taller and heavier than their male cou

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male counterparts between 12 and 14 years of age. Adult height is reached after a final phase of decelerating growth, at about 18 years in boys and 16 years in girls (Shephard, 1982; Malina & Bouchard, 1991). Due to the longer period of preadolescent growth and a slightly greater spurt in boys, adult men are generally taller than women. On average, boys have two years longer of preadolescent growth than girls and therefore are taller when they begin their adolescent growth spurt (Marshall & Tanner, 1986).

Although nearly all skeletal dimensions accelerate during adolescence, the effect is not uniform throughout the skeleton (Eveleth, 1978). There is a greater increase in the length of the trunk than in the length of the legs. As such, the proportion of the total stature that is due to growth of the trunk rises during adolescence. Also, the spurt begins at different times in different parts of the body (Marshall & Tanner, 1986; Malina & Bouchard, 1991). The legs experience their growth spurt earlier and their peak growth velocity about 0.6 years earlier than the trunk. Because of this growth pattern, the ratio of sitting height to stature is the lowest during the adolescent growth spurt, and then increases into late adolescence. Girls' sitting height/stature ratio becomes slightly higher than that of boys of corresponding age at the beginning of their growth spurt and remains so through adolescence into adulthood. The longer period of preadolescent growth in boys is also largely responsible for the fact that men's legs are longer than women's in relationship to the length of the trunk because the legs grow faster than the trunk immediately before adolescence.

Girls on the average have larger bicristal breadth than boys from middle childhood through late adolescence (Malina & Bouchard, 1991). On the other hand, boys are larger in biacromial breadth at all ages with the exception of ages 10 to 12. During the adolesc

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the adolescent spurt, boys gain more than girls in biacromial breadth, whereas girls gain slightly more than boys in bicristal breadth. Boys, however gain twice as much in biacromial breadth during the spurt, whereas there is a small difference in the amount gained between the two breadth dimensions in girls. Thus, in young adulthood, males have especially broad shoulders, but both sexes are similar in width across the iliac crest.

The growth spurt for body mass corresponds generally with the rapid growth of height, although it continues for a longer time (Tanner, 1962). Girls show a particularly a rapid gain between 12 and 13 years of age due to the increase in fat content of the breast and other parts of the body. In boys, gain in body mass is partly due to increase in height, and partly due to increase in lean body mass. Skeletal muscle and bone tissue are major components of lean body mass. Both tissues show patterns of age and sex-associated variation during childhood, adolescence, adulthood, and aging that are similar to those of lean body mass (Bouchard, Malina, & Perusse, 1997). Muscle widths have their peak velocity more nearly coincident with sitting height than with PHV (Tanner, Hughes & Whitehouse, 1981). Prior to the onset of adolescence, males have greater breadth of muscle and bone than do females of corresponding age (Malina & Johnston, 1967). For the average child, the whole muscle spurt lasts approximately two years from start to finish. At adolescent ages, the mean value for muscle breadth becomes greater in females until about 15 years of age when male muscle breadths are again larger. However, this temporary advantage in female is only in measure of the calf, not in arm musculature. This is largely due to a more pronounced growth spurt in the calf muscle in girls in comparison to boys than arm muscle for all ages (Tanner, 1981).

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Boys and girls both gain body fat early in adolescence (Forbes, 1986). However, the boys' gain stop or reverses temporarily, while girls continue to pun on fat as adolescence proceeds. Females show consistently greater values for fatness at all ages than do males. Fat mass and subcutaneous fat increase with age from 9 to 18 in girls and from 9 to 13 in boys (Malina & Bouchard, 1988). Fat mass changes only slightly between 14 and 17 years of age in boys, while subcutaneous fat declines gradually.

The ratio of trunk to extremity skinfolds is rather stable in both sexes during childhood and begins to rise after 8 to 9 years of age in girls and 9 to 10 years in boys (Malina & Bouchard, 1988). The ratio increases with age through male adolescence, but changes little after 12 to 13 years of age in girls. In girls, both trunk and extremity fat appear to accumulate at a reasonably similar pace after 12 years of age. In boys, skinfolds for the trunks increase in thickness during adolescence, while those in extremities decrease in thickness (Beunen et al., 1988). Growth velocity for the triceps and calf skinfolds increases during early adolescence, but declines and becomes negative between 14.5 to 15 years. Growth of the subscapular and suprailiac skinfolds accelerates and is reasonably constant during early adolescence but they differ later in adolescence. The velocity of the subscapular skinfold then increases slightly while that of the suprailiac skinfold declines considerably.

Biological Maturation

Although human beings generally follow a similar pattern of growth and maturation with regard to age, some variations do occur between individuals of the same chronological age. These variations are especially apparent during the adolescent growth spurt (

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growth spurt (Marshall & Tanner, 1986; Malina & Bouchard, 1991). The time at which the adolescent spurt begins varies from child to child. Thus, within a given age group, children may have a different maturity status.

Measures of maturity vary depending on the biological system used (Malina, 1988a; Malina & Bouchard, 1991). Sexual maturity is fully functional reproductive capability, while skeletal maturity is a fully ossified skeleton. More commonly used maturity indicators are skeletal maturation, sexual maturation, and somatic maturation. Dental maturity, as measured through dental eruption and calcification, is less extensively used in the study of growth and maturation.

Skeletal maturation refers to the degree of development of the skeleton as shown by X-rays. It is an ideal indicator of maturity because its development spans the entire period of growth. The assessment from the radiograph is based on the recognition of maturity indicators; the initial appearance of specific bone centers, gradual shape differentiation of individual bones, and the fusion of epiphyses with their respective diaphysis (Tanner, 1962; Roche, 1986). Currently, commonly used methods to assess skeletal maturation are the Greulich-Pyle and the Tanner-Whitehouse methods (Malina & Bouchard, 1991). Recently, the Fels method has been developed as an extension of the RWT method for the knee to the hand and wrist (Roche, Chumlea, & Thissen, 1988).

Assessment of sexual maturity is based on the development of secondary sex characteristics, including the age at menarche for females. Maturity indicators include pubic hair development in both sexes, breast development in girls, and genital development in boys. The most commonly developmental criteria used for these characteristics are those described by Tanner (1962) which are based on a 5-stage scale. Stage 1 indicates the prepubertal state of development, absence of development for each characteristic. Stage 2 indicates initial development of each characteristic. Stage 3 and 4 indicate continued development of each and may be difficult to assess (Malina, 1988a). Stage 5 indicates the adult or mature state of development for each characteristic.

Somatic maturity is most often viewed in terms of the timing of maximum growth during the adolescent growth spurt, that is, age at peak height velocity (PHV) (Malina, 1988a; Malina & Bouchard, 1991). Age at PHV is derived by fitting growth curves either graphically or mathematically to individual growth records for stature. Another indicator is percentage of adult stature; that is, the height attained at a particular age expressed as a percentage of adult stature. Similar to age at PHV, this indicator also requires longitudinal data. However, parental statures can also be used to provide a target range within which the adult stature of the child will likely fall.

Menarche, the first menstrual period, is also most commonly used maturity indicator for female adolescence (Malina, 1998a). There is no corresponding physiological event in male adolescent. Age at menarche can be estimated with prospective, status quo, or retrospective methods (Malina, 1996). The prospective method is based on longitudinal studies in which girls are examined at close intervals whether menarche has occurred and when. The status quo method is used to estimate age at menarche in a sample of girls. Two pieces of information are required; each girl's exact age, and whether or not she has attained menarche. The retrospective method requires the individual to recall the age at which she attained menarche. It is also the most widely used method in estimating age at menarche.

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Because different maturity indicators are measured through different biological systems, there is variation in maturity status obtained from these indicators. Nevertheless, these maturity indicators are related to each other, except for dental maturation which is not strongly related to the other maturity indicators (Fillippson & Hall, 1976; Demirjian, Buschang, Tanguay, & Patterson, 1985). Dental maturation tends to proceed independently of skeletal, somatic, and sexual maturation, suggesting mechanisms controlling dental development are independent of other indicators of maturity

A summary of correlations between different maturity indicators from several studies by Malina (1988a, 1988b) showed moderate relationships between the indicators, and that correlations for boys tend to be somewhat lower than those for girls. A study by Bielicki, Koniarek, & Malina (1984) on the interrelatedness among these maturity indicators reported the presence of general maturity factor that discriminates among individuals who are early, average, or late maturers. This study also showed sufficient variation among maturity indicators that no single system provides a complete description of the tempo of maturation of an individual during adolescence.

Assessing biological maturation through the observation of maturity indicators is not without problems. For skeletal maturation, difficulties include the time needed for the assessment of so many bones, the expense of radiographic films, and the risk of excessive radiation (Roche, 1986). The secondary sex characteristic is a continuous process upon which the stages are superimposed. Thus, the 5 stages scale are somewhat arbitrary, as is the case with other developmental scales. Assessment of secondary sex characteristics also involves invasion of individual privacy, which is a matter of m

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matter of much concern for many adolescents (Malina & Bouchard, 1991). Use of the retrospective method in determining age at menarche may be unsatisfactory because a subject's recollection may be inaccurate, or some girls may deliberately give an incorrect answer.

Apparently, biological maturation is most accurately assessed by measuring skeletal age because the development of the skeleton spans the entire period of growth (Tanner, 1962; Clarke, 1971; Roche, 1986; Malina & Bouchard, 1991). However, in large scale research and with limited expenses this is not always possible. Despite the limitation of Tanner's stages of development (superimposing a discrete series of stages onto a continuous process, and being limited to pubertal years), it is less intrusive and easier to use with large subject numbers than is skeletal age. In some studies, self-assessment of sexual maturation has been used to address the concern of invasion of privacy (Duke, Litt, & Gross, 1980; Neinsten, 1982; William, Cheyne, Houfkooper, & Lohman, 1988; Jones, Hitchen, & Stratton, 2000). Self-assessment of sexual maturation has been compared to assessment by physicians and has been found to have good concordance.

Maturity associated variation in growth

Although the concept of maturity differs from growth and both processes are probably under separate genetic regulation, they are related (Tanner, 1962; Malina, 1988b). Children who differ in maturity status also differ in size, physique, and body composition. This maturity-associated variation in growth is most apparent at the most extremes of the continuum (Malina & Bouchard, 1991). Children are commonly grouped into categ

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into categories of advanced (early), average, and delayed (late) maturity on the basis of skeletal age, age at menarche, or secondary sex characteristics, and their growth status can be compared from childhood through adolescence. Similarly, children of contrasting maturity status can be compared within a single age group to provide indication of the maturity-associated variation within a narrow range.

Several studies suggested that there is a relationship between physique and rate of maturation (Hunt, Cocke, & Gallagher, 1957). Other reviews also have noted that skeletal age is positively correlated with growth changes in fat, muscle and bone tissue, causing early maturers to have more weight per unit of height than do late maturers during adolescence (Tanner, 1962; Malina, 1974). In boys, the naturally slow maturer is often predominantly ectomorphic while the early maturer is mesomorphic (Acheson & Dupertuis, 1957; Clarke, 1971). These differences between early and late maturers are more apparent during late adolescence. Ectomorphy is also associated with lateness in maturation in girls, but endomorphy or a combination of endomorphy and mesomorphy is associated with early maturation.

Since physique is concerned with body size, body composition and body structure (Boileau & Lohman, 1977), relationships between somatotype and maturity status would suggest similar variation in these aspects due to contrasting maturity status. A study by Lindgren (1976) on Swedish children found that mean weight and mean height were significantly different between the early, average and late maturers for boys and girls during puberty. The early maturers of both sexes are taller and heavier than their average and late maturing age peers. Mean height differed between the maturity groups at ages 10.0 – 14.0 years in girls and 10.5 –17.0 years in boys. Mean weight at successiv

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successive ages differed between maturity groups at all ages from 10 – 16 years in girls, and from 10.0 – 18 years for boys. The growth rate in height in relation to age at peak height velocity was found to be significantly greater in early maturers of both sexes from at least seven years before until two years after PHV (Hagg & Taranger, 1992). The amount of growth during the pubertal growth spurt was significantly greater in the early maturers of each sex. The lag periods between the occurrence of maturity indicators of skeletal and pubertal development in relation to age at peak height velocity differed between early and late maturers. The maturity indicators occurred earlier in relation to PHV in the late maturer of each sex.

In girls, there were significant differences in height between the maturity groups from 5 to 14 years of age, but final height did not differ between the groups (Hagg & Taranger, 1991). In boys, there were significant differences in height between the maturity groups from 12 to 16 years but no significant difference was found at the age of 17 years. Consequently, adult height of the late maturers eventually attained or perhaps surpassed the stature of early maturing children (Malina & Bouchard, 1991; Hagg & Taranger, 1991)

Other studies also showed maturity associated variation in growth (So, 1995; Beunen, Malina, Lefevre, Claessens, Renson, Simons et al., 1994). There were consistent differences among Belgian boys of contrasting maturity status during adolescence in body weight, skeletal lengths and breadths, circumferences, and skinfolds of the trunk (Beunen, Malina, Lefevre, Claessens, Renson, & Simons, 1994; Beunen, Ostyn et al., 1997). However, there were no differences in skinfolds on the extremities. A fairly high percentage of the variation in body dimensions between 13 and

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16 years is explained by skeletal age (approximately 50% for stature), and the percentage of explained variance reaches its maximum at 14 to 15 years (Beunen, Ostyn, Simons, Rensen, & Van-Gerven, 1981). The highest percentages were found for linear dimensions and weight, followed by bone width dimensions and circumferences. However, triceps and calf skinfolds were not found to be related to skeletal age. In girls, skeletal age was found to be most highly correlated with lengths and then with breadths, circumferences and skinfolds (Beunen, Malina et al., 1997). Skeletal age per se or in combination with chronological age is a significant predictor of somatic characteristics. Chronological age alone was not found to contribute in the prediction of body measurements.

Absolute fatness estimated from four skinfolds in boys was positively related to skeletal maturity but the correlations were rather low (Beunen et al., 1982). These correlations tended to decrease with age from 12 to 17 years. Comparison between the extreme groups, the fattest and the leanest, indicated that the leanest boys were the most delayed in skeletal maturity. Correlations between adiposity and maturity indicators in girls showed a similar trend (Beunen, Malina, Lefevre, Claessens, & Renson, 1994). The fattest girls were as equally advanced as the leanest girls were delayed in skeletal maturation. The attained stature that was consistent with the maturity data indicated that the size differences between fat and lean girls were primarily due to maturity differences.

Other factors influencing growth

The growth and maturation of human beings depends on the integration of many factors. A child's growth depends on the child's genetic endowment and the environment in which the child lives, and interaction between the two (Eveleth & Tanner, 1990). As such, there are large differences between populations in height, weight, and age at puberty. Children of the developing world, on average, are shorter and lighter than children in the developed world population (Tables 2 & 3). However, it should be noted that while a portion of these differences is genetic in origin, a large portion is due to environmental factors. Environmental factors such as culture, malnutrition and infectious disease, and poverty are among the major factors that affect the growth of children in the developing world (Gopalan, 1992; Stephenson, Latham, Adams, Kinoti & Perte, 1993).

Comparative growth studies of children of different races growing under similar conditions have shown that population differences in body shape and size are due to their genetic origin. Aschroft and Lovell (1964) found that children of African, Afro-European and European ancestry were similar in size but were considerably bigger than Chinese of the same economic class. Eveleth and Tanner (1990) in their world wide comparison of body size concluded that Afro-American children growing up under favorable conditions are a little taller and heavier than Europeans and Euro-Americans living in the same cities. This is partly because they are a little more advanced in maturity. Asians, on the other hand, are smaller despite being further advanced in maturity. Indonesian-Malay groups are within the Europeans range for height until 12 to 13 years of age. After 13 years of age, all Indonesian-Malays are smaller than Europeans. They mature earlier than Europeans, so they stop growing at an earlier age with a final adult height lower than that of Europeans.

Table 2. Height and weight for boys between 13 and 18 years of age in selected countries

Country (sample)*	Authors	Age 13		14		15		16		17		18	
		Height (cm)	Weight (kg)	Height (cm)	Weight (kg)	Height (cm)	Weight (kg)	Height (cm)	Weight (kg)	Height (cm)	Weight (kg)	Height (cm)	Weight (kg)
Belgium (national)	Beunen et al. (1988)	151.3	41.2	157.4	46.1	16.2	52.3	171.6	58.4	174.8	63.0	176.5	66.7
Netherlands[a] (national)	Roede & van Weiringen (1985)	157.5	44.5	165.8	50.9	173.2	57.1	177.4	62.1	179.6	65.9	180.9	69.0
US (national 50th percentile)	Hamill et al. (1979)	156.5	44.95	163.1	50.77	169.0	56.71	173.5	62.10	176.2	66.31	176.8	68.88
Hong Kong [a] (Chinese)	Fung et al. (1985)	154.1	42.0	160.0	46.0	164.0	49.5	167.4	52.6	169.6	55.1	170.5	57.0
Japan (Kanto - agricultural)	Ohsawa, Kokudo, Kasai, & Okoun (1995)	158.06	49.90	162.83	52.87	165.99	56.88	167.77	57.26	168.39	59.08	168.22	59.21
Thailand (northeastern- mixed)	Ohsawa et al. (1995)	149.84	39.18	155.86	43.78	160.32	47.53	162.66	51.08	163.43	53.18	163.60	53.64
Malaysia[b] (rural)	Lin & Siong (1997)	144.5	34.5	150.0	40.5	154.0	44.0	162.0	52.5	165.0	57.0		
Malaysia (national 50th percentile)	National Sports Council (1998)	153.8	43.6	161.2	49.4								
Indonesia (East Java - agricultural)	De With, Kusin, Kardjati (1985)	133.6	27.3	139.6	31.4	144.8	34.0						

* all values for each study are mean values unless otherwise indicated

[a] adapted from Eveleth and Tanner (1990)

[b] approximated from a graph

Table 3. Height and weight for girls between 13 and 18 years of age in selected countries

Country (sample)*	Authors	Age 13 Height (cm)	13 Weight (kg)	14 Height (cm)	14 Weight (kg)	15 Height (cm)	15 Weight (kg)	16 Height (cm)	16 Weight (kg)	17 Height (cm)	17 Weight (kg)	18 Height (cm)	18 Weight (kg)
Belgium [a] (Flemish)	Simons et al. (1990)	155.8	46.2	160.2	50.9	162.1	53.3	163.2	53.3	164.0	56.4	164.2	57.0
Netherlands[a] (national)	Roede & van Weiringen (1985)	160.6	47.8	164.0	52.2	166.4	55.6	167.7	57.5	168.0	58.5	168.2	59.4
US (national 50th percentile)	Hamill et al. (1979)	157.1	48.10	160.4	50.28	161.8	53.68	162.4	55.89	163.1	56.69	163.7	56.62
Hong Kong [a] (Chinese)	Fung et al. (1985)	152.7	42.0	155.6	46.0	157.2	49.5	157.8	52.6	157.6	55.1	157.2	57.0
Japan (Kanto - agricultural)	Ohsawa et al. (1995)	154.00	46.27	154.94	49.43	155.98	50.52	156.21	50.41	156.58	50.52	156.44	50.86
Thailand (northeastern- mixed)	Ohsawa et al. (1995)	148.69	40.45	152.08	44.08	151.03	44.93	154.30	48.23	153.83	47.74	154.12	50.03
Malaysia[b] (rural)	Lin & Siong (1997	145.00	37.00	147.00	42.00	148.00	44.00	150.00	47.00	150.00	49.00		
Malaysia (national 50th percentile)	National Sports Council (1998)	151.8	42.9	155.4	45.3								
Indonesia (East Java - agricultural)	De With, Kusin, Kardjati (1985)	136.2	29.3	141.6	33.0	144.8	35.2						

* all values for each study are mean values unless otherwise indicated

[a] adapted from Eveleth and Tanner (1990)

[b] approximated from a graph

Population differences in body proportion also exist. Smith and Brown (1970), in their study of preschool children in Hawaii, observed that Japanese were as heavy as part-Hawaiians but shorter in stature, although the trunk lengths were similar. Therefore, the differences in stature are due to the shorter legs of the Japanese. Grantham-McGregor, Desai, and Back (1972), on the other hand, found that Jamaican Negro infants had longer legs than Europeans. Malina (1969), in a comparative survey of growth of American Negro and white children, observed that Negro children and adults, had shorter trunks, a more slender pelvis, longer upper extremities, greater arm span, and longer lower extremities. A study of population differences in the body shape of children and adolescents concluded that Australian aborigines have the longest legs to sitting height followed by children of African ancestry, while Japanese have the shortest legs (Eveleth, 1978).

In most populations, growth and maturity status are strongly related to SES, suggesting the influence of SES on growth and maturation. Significant superiority in anthropometric measurements of upper SES was also observed among Indian school children aged 6 - 17 years, in Durban, South Africa (Walker, Walker, Jones, & Kadwa, 1989). Lower SES girls in India were significantly smaller in every physical measurement when compared to upper SES girls (Qamra, Mehta, & Deodhar, 1990). The onset of menarche, breast, and pubic hair development were also significantly delayed in lower SES girls by 0.8 years (Qamra, Mehta, & Deodhar, 1991). A study of sexual maturation and growth patterns in Egyptian boys also showed a significant effect of social class on the mean ages of onset of puberty, and height and weight (Hafez, Salem, Cole, Galal, & Massoud, 1981). Most pubertal changes in boys and girls in Newcastle upon Tyne showed gradients by social class as determined by father's occupation level (Billewicz, Fellowes, & Thomson, 1981). In boys, the development was later in unskilled manual occupations, whereas in girls the greatest differences were between those with fathers in non-manual occupations and the remaining occupations.

Satisfactory growth of children is also dependent on nutritional status and health condition, which in turn, are related to SES. This is particularly true in developing countries where urban-rural differences in nutritional status are signified by SES differences. In general, the nutritional status is lower in rural areas, although poor urban children sometimes suffer from higher prevalence of malnutrition than rural children (Chen, 1976; Chen, 1977a; Chen, 1977b;Cameron, Kgamphe, Leschner, & Farrant, 1992). Characteristic features of undernutrition are stunted growth, delayed biological maturation, reduced muscle mass, and decreased physical working capacity (Malina, Little, Buschang, De Moss & Selby, 1985; Malina & Buschang, 1985). The severity of the physiological effect of malnutrition can range from mild to severe and is due to the interaction of intensity, duration and timing of the stress (Malina et al., 1985). Stunting indicates that undernutrition has been present over a long period, while wasting indicates current undernutrition (Chen, 1976).

<u>Indicators for SES and Nutritional Status</u>

Generally, the socioeconomic status score is a multiple item measure derived by averaging scores for the component items of occupation, education and family income (Miller, 1983). Thus, for the construction of an index, occupational prestige rating, weight score for education, and income have to be determined first. Occupational prestige rating

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rating, for example, is determined through opinions from a national sample of a population. For that matter, the prestige rating is only applicable for that population and attempts to use such a rating for other populations may not be appropriate.

For cross national comparison of socioeconomic conditions, WHO recommended the use of indicators such as estimates of life expectancy, real gross domestic product (GDP) per capita, and average years of education for populations aged 25 years and above (WHO, 1999).

Infant and preschool children mortality rates are accepted indicators of health and nutritional status of a population (Martorell, 1982; WHO, 1999). The measure of malnutrition of a population is determined by the percentage of children under 5 years who are stunted. For older children, the World Health Organization has advocated the use of weight-for-age, height-for-age, and weight-for-height as the basis for classification of nutritional status (WHO, 1995). Weight-for-age, height-for-age, and weight-for-height values that are between minus 2 SD and plus 2 SD of the National Center for Health Statistics (NCHS) median are considered as normal growth.

For various limitations of weight-for-age, height-for-age, and weigh-for-height, WHO recommended the use of Body Mass Index as the basis for anthropometric indicators of thinness and overweight during adolescence (WHO, 1995). Weight-for-age is considered uninformative or even misleading in the absence of corresponding information on height-for-age, and the combined use of these data to assess body mass is awkward and has yielded biased results. The use of weight-for-height poses problems because weight/height relationships change dramatically with age. Although BMI has not been f

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been fully validated as an indicator of thinness and undernutrition in adolescents, it provides a single index of body mass and height, applicable at both extremes.

Socioeconomic and Nutritional Conditions in Malaysia

Malaysia's socioeconomic and health indicators have shown a steady improvement since colonial times. Although this may be taken as part of worldwide trend, the rapid rate at which this has occurred is a reflection of the wealth and economic growth in the country. Malaysia's infant mortality rate (IMR) in 1998 is already less than 20 per 1000, the level which is considered desirable in countries where health and social development has largely eliminated the environmental and demographic risks linked to infant death (WHO, 1999). In fact, by 1998, Malaysia's IMR had dropped to one third of its IMR in 1978. The rate is catching up to that of developed countries like the United States and the United Kingdom.

For comparison, basic indicators of socioeconomic and nutritional conditions for Malaysia and few selected countries are presented in Table 4 (WHO, 1992; WHO, 1999). Also reported is the rank for Human Development Index (HDI) for developing countries to show relative conditions for Malaysia as compared to other developing countries. This index is derived from data on life expectancy, educational attainment, and income. Malaysia's HDI ranked 20th among the developing countries and third among the South East Asian Countries (WHO, 1992). It should also be noted that most countries of South and South East Asia fall in the 'Medium' or 'Low' categories for HDI; indeed the only Asian countries that qualify for the 'High' category are Japan, South Korea, Singapore, Thailand and Malaysia (Gopalan, 1992).

Table 4. Basic indicators for socioeconomic and nutritional conditions for selected countries

	Infant mortality rate (1998) [a] (per 1000)	Life expectancy (1998) [a] (years)		GDP per capita (1982-1992) [a] (US dollar)	Years of education for population aged 25 + (1995)[a]	Human development index (1991)[b] (rank [c])
		male	females			
USA*	7	73	80	17945	12.1	--
UK*	7	75	80	12724	8.7	--
Japan *	4	77	83	15505	9.2	--
China**	41	68	72	1493	5.2	49
Malaysia**	11	70	74	5746	5.5	20
India**	72	62	63	1282	3.5	90
Thailand**	29	66	72	3942		33
Indonesia**	48	63	67	2102	3.9	65
Brunei**	10	73	78			11
Singapore**	5	75	79	12653	5.5	7
South Africa**	59	52	58	3068	4.8	25

[a] adapted from WHO (1999) **developing country *developed country
[b] adapted from WHO (1992)
[c] data reported developing countries only

The improving health and nutritional conditions as indicated by indicators reported by WHO (1999), however may not reveal how this improvement is shared among different sectors of the Malaysian population. The low national mortality rates are but average figures and there are districts with mortality rates are much higher that the national figures (Chee, 1990). In some cases, the IMR has risen in some rural areas due to poor medical facilities, continued use of traditional medicine, waterborne diseases, poor maternal nutrition, and inadequate personal hygiene. The five highest districts with the highe

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the highest IMR were found in the states of Pahang, Trengganu, Kelantan, Perlis, and Kedah, where the population of rural and Malay population is higher (Arshat, 1986).

Urban-rural differences in IMR in Malaysia is closely associated with inter ethnic differentials. The rural population is largely Malay and the urban population predominantly Chinese. The urban population and the Chinese ethnic group also have higher overall incomes (Malaysia, 1989). So, it seems that differential health status in Malaysia is indirectly associated with the level of socioeconomic development as well as socioeconomic status. The National Health and Morbidity Survey carried out in 1986-1987 (Public Health Institute, 1988), found that both acute and chronic illness rates were higher among those earning lower incomes, those with poor or no education, as well as those having less skilled occupation.

Growth of Malaysian children

Most studies of children growth in Malaysia are to examine the relationship between nutritional status and socioeconomic status, and urban-rural nutritional status differences. A review of nutrition research pointed out that mild and moderate malnutrition exists to a considerable extent in rural and urban poor communities (Wan Ariffin, 1994). This is manifested in widespread growth retardation, specifically in underweight and stunting of children. Results of anthropometric assessment of boys and girls aged 18 years and below in rural community groups showed that the prevalence of underweight (weight-for-age) among boys was 29.8 % and for girls 25.5 % (Lin & Siong, 1997). The prevalence of stunting (height-for-age) was 31.3 % for boys and 26.9 % for girls. By age groups, the highest prevalence of underweight was among children aged 1

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- 6 years old. A survey of primary school children in urban poor populations found that 27% of the children were underweight and 25% were stunted (Chen, 1977a). The prevalence of malnutrition in children aged 0 - 72 months among squatter communities was found to be 23% underweight and 29% stunted (Kassim, 1989). The proportion of malnourished children was low among the 0 - 6 months age group, but there was severe acute malnutrition among the 6 - 24 months age group and widespread stunting among the 24 - 72 months age group.

Growth rates of children in poverty villages were found to be inferior when compared to those of urban children in the capital city, Kuala Lumpur (Chong & Lim, 1975). Similar results were also obtained by earlier studies comparing growth achievement of four Malay pre-school children from a very poor rural inland area, a village where the Applied Nutrition Project is carried out with army children, and an upper income group in Kuala Lumpur (Chong, McKay, & Lim, 1972; Chong & Lim, 1975). It was found that the growth achievements of children from the army, and those under the Nutrition Project were superior to those in poor rural areas, but were still below the level reached by the upper income children.

Inter-ethnic comparisons of growth achievement also found differences among Chinese, Malay, and Indian school children aged 6 to 11 years (Chen, 1976). On the whole, the Chinese children were taller and heavier than the Malays and the Indians who were the least heavy among the three ethnic groups. However, the growth status among higher income children in the three ethnic groups did not differ significantly. Economically the Indians were the poorest among the three ethnic groups and they had the largest family size. This finding suggested that income is a confounding factor in ethnic c

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ethnic differences of the growth achievement. Rampal (1977) also noted that the differences in nutritional status of different ethnic groups were due to differences in socioeconomic status. It seems likely that Malaysian children of different ethnic groups can attain similar statures if environmental conditions are similar.

Study of the secular trend of growth in Malaysian children indicated a positive trend in height, weight and head circumference (Chen, 1990). Boys and girls from birth to 5 years of age of the 1980 - 1985 cohort are taller, heavier and have bigger head circumference than children of the 1968 - 1973 cohort, and the difference widens as the child grows older. This result reflects an improvement of living conditions with time. In the last two decades, there has been an improvement in the social, economic, and environmental standards of the country, and over the years, the budget for health has been increasing steadily (Wan Arifin, 1994). These improvements may have lead to better nutritional conditions. The growth achievement of privileged Malay pre-school children has been found to closely approximate the Boston standard (Mckay, 1971). Similar study on children aged 3 - 12 years from wealthy families in Malaysia have also shown that the anthropometric measurement patterns were quite similar to NCHS except for having a lower median weight-for-age and height-for-age.

Growth of Malaysian adolescents compared to other populations can be found in Tables 2 and 3. Malaysian adolescents are generally smaller than the Europeans, Americans, and the Japanese but bigger than the South East Asians (Thailand, Indonesia). However, Malaysian rural adolescents are shown to be smaller and lighter than the Malaysian national sample and other population with exception of the Indonesians. As indicated earlier, growth is greatly influenced by environmental factors.

The rural Malaysian and the Indonesians adolescents are more likely subjected to nutritional problems.

In summary, rural-urban and ethnic differences in growth among Malaysians can be largely explained by socioeconomic differences. Rural populations mainly consist of the Malays and the Indians, while the urban population is predominantly Chinese. The urban population and the Chinese ethnic group also have higher overall incomes. Hence, the inter-ethnic differences are also a reflection of rural-urban differences, as well as socioeconomic differences which is largely determined by household income. There is also indication that with better living conditions the growth achievement of Malaysian children will continue to improve.

Motor Performance

Performance on motor tasks is viewed in terms of the process and the product of the particular activity under observation (Malina, 1975). Changes in basic skills, such as running, jumping and throwing, when measured for performance, speed, distance, or accuracy, reflect quantitative improvement in motor performance (Haywood, 1993). A comprehensive motor performance test battery would theoretically represents all the factors that enter into various types of physical performance. Those qualities that are considered motor performance qualities and which make up the majority of test items for motor performance test batteries usually include speed, power, agility, reaction time, hand and eye coordination, and balance (Johnson & Nelson, 1979). Other test items, which are sometimes included, are strength and endurance. It is essential that a test battery be selected with a specific purpose in mind, in which the motor tasks of the test items accurately measure the motor performance qualities to be measured.

Motor tasks and factors of physical performance included in several motor performance studies are summarized in Table 5 (Clarke, 1971; Branta, Haubenstricker, & Seefeldt, 1984; Beunen et al., 1988). Running ability usually has been assessed in one of three ways: (a) by a dash, in which the focus is on speed and power, (b) by an agility run, in which speed is combined with quickness in changing body direction, and (c) by an endurance run, in which speed is largely a function of the cardiovascular system.

Table 5. Motor tests included in several motor performance studies

	Motor tests	Factor
Clarke (1971)	Standing broad jump	Explosive power
	Sixty-yard shuttle run	Speed and agility
	Total body movement test	Reaction and speed of movement of the
	Arm movement tests	arm and leg
Branta, Haubenstricker,	Flexed-arm hang	Strength and endurance of shoulder girdle
& Seefeldt, (1984)	Vertical jump	Leg power for vertical jump
	Thirty-yard dash	Speed
	Sit and reach	Flexibility
	Agility shuttle run	Speed and agility
	Standing broad jump	Leg power for horizontal jump
	Endurance shuttle run (400 ft)	
Beunen et al. (1988)	Arm pull	Static strength
	Vertical jump	Explosive strength
	Bent arm hang	Functional strength
	Leg lifts	Trunk strength
	Plate tapping	Speed of limb movement
	Shuttle run (50 m)	Running speed
	Sit and reach	Flexibility

The two tasks most commonly used to test jumping performance in children and adolescents are the standing long jump and the vertical jump (jump and reach). The standing long jump measures power of the legs in jumping forward, while the vertical jump measures power of the legs in jumping upward. The arm hang measures muscular strength and endurance of the arms and shoulder girdle. Leg lifts are used to measure trunk strength and arm pulls for static strength. Speed of the limb is measured by plate tapping, while reaction time is measured by total body and arm movement tests.

Age related changes in performance during adolescence

It is well established that there are age related changes in motor performance (Clarke, 1971; Ellis, Carron, & Bailey, 1975; Ostyn, Simons, Beunen, Renson, & Van-Gerven, 1980; Branta et al. 1984; Beunen et al., 1988). Since children and adolescents become taller, broader, and stronger with advancing age, it was generally assumed that these changes would be accompanied by similar progress in the development of basic motor skills and abilities (Branta et al. 1984). This assumption appears logical and was supported by evidence that body size and strength contributes to motor performance.

The increase in strength due to increasing age is related to increase in total muscle mass (Shephard, 1982). The total muscle mass increases progressively from 25% of birth weight to 40% of body weight as an adult. Much of this increase of lean mass occurs during puberty (Tanner, 1962; Shepard, 1982). The peak muscle growth velocity is somewhat later than peak height velocity and thus occurs coincidentally with sitting height and shoulder width. Female shows less pubertal increase in lean mass and at maturity both muscle mass and muscle force are only 60% of the male values (Tanner, 1981). However, girls' adolescent spurt in muscle occurs earlier than that of boys and as such, girls on average have more muscle than boys for a short period of time.

At adolescence, the muscles not only increase in size; they also increase in strength to a proportionately greater degree (Tanner, 1962). The increase is more than predicted from growth in stature, and is especially apparent in male adolescents (Rarick & Smoll, 1967; Beunen & Malina, 1988). In boys, strength increases linearly with age until 13 to 14 years of age through the late teens, with an acceleration during the adolescent growth spurt (Malina, 1986; Beunen et al., 1988; Beunen & Malina, 1988). In girls, strength increases linearly with age through about 15 years with no clear evidence of an adolescent spurt. On the average, boys demonstrated greater strength than girls at all ages (Beunen & Malina, 1988). The difference is greater during adolescence due to marked acceleration of strength development in boys. However, growth in strength of the upper extremities is more variable than in the trunk or lower extremities (Rarick & Smoll, 1967; Carron & Bailey, 1974). Nevertheless, sex differences in strength are more marked in the upper extremity and the trunk than in the lower extremity, even after adjusting for size differences between boys and girls.

Like strength, motor performance generally improves with age, with a clear adolescent spurt in boys but not in girls (Beunen & Malina, 1988; Malina & Bouchard, 1991). Significant positive correlations between strength and performance indicate that stronger children were the children who performed better (Ball, Massey, Misner, Mckeown, & Lohman, 1992). However, the pattern of improvement of strength and motor performance is also not uniform in all tasks. Strength may be important to the successful performance of some motor performances but not as important to others. It is likely that performance related to power events would show a similar trend to that of strength.

Performances in a variety of motor tasks improve from childhood through adolescence in boys, with some suggestion of a spurt in power tasks such as the vertical jump and the distance throw (Branta et al., 1984; Haubenstricker & Seefeldt, 1986; Beunen & Malina, 1988). The performances of boys exceed those of girls, and the differences become larger with increasing age. An exception is flexibility, usually measured with the sit and reach test, in which girls show greater flexibility at virtually all ages (Haubenstricker & Seefeldt, 1986).

The performances of girls, on the other hand, improve only to about 13 to 14 years of age, with little subsequent improvement (Branta et al., 1984; Haubenstricker & Seefeldt, 1986). However, such findings were only based on children up to 14 years and may not reveal the improvement thereafter. A more recent report of this study which includes data of older adolescents showed that the plateau in performances in adolescent girls has shifted to a slightly older age. Performances of girls increased progressively although not at the same rate as that of boys, until the mid-teen years on some tasks and until 17.5 years on others. Specifically, continuous improvement in performances occurred until 15 years on the agility shuttle run, until 16 years on flexed arm hang, standing long jump, and endurance run; and until 17.5 years on the jump and reach and thirty-yard dash. In contrast to boys, the flexibility of girls was relatively constant from 5 to 11 years, increased through 15 years, and then tended to plateau.

Performance in power tasks, such as the softball throw, the standing long jump and the dash tends to show reasonably good stability over periods of 2-3 years, whereas other tasks such as hopping, the flexed arm hang, and sit and reach are less stable (Branta et al., 1984). On the other hand, the stability of strength of upper extremities is more variable than the lower extremity (Rarick & Smoll, 1967). The inconsistency between the stability of limb strength and motor performance associated with them suggest that motor performance does not depend on strength alone. Size, physique, and body composition and size may also be contributing factors.

Physique and body structure generally have been found to have a significant relation to physical performance (Boileau & Lohman, 1977). However, physique does not markedly influenced performance except at the extreme of the continuum (Malina, 1975). A high degree of endomorph definitely limits physical performance capacity, while children with a high degree of mesomorphy are more adapted to motor performance. Nevertheless, correlations between physique and strength and performance are at best moderate and not sufficiently high for predictive purposes (Malina, 1975).

Correlations between height and weight and performance in commonly used motor tasks during the adolescent years are generally low and in same direction as those for middle childhood (Malina, 1975). Items in which the body is projected tend to show, but not consistently, negative correlations with body weight. Some data show that shorter boys between 6 and 12 years tend to be stronger per unit of body weight than taller boys, and also to have better performance scores in running and jumping.

Body composition is determined by leanness and fatness and most often is predicted by skinfolds (Malina et al., 1982). Correlations between skinfold thicknesses and performance are consistently negative suggesting the negative effect of fatness on motor performance (Malina, 1975). Negative influence of body fatness on physical performance occurs both mechanically and metabolically (Boileau & Lohman, 1977). Mechanically, excess fatness is detrimental to performance involving acceleration of body weight because it adds non-force producing mass to the body. Metabolically, excess fatness increases the metabolic cost of performing work in activities requiring movement of the total body mass. Thus, one would expect that in most types of performance involving translocation of the body mass a low relative fatness to be advantageous in both a mechanical and metabolic sense.

It should be noted that correlation analyses relating a specific body dimension to motor performance may have limitations. Anthropometric factors influencing strength and performance are themselves related, thus, a set of selected anthropometric dimensions would account for a significant variation in physical performance (Slaughter, Lohman, & Boileau, 1982). Using a step-down regression procedure, height, upper arm circumference, abdominal and calf skinfold were identified as significant predictors of physical performance (Slaughter et al., 1982). Analysis of canonical correlation on two sets of variables, anthropometric and physical performance, also indicated that children with greater weight, thigh volume, and height will perform well on performance measures requiring high intensity work production (Docherty & Gaul, 1991).

Maturity associated variation in performance

Any consideration of the relationship between maturity status and performance must include the interrelationships among size, physique, composition and maturity status (Malina, 1988b). Child who differs in maturity status also differs in size, physique, body composition, strength, and motor performance (Malina,1975; Malina, 1988b). Strength and performance are related, and anthropometric factors influencing strength and performance during development are themselves related.

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During adolescence, maturity relationships to strength and performance are positive for boys, but no clear pattern is apparent for girls (Malina, 1975). Motor performance (i.e. arm pull, vertical jump, sit and reach, shuttle run, plate tapping, leg lifts, and bent arm hang) of early maturing Belgian boys are better than average- and late-maturing boys (Beunen et al., 1981; Malina & Bouchard., 1991, Beunen & Malina, 1996). Similar results were also found by Clarke (1971) for boys 9 to 17 years of age where the more advanced maturity group had superior means in motor performance. Significant mean differences were obtained most frequently at 15 years of age. Later in adolescence, that is, about 17 to 18 years of age, the size, strength, and performance differences between boys of contrasting maturity status are reduced or disappear (Malina, 1996). The differences between boys of contrasting maturity status are most apparent between 11 to 14 years, and it is the early-maturing boys who often have the advantage in many sports.

Maturity associated variation in motor performance of girls is not consistent from task to task across age (Malina & Bouchard., 1991). The arm pull shows maturity associated variation similar to that for boys. However, there is a considerable variation among the three contrasting maturity groups on the other tasks. Late maturing girls, on the other hand, perform better in the bent-arm hang and leg lifts at ages 12 and 13 but do not differ from the other groups at ages 14 and 15. In general, motor performance of adolescent girls is poorly related to maturity status, and it is often the later-maturing girls who attain better performance in later adolescence (Malina, 1996).

A recent study by Jones et al. (2000) also suggested that sexual maturity has a large influence on physical fitness measures in boys but has less effect in girls. Although

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stage of sexual maturity was also found to be significantly correlated with all physical fitness measures in boys and girls, this study revealed that when stature and mass were taken into account significant differences were evident between sexual maturity stages in boys but not girls. This finding suggested that increases in mass and stature were primarily responsible for variation in girls' physical performance throughout maturation, whereas in boys there are some qualitative differences in performance due to other factors. It is likely that increasing levels of androgens, particularly testosterones, contribute considerably.

It was earlier indicated that a set of selected factors would account for more variation in physical performance than any factor alone. Katzmarzyk, Malina, & Beunen (1997) highlighted the interrelationships among skeletal maturity, body size, strength and motor fitness in their study on American children 7-12 years. Strength items included were right and left grip strength, and pushing and pulling strength of the shoulders. Motor fitness items included a 35-yard dash, the standing long jump, and softball throw for distance. Regression analyses of the data showed that the strongest predictor of strength was body mass, while chronological age was the best predictor of motor performance. However, the significance of the interaction terms indicated that all the predictors were interrelated.

The contribution of combined predictors on performance was also reported by Beunen et al. (1981) on their study of motor fitness of Belgian boys ages 12 to 19 years. The interaction between chronological age, skeletal age or in combination with height and weight have the highest predictive value for motor fitness components except for trunk strength (leg lifting) and functional strength (bent arm hang). However, except for static s

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static strength (arm pull), the predictive value is rather low, varying between 0 % and 17 %. In girls, on the other hand, chronological age, skeletal age, stature and weight and their interactions explain less than 10% of the variance in most physical fitness items. However, for physical work capacity (PWC), arm pull strength, and bent arm hang, the interaction terms explain between 12% and 67% of the variance (Beunen, Malina et al., 1997).

Other factors Influencing performance

Earlier discussions have shown that body size, body composition and physical performance are interrelated. Furthermore, body size and body composition are known to be influenced by environmental factors such as socioeconomic and nutritional status. This suggests that factors influencing growth would also influence physical performance. There is also evidence suggesting racial and ethnic variation in motor performance.

Black children of school age, particularly boys, perform consistently better than White and Mexican-American in running speed (dashes) and the vertical jump with somewhat less consistent results for the standing long jump and softball throw for distance (Malina, 1988c). In contrast, differences in the motor development and performance of Mexican-American and White children were generally inconsistent and slight. However, from a socioeconomic perspective, this finding could be accounted to socioeconomic variation in rearing and parental supervision which underlies the superior performance of the Black children and youth. It is assumed that a more permissive rearing atmosphere characterizes lower socioeconomic social classes, which provides greater

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greater freedom for physical activity and in turn enhances motor development during infancy and childhood.

SES and nutritional status are other factors that may affect physical performance. As in growth studies, these factors together with ethnicity and body size are interrelated especially in most developing world populations. Children of European ancestry who were of higher SES, were taller and heavier, and had higher absolute performances compared to boys of African ancestry (Ghesquiere & Eeckels, 1984). In undernourished children, reduction in body size and wasting of muscle mass were the main contributors to low motor performance and low physical fitness (Malina & Buschang, 1985; Spurr, Reina, Dahner, & Barac-Nieto, 1983). However, when motor performances were expressed relative to body size, differences between undernourished children and normal children were significantly reduced or disappeared (Ghesquiere & Eekels, 1984; Malina, Little, Shoup, & Buschang, 1987). This finding, however, did not mean that undernourished children were physiologically adapted to their condition; rather, it emphasized the role of reduced body size in the performance of children (Malina et al., 1987).

Motor performance of Malaysian children

A normative data set for Malaysian children ages 11 to 14 years old for five motor performances was constructed by the National Sports Council (Appendix A). These data were developed mainly due to the need for a reference for the sports talent identification process currently carried out by the council and the sports school. It should be noted that the sample number is largest for the 12 years old because the talent identification proces

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process is mainly conducted for children of this age. Motor performances included are those used for the selection of students of the sports school; 3-kg weight throw, vertical jump, 40-meter dash, agility hexagon, and 800-meter run.

For investigation of age related variations in motor performance among Malaysian children, the 50th percentile score for each motor task is presented in Table 6. For both boys and girls, there is an increase in performance over increasing age in only one of the tasks; the weight throw. The vertical jump for boys shows a decline at age 12, and then increases. For girls, this performance declines after age 11 until 13 years, and then shows an increase at age 14. For the other three tasks, boys' and girls' performance increases until the age of 13 years, and then shows a decline at the age of 14 years.

Table 6. Motor performance of Malaysian children (50th percentile score)

Gender	Motor Performance		Age (years) 11	12	13	14
Boys		N	276-426	32574-40129	9840-11940	615-828
	Weight throw (m)		5.5	6.0	6.6	7.0
	Vertical jump (cm)		33.9	32.1	35.9	37.8
	40-meter dash (sec)		7.46	7.27	6.84	6.99
	Agility hexagon (sec)		19.72	18.87	18.08	19.49
	800-meter run (sec)		266.2	259.2	238.5	251.1
Girls		N	229-379	33520-42248	9755-13428	348-540
	Weight throw (m)		4.2	4.7	4.7	4.8
	Vertical jump (cm)		29.6	28.6	28.1	29.3
	40-meter dash (sec)		8.22	8.06	7.85	8.04
	Agility hexagon (sec)		22.5	20.15	19.70	20.92
	800-meter run (sec)		283.9	294.6	285.7	290.48

Source: National Sports Council, Malaysia (1998)

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This trend, however, is not consistent with other studies (Branta et al., 1984; Haubenstricker & Seefeldt, 1986; Beunen et al., 1988) discussed earlier. As such, there is an indication that the normative data are not "the norms" for motor performance of Malaysian children, especially for the 11 and the 14-year-olds. The sample size for these age groups is relatively small, and thus, may not be representative of the Malaysian children. Nevertheless, gender differences in motor performance among Malaysian children were consistent to those reported in other studies. The performances of boys exceed those of girls and the differences become larger with increasing age.

Study of Young Athletes: General Considerations

Any attempt to examine the influence of training programs on young athletes is immediately beset with several problems. This has to do with the fact that physical training may induce changes in the same direction and approximately of the same magnitude as expected growth changes (Bailey & Mirwald, 1986). According to Malina et al. (1982), studies on young athletes should take into consideration such matters as definition, selection, variation of biologic maturity, and related factors that determine successful performance. Growth, maturation and physical performance are interrelated, and sociocultural factors are also related to growth and performance.

There is also need to quantify and qualify the training programs: e.g. frequency, duration and intensity of the training (Bailey et al., 1986). Finally, the method used should be able to tease out the effect of the program from those of growth and maturation (Bar-Or, 1993). To correctly evaluate training-induced changes during growth, one must therefore include a carefully selected control group. Matching the groups by chronological age alone may not be adequate. One must consider also the biologic age and spontaneous development of the subjects such as body height and body mass (Bar-Or, 1989; Meszaros et al., 1985).

Characteristics of young athletes

Young athletes are usually defined by success on interscholastic or agency teams, in national and international competitions, and in selected club and age-group competitions (Malina et al., 1982). They are a highly selected group, ordinarily based on skills, but sometimes size and physique may also be the criteria (Malina, 1996). Part of the variation in size, physique, and body composition is due to the variation in maturity status (Malina, 1998). This variation may be more significant at certain ages and in specific sports where size has a significant advantage. Children advanced in maturity differ in size, physique, and body composition compared to those who are average or delayed in maturation. The differences are especially pronounced during the adolescent phase of growth, about 9 through 16 years of age. Among boys, early maturation is positively correlated to strength and motor performance. Among girls, the relationship of strength and performance to biologic maturity is not consistent. Girls who mature later generally have better performance, and the differences between contrasting maturity groups are more apparent in later adolescence.

Early maturing males have had much success in team sports and other events that require motor skill prowess. It has been shown that physical characteristics are a selective factor in many sports, and success in sports at young ages is greatly influenced by size and physique (Malina, 1994a; Malina, 1996; Malina, 1998). Boys regularly active and successful in sports tend to be advanced in biological maturation, which accounts for their larger body size and more rapid growth during childhood and adolescence. Hale (1956) studied 112 boys who participated in the 1955 Little League World Series. He found that 17% of the participant were pubescent, 37.5% were prepubescent, and 45.5% were post pubescent. Furthermore, all who batted fourth and most of the starting pitchers were post pubescent. Krogman (1959) after analyzing 55 boys who played in the 1957 Little League World series stated that advanced biological maturation is a favorable factor in Little League baseball after finding that 71% of the participant were advanced in skeletal development.

Results from the studies by Hale (1956) and Krogman (1959) reflect the size advantage of early maturing boys in a sport in which many youngsters are selected for a position according to their size. Other sports such as football and basketball also show similar trend. Regular and outstanding interscholastic football layers were advanced in skeletal maturity at all ages between 10 to 15 years compared to non-participants (Clarke, 1971). Outstanding basketball players between 13 and 15 years, and track athletes between 12 to 15 years, were also advanced in skeletal maturity status compared to the non-participants. However, no maturity differences were observed between the senior high school athletes and non-participants.

Numerous reviews of the existing data on growth and maturity characteristics in young athletes have been published by Malina (1982, 1988a, 1988b, 1994,1996, 1998) and Malina et al. (1982). Characteristically, the median heights and weights of young athletes in several sports have been compared to the US reference data, while trends in maturity status were determined based upon skeletal age and secondary sex characteristics.

In general, athletes of both sexes in team sports have statures that equal or exceed reference medians (Malina, 1994; Malina, 1998). Similarly, the average statures of young athletes of both sexes in individual sports equal or exceed those of the US reference group. Gymnastics is the only sport that consistently presents a profile of short stature in both sexes. Although data are limited, figure skaters of both sexes also present shorter statures. Female ballet dancers tend to have shorter statures during childhood and early adolescence, but catch up to nondancers in late adolescence.

Body weights present a similar pattern. Young athletes in most sports have, on the average, body weights that equal or exceed the reference median. Only gymnasts and figure skaters consistently show lighter weights. Gymnasts and figure skaters, however, have adequate body weight for stature, while ballet dancers have low body weight for stature.

With few exceptions, male athletes of different competitive levels in a variety of sports are characterized by average or advanced in biological maturation (Beunen & Malina, 1996; Malina, 1994a; Malina 1998). Other than gymnasts, there is a striking lack of later maturing boys who are successful in some sports during early adolescence. However, later maturing boys are often successful in some sports in later adolescence (16 to 18 years), which demonstrates the catch-up in skeletal maturation and reduced significance of maturity-associated variation in body size and in the performances of boys in late adolescence (Malina, 1998).

At the senior high school ages, skeletal maturity did not consistently differ between the athletes and nonathletes, probably reflecting the catch-up of late maturing boys, and perhaps greater selection for skills (Malina, 1988b). The catch-up of late maturing boys durin

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during the high school years reduces the size differences so apparent in early adolescence. Also, at more competitive levels, skill is of more importance than the advantage afforded by larger body size and greater strength at the younger ages.

Most discussions of maturation of female athletes focus on the age at menarche, which is a late event in the pubertal sequence (Malina, 1998). Allowing for variation among samples within a sport, the prospective and status quo estimates for gymnasts, divers, and ballet dancers are reasonably consistent with the retrospective data, indicating later ages at menarche (Malina, 1996). On the other hand, the prospective and status quo data for track athletes, the status quo data for swimmers, and the prospective data for rowers are earlier that the retrospective estimates for late adolescent and adult athletes.

Female athletes tend to be average or later in biological maturation. Gymnast and ballet dancers tend to be later in maturation (Malina, 1998). Volleyball and basketball players are considerably taller and heavier than average. However, the maturity status of these athletes indicates skeletal ages, and secondary sex development that approximate the average. Hence, these athletes' larger size is not a function of accelerated growth rates or advanced maturation; it likely reflects the demand of the sports. In contrast to boys, there is a striking lack of early maturing girls who are successful in sport during adolescence, with the exception of swimmers during early and midadolescence. It also appears that average and late maturing girls persist in sport in later adolescence.

Relationships between anthropometric variables and motor performance among athletes are similar to those of non-athletes (Docherty & Gaul, 1991; Bale, Mayhew, Piper, B

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Piper, Ball, & Willman, 1992). Physical maturation, as reflected by height and body mass is a major contributor to increases in motor performance. A higher percentage of body fat and more endomorphy were related to poorer performance for relative aerobic capacity, 40-yard dash, and agility in boys, but only for upper body muscular endurance for girls. Mesomorphy has higher relationships with performance variables among male athletes than female athletes. Additionally, athletes' position within a sport and the participation of athletes in a certain sport is determined to some extent by their anthropometric characteristics. Body mass was found to differentiate between event participation in track and field (Hollings & Robson, 1991), while the centers in female basketball were much taller, had longer limb length, hip width and were more muscular than the guards (Bale, 1991).

Training responses in adolescents

One of the important factors of a sports program is the nature of the training involved. Physical activity is not necessarily the same as regular physical training (Bailey et al., 1986). Although physical activities are part of training program, not all physical activities qualify as training (Malina & Bouchard, 1991). These authors further defined physical training as regular, systematic practice of specific physical activities. Training should be sport specific, with the conditioning program specifically emphasizing the energy system required by a particular sport.

The frequency, intensity, and duration of each training program must be able to cause beneficial effects (Shephard, 1978; Wilmore & Costill, 1994). All well designed training programs must also incorporate the principle of progressive overload. In genera

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general, this principle holds that to maximize the benefits of training, the training stimulus must be progressively increased as the body adapts to the current stimulus. The body responds to training by adapting to the stress of the stimulus. The only way to continue to improve with training is to progressively increase the training stimulus, or stress. However, to determine at which stage of training to introduce a new stimulus is not that easy. It requires highly qualified coaches with broad training knowledge and experiences.

There are two approaches frequently taken in studying the effects of training on the physical performance of children and adolescents (Shephard, 1982; Bailey et al., 1986). The traditional approach to studying the influence of exercise, physical activity, or training on physical performance has been to compare athletes with nonathletes or trained subjects with untrained subjects, or to compare subjects according to various levels of physical activity. Another approach taken is to evaluate the influence of added physical activity or through an enriched physical activity program.

Studies of various types on young athletes indicate that children respond to vigorous training. Adolescent boys attending special swimming schools in Czechoslovakia were found to have vital capacities that exceeded normal age and height standards, and their heart volumes increased more rapidly than those of non-athletes (Sobolova, Seliger, & Grussova, 1971). Observation of female students attending similar schools noted that intensive training led an increase in aerobic power rather than the decline usually seen between 12 and 15 years of age (Sprynarova, Parizkova, & Jurinova, 1978). Bulgarian students, aged 9 to 16 years, who had been recruited to sports schools at a very early age had 18% to 24% advantage over non-athletic students of the same age in terms of maximum oxygen intake (Iliev, 1978).

Several other studies have also reported positive effects of intensive training on performance by comparing young athletes with nonathletes. Prepubescent, pubescent, and post pubescent males had significant strength gains after undergoing a 9-week resistance training program (Pfeiffer & Francis, 1986). Trained 15-year-old boys from a Belgrade swimming team exhibited higher maximal aerobic power in absolute values, and when expressed per kilogram body mass than the untrained group (Nikolic & Ilic, 1992). Sady et al. (1994) also found higher anaerobic performance in trained young wrestlers when compared to non-athletes with similar pubertal development. Tharp, Johnson, and Thorland (1984) found that male sprinters and distance runners had significantly higher anaerobic power and capacity than non-athletes in all the age groups studied: 10 - 11 years, 12 - 13 years, and 14 - 15 years.

Another approach taken to evaluate the influence of physical activity on performance has been the application of enriched physical education programs in school settings. Students enrolled in an enhanced physical education program (increasing the number of required physical education classes from three to five per week) for a one-year period showed a significant increase in handgrip force and performance test scores (Kemper, Verschuur, Ras, Snel, Splinter, & Tavecchio, 1978). A more recent study by Shephard and Lavallee (1994) reported similar findings, supporting the favorable effects of enhanced physical education programs on physical performance. Children who were assigned to experimental program that added five hours of specialist-taught physical education showed better aerobic power, isometric muscle strength, anaerobic power

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(47.5 m dash), coordination (shuttle run), and muscular endurance (sit-ups and flexed arm hang) than children in regular physical education programs. A study with similar findings on older children and adolescents was reported by Elnashar and Mayhew (1984). The fitness of Egyptian school children (9 to 18 years) as measured by the 6-item AAHPER test showed a significant improvement after eight weeks of twice weekly intensified physical education instruction.

Despite numerous reports of positive training responses in children, several authors have observed otherwise. Increased physical activity in the form of sport participation showed no significant influence on most motor fitness items except for pulse rate after a step test, pulse recovery after the step test, and the bent arm hang (Beunen et al., 1992). More active boys obtained better results than nonactive boys from age 14 years onward, but only for pulse recuperation and for performance on the bent arm hang. On the other hand, the active boys had less flexibility as indicated by lower sit and reach scores. They further suggested that the weak relationship between physical activity and physical performance might be due to the failure of the training stimulus to induce positive effects on performance.

Similar results were also presented by Andersen (1994) where a change in physical activity or sports related activity did not relate to change in physical fitness level for boys and girls 16.5 years of age. The relationships between level of sports participation, either for competition or health, or "no activity", and physical fitness measures were weak or non-significant. The author further suggested two additional explanations for these findings; part of the variability in fitness is explained by genetics, and that g

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and that growth and hormonal changes, especially in boys, override the stimulus of training.

Katzmarzyk, Malina, Song, and Bouchard (1998), found a significant relationship between activity and health related physical fitness, but a large part of the variability (80-90 %) was not accounted for by physical activity. They suggested that factors other than physical activity exerted a significant influence on the health-related physical fitness of children and youth. These factors were probably rooted in the biological and behavioral domains of changes associated with normal growth, maturation, and development from childhood through adolescence.

The evidence presented above suggests that child are susceptible to training effects during the adolescent period. The positive effects of training on physical performance, in turn, are associated with various training adaptations. Morphologically, regular training in children and adolescents results in a decrease in fatness and an increase in fat-free mass, quite often with an increase in body weight (Malina, 1989). Regular training in a youth strength-training program has the potential to increase bone mineral density and improve motor performance skills, as well as enhance sports performance, especially in those athletic activities in which strength, power, or speed are required (Webb, 1990; Faigenbaum, 2000).

Maximal aerobic power of children can be significantly increased in response to a vigorous, intensive training program (Krahenbuhl et al., 1985). Ventilatory efficiency of children at exercise is augmented by aerobic training and maximal values of ventilation and breathing frequency are increased in children and youth by endurance training (Zauner, Maksud, & Melichna, 1989). Although children respond to aerobic training as do adults, such training in the first decade of life has been reported to have negligible effects. It seems that control of ventilation at exercise is the same in children as adults, but exercise ventilation is less efficient in children. Aerobic trainability in young boys appears to improve markedly during the adolescent years (Naughton, Farpour, Carlson, Bradney, & Van Praagh, 2000). One of the most plausible explanations for this observation is the 'trigger hypothesis" which links increased aerobic improvements in adolescence with hormonal changes and substantial growth of the cardiorespiratory and musculoskeletal systems.

Anaerobic training appears to improve children's anaerobic capacity by increasing resting levels of phosphocreatine, adenosine triphosphate (ATP), and glycogen, increasing phosphofructokinase (PFK) activity and maximal blood lactate levels (Eriksson, 1972; Fournier et al., 1982; Bar-O, 1983). Phosphofructokinase which catalyzes anaerobic glycolysis is believed to be the main determinant of anaerobic capacity and is highly adaptive to training (Martin & Malina, 1998).

Training adaptations are specific to the mode of training; aerobic or anaerobic (Fournier et al., 1982). A study on the effects of three-month sprint and endurance training programs on 16-17 year-old male adolescents showed that the sprint trained group had significant increase in glycolytic (phosphofructokinase) enzyme activity, while the endurance training resulted in significant increase in oxidative (succinate dehydrogenase) enzymes. The study also showed that enzyme changes in adolescents due to training were similar in direction but different in magnitude to those found in adults. The reduced anaerobic power of the adolescent athletes compared to that of an adult has

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adult has been attributed to the intrinsic properties of the muscle that are yet to be fully understood (Naughton et al., 2000).

There is also a different training adaptation between male and female adolescents (Tharp et al., 1984). When expressed relative to morphological characteristics; height, body mass, lean body mass, and body surface area, no significant differences were found between sprint and distance female athletes for anaerobic power or capacity. However, male sprinters developed consistently greater anaerobic power and capacity than the distance runners. These findings suggested that in females, the difference in anaerobic performance was largely dependent on their morphological characteristics, while in males adaptation to training might be another factor influencing anaerobic performance.

Another concern surrounding increased physical activity or sports participation in adolescents is whether training for sports influences growth and maturation. In numerous comprehensive reviews of this area, Malina (1982, 1988a, 1988b,1989, 1994a, 1996, 1998) has made some interesting and relevant observations. Regular training has no apparent effect on attained stature, timing of PHV, and rate of growth in stature for in boys and girls, however, it affects weight and body composition (Malina, 1989). Increased physical activity in boys 13 -18 years of age did not significantly affect growth in somatic dimensions, including skinfolds, age at PHV, and skeletal maturation (Beunen et al., 1992). Similar finding were also reported for young British athletes age 8-19 years from four different sports; soccer, gymnastics, swimming, and tennis (Baxter-Jones, Helms, Mafulli, Baines-Preece, & Preece, 1995). Among girls, regular training in sport during puberty and the adolescent spurt did not apparently influence the timing and progressio

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progression of somatic and sexual maturation (Geithner, Woynarowska, & Malina, 1998; Malina & Bielicki, 1996).

Summary

It is evident that students of the sports school are young athletes and different from their peers in that they are successful in sport. They are a highly selected group, ordinarily based on skills and their physical performance. In addition, they are provided with better training opportunities and are more actively involved in sports activities than students in ordinary schools.

However, there are numerous other factors that affect adolescents' physical or athletic performance. Sometimes, size and physique may also be criteria. Although human beings generally follow a similar growth pattern, some variations occur between individuals of the same chronological age. Boys who are advanced in maturity status are generally taller and heavier, have more weight for stature, are more mesomorphic, are stronger and perform motor tasks requiring speed and power better than boys delayed in maturity status. In contrast to boys, the motor performance of adolescent girls is poorly related to maturity status, and it is often the late-maturing girls who attain better performance in late adolescence.

Boys who are successful in sports from relatively young ages tend to be advanced in biological maturation. Oftentimes, these young athletes differ in size, physique, and behavior when compared to their peers. They are generally taller and heavier than the reference population. Female athletes tend to be average or later in biological maturation, especially in ballet, diving, figure skating and gymnastics.

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Any study or discussion of youth sport cannot be done in a purely biological or purely social or cultural manner. Growth and maturation cannot be treated in isolation from cultural or social conditions. The processes underlying growth and maturation, apart from genetic, are also affected by environmental factors such as socioeconomic status, and health and nutritional conditions of the individuals.

CHAPTER 3

METHODS

The purpose of this study was to determine the current status of the sports program of a sports school in Malaysia, and to determine the effectiveness of the school program. The current status of the sport component of the school program was determined by comparing it to the original plan for the sports school. Using information submitted by the principal administrator and coaches of the sport school, a profile of the current program was established and compared to the original plan for the school.

The effectiveness of the sports school program was determined by examining the two components of the program, academic and sports. The academic achievement and motor performance of students enrolled in the sport school were compared to those of students from ordinary schools. Students' examination results were used to assess academic achievement while a battery of motor performance tests was used to assess the sports component of the program.

Design of the Study

The research process was divided into two parts. The first part was to determine the current status of the sports component of the school program, focusing on the characteristics of its current sports program and problems associated with its implementation. The second part focused on the central objective of the research, to determine the effectiveness of the school's program.

The current status of the sports program of the sports school was assessed through the use of a checklist. Using the checklist, the present status of three main areas of the sports program; namely, program content and policy, privilege and opportunity, and facility and training were compared to it's original plan.

Program effectiveness was examined using a non-equivalent pretest-posttest comparison group design. It was basically a two-factor (2 by 3) design with school and age groups as the independent variables. Academic achievement and motor performance scores of sports school students were compared to those of a comparison group comprised of students from ordinary schools. The purpose of the comparison group was to determine whether the program in the sports school had a differential effect on the academic achievement and motor performance of its enrollees. Several other variables were measured and constructed and used as covariates to control for preexisting differences between the two groups.

The logic of employing this design was that the two groups were not selected randomly from the same population as program recipients (Cambell & Stanley, 1966; Weiss, 1998). Since the comparison group was not similar to the program population, there was a need for statistical adjustments for preexisting differences between the two groups. A common method used to equate program participants and members of the nonrandom comparison group is to control statistically for the variables on which they differ. In the context of this study, variables that were likely to affect motor performance and ac

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and academic achievement were identified and the differences between the groups on those variables were controlled when analyzing the data.

Definition of Variables

The determination of the current status of the sports program was made by assessing three main areas of the program; policy and content, privilege and opportunity, and facilities and training. Policy and content are concerned with the goals, objectives, and sports program of the school, as well as the process for selecting teacher-coaches and students for the sports school. Privilege and opportunity refer to the privileges and opportunities received by students and teacher-coaches in the sports school, while facilities and training deal with facilities available and the sports training schedule at the sports school.

The independent variable to determine the effectiveness of the program is type of school. The dependent or outcome variables are the students' academic achievement and motor performance. Characteristics such as growth (stature and mass), proportions (sitting height/stature ratio), limb circumferences, body composition (sum of skinfolds, trunk/extremity skinfold ratio), estimated arm and calf musculatures, and nutritional status (body mass index) were also measured or derived form other measurements. In addition, the monthly incomes of parents were gathered as a measure of socioeconomic status, and students were classified as urban or rural by comparing their home addresses to a list of rural and urban areas in Malaysia. These variables were used as covariates to control for the effect of the independent variable on the outcomes.

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Participants

Participants in the study were the principal administrator and 37 coaches of the sports school, 226 boys and girls from the sports school, and a similar number of students from two ordinary schools in Malaysia. Twenty-three of the coaches were teacher-coaches comprised of 3 females and 20 males representing 11 sports (Table 7). Their ages were between 29 and 46 years with a mean age of 35.3 years. All non teacher-coaches were foreign coaches attached to the National Sports Council. They were comprised of 12 males and two females and their ages ranged from 35 to 60 years.

Table 7. Number of coaches who participated in the study

	Sports	Male	Female	Total
Teacher-coaches	Soccer, Sepak Takraw, Netball, Track and Field, Volleyball, Basketball, Field Hockey, Squash, Gymnastic Artistic, Cricket, Rugby	20	3	23
Non teacher-coaches	Soccer, Squash, Track and Field, Tennis, Fencing, Diving, Golf, Equestrian, Cricket	12	2	14
	Totals	32	5	37

The students were comprised of three different age groups; 13-year-olds, 14-year-olds, and 16-year-olds. In the Malaysian school system, these groups were differentiated by their grade level; Form One, Form Two, and Form Four. They were classified by the year in which they were born. The students' birth dates were obtained from their school records. The birth dates were verified through their birth certificate or an identity card when they were enrolled in the school. As such, the three different groups were born in 1987, 1986 and 1984, respectively. Their ages at the beginning of the study were between 146 to 155 months, 156 to 165 months, and 182 to 191 months for the 13-year-olds, 14-year-olds, and the 16-year-olds group, respectively. The number of students by school, age group, and gender is presented in Table 8. A total of 71 students from each type of school were in Form One (13-year-olds), 77 in Form Two (14-year-olds), and 78 in Form Four (16-year-olds). Due to the policy of the Ministry of Education concerning the involvement of students as research subjects, Form Three (15-year-olds) and Form Five (17-year-olds) students were not included in the study. According to this policy, these students are not allowed to participate in any type of research that requires their active participation because they will be sitting for their public examination at the end of the school year. The Pre-University students of the school also did not participate in the study because their school session only started in June, 2000.

Similar numbers of students from the same age groups, matched for gender and ethnic composition, were selected from two ordinary schools. Prior to school selection, an approval from the Ministry of Education, Malaysia was obtained. Upon approval from the Ministry, several ordinary schools located in urban areas were identified to be included in the study. The researcher then visited the schools and two schools were finally selected based on the availability of teachers and coaches, of testing facilities, and more importantly, the readiness of the school to be involved in the study. The availability of teachers was based on their academic qualification, a degree in physical education and exercise science, while testing facilities were determined by the availability of adequate testing areas and testing equipment.

Table 8. Number of students included in the sample by school, age group and gender

	Sports School		Ordinary School		Subtotal		Total
Age Group	Boys	Girls	Boys	Girls	Boys	Girls	
13-year-old	51	20	51	20	102	40	142
14-year-old	56	21	56	21	112	42	154
16-year-old	53	25	53	25	106	50	156
Totals	160	66	160	66	320	132	452

Participants selected from the sports school were also screened based on their sports participation. Only those involved in soccer, sepak takraw, netball, track and field, volleyball, basketball, field hockey, squash, cricket, and rugby were included in the study. Swimmers, gymnasts, divers, equestrians, weight lifters, and archers were excluded because these athletes underwent very highly specific training programs. Moreover, these athletes, except for the archers and equestrians, were not allowed to participate in the study by the relevant authorities as they were national athletes involved with the national team training program.

The distribution of the sports school students who participated in the study by age group, ethnicity, and sports for each gender is summarized in Tables 9 and 10. It should be noted that the sample size from the sports school was slightly smaller than the overall school enrollment for the selected age groups and sports (Appendix B). Ten subjects, five boys from the 14-year-olds group, four boys from the 16-year-olds group, and one girl f

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girl from the 16-year-olds group had incomplete data records due to injury or because they had moved from the school before the time of posttest data collection

Table 9. Distribution of sports school boys who participated in the study by age group, sports and ethnicity

	13-year-olds				14-year-olds				16-year-olds				Totals
Sports	M	C	I	O	M	C	I	O	M	C	I	O	
Soccer					12		1		25				38
Sepak Takraw	7		1		3				2				13
Track and Field	4	1			6	3			5		1		20
Volleyball	3	1			3				4	1			12
Basketball						3				4			7
Field Hockey	4		1		7				8				20
Squash	1				6	1			2	1			11
Cricket	4				9		2						15
Rugby	24												24
Totals	47	2	2		46	7	3		46	6	1		160

M: Malay C: Chinese I: Indian O: Others

Table 10. Distribution of sports school girls who participated in the study by age group, sports and ethnicity

	13-year-olds				14-year-olds				16-year-olds				Totals
Sports	M	C	I	O	M	C	I	O	M	C	I	O	
Netball	5		1		6	1			9		1		22
Track and Field	4	1	1		2		1		5	1			15
Volleyball	2	1			1	1				1			6
Basketball						2				3			5
Field Hockey	3				7				5				15
Squash	2												2
Totals	16	2	2		16	4	1		19	5	1		66

M: Malay C: Chinese I: Indian O: Others

The two ordinary schools selected for the study were labeled ordinary school A and ordinary school B. Ordinary school A has a total enrollment of 2222 students comprised of 1205 boys and 1017 girls, while ordinary school B has an enrollment of 2243 students with 1098 boys and 1145 girls. Both schools are located within the city limits of one of the state capitals in Malaysia.

Students in the ordinary schools had two 40-minute physical education classes a week. In addition, some of the students had the opportunity to be involved in inter-school age group sports competition held at district, state, and national level. Summary of ordinary school students' level of participation is presented in Table 11.

Distribution of subjects according to place of residence (rural or urban) nutritional is presented in Table 12. Rural or urban category was determined by comparing students' addresses with a list of rural and urban areas provided by the Department of Statistics, Malaysia. Nutritional status was classified as overweight based on the BMI cut off points for overweight and obesity published by Cole, Bellizzi, Flegal, and Dietz (2000). The cut off points presented by these authors were based on a heterogenous population (Brazil, Great Britain, Hong Kong, Netherlands, Singapore, and United States) and are more internationally acceptable than the percentile cut off values for the US population published by Must, Dallal, & Dietz (1991a, 1991b). However, Cole at al. (2000) did not provide cut off values for undernourished children. Therefore, the cut off values for undernourished individuals were based on Must, Dallal, & Dietz (1991a, 1991b) as recommended by WHO (1995). The cut off points for undernourished, nutritionally normal, overweight, and obesity for each age group is presented in Table 13, and the distribution of subjects according to their nutritional status is presented Table 14. However, it should be noted that the distribution for the sports school students might not correctly indicate their true nutritional status because BMI is not regarded as an accurate indicator of nutritional status for athletes.

Table 11. Level of sports participation for ordinary school students by gender and age group

	13-year-olds			14-year-olds			16-year-olds		
Level	District	State	National	District	State	National	District	State	National
Boys									
Soccer		2	1		2	2	2	5	2
Sepak		2		2	1		2		
Track and	3			2			2	2	
Volleyball							1		
Field Hockey				2	2		2		
Rugby	3			2			2		
Totals	6	4	1	8	5	2	11	7	2
Girls									
Netball				1			1		
Track and	1			2					
Volleyball							2		
Badminton							1		
Field Hockey				1			2		
Totals	1			4			6		

Table 12. Distribution of subjects by place of residence

Gender	School	Age group					
		13		14		16	
		Rural	Urban	Rural	Urban	Rural	Urban
Boys	Sports school	10	41	7	49	9	44
	Ordinary school		51		56	5	48
Girls	Sports school	3	17	2	19	4	21
	Ordinary school		20		21		25

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Table 13. Cut off points or percentile for nutritional status based on BMI

Age (years)	Cut off points or percentile (BMI)							
	Undernourished*		Nutritionally normal		Overweight**		Obese**	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
13	BMI-for-age < 5th percentile for all ages		BMI smaller than cut off point for overweight and larger than cut off percentile for undernourished		21.9	22.6	26.8	27.8
14					22.6	23.3	27.6	28.6
15					23.9	24.4	28.9	29.4

* based on Must, Dallal, & Dietz (1991a, 1991b).
** based on Cole, Bellizzi, Flegal, and Dietz (2000).

Table 14. Distribution of subjects by nutritional status

Gender	School	Age group											
		13				14				16			
		UN	NN	OW	OB	UN	NN	OW	OB	UN	NN	OW	OB
Boys	Sports school	2	47	2		3	46	7			51	2	
	Ordinary school	3	46	2		7	43	6		1	47	5	
Girls	Sports school		20				21			1	24		
	Ordinary school		20				20	1		1	19	5	

UN: undernourished NN: nutritionally normal OW: overweight OB: obese

Although the ordinary schools were located in urban areas, some students in these schools were from rural areas. One of the ordinary schools has hostel facilities to cater for these rural students. For nutritional status, composition of subjects for the 13-year-olds group was comparable between the sports and the ordinary schools. For the 14-year-olds group, boys of the ordinary school had more undernourished cases than the sports school. Boys and girls of the ordinary schools had more overweight cases than the sports school for the 16-year-olds group. None of the students participated in the study were in the obese category.

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Self-assessment of sexual maturity was used to determine the maturity status of the male students participated in the study. This assessment was based on descriptions and diagrams of stages of the pubic hair development (Tanner, 1962). Distribution of sexual maturity stages of the boys who participated in the study is presented in Table 15. Among the 13- and 14-year-olds, the sports school had more students at the higher stages than boys in the ordinary schools. However, among the 16-year-olds the number of boys at each maturity stage was comparable between the two schools.

Table 15. Distribution of male subjects by sexual maturity stage

Age group	School	Sexual maturity stage				
		1	2	3	4	5
13	Sports		14	24	13	
	Ordinary	12	39			
14	Sports		5	33	18	
	Ordinary		40	16		
16	Sports			5	31	17
	Ordinary			8	33	12

Instrumentation

Data were collected through several techniques. A model for collecting, organizing, and evaluating information relating to status of a program by Tyler (1981) was adapted to determine the current status of the sports program of the sports school. A checklist was developed to compare current status with the original plan of the sports school (Appendix C). This checklist, which was developed based on the original plan of the sports school, assessed the current status of the sports program through it's three main areas; program content and policy, privilege and opportunity, and facility and training. Related information was gathered fr

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was gathered from records and reports provided by the school, feedback from interviews with the school administrator (Appendix D), and from a survey questionnaire distributed to coaches (Appendix E).

Students' personal background information such as parents' monthly income and students' academic achievement was collected from respective school records. Academic achievement was based on the students' grades in their most recent examination, the mid-year examination. Examination results from the previous year were used to control pre-existing differences between the sports and the ordinary school students. Examination results used for this purpose were the Primary School Assessment Test (UPSR) for Form One, end of year examination for Form Two, and the Lower Secondary Assessment Test (PMR) for the Form Four students.

Students' physical characteristics were collected through anthropometric measurements, while a battery of motor performance tests was used to assess motor performance. A form was prepared to record each subject's personal information (i.e., date of birth, level of sport participation, time spent on sport/physical activities, home address) as well as the anthropometric and motor performance data (Appendix F). Self-assessment of sexual maturity was used to determine the maturity status of the male students (Appendix G). This assessment was based on descriptions and diagrams of stages of the pubic hair development (Tanner, 1962). However, due to social and cultural constraints, skinfold measurements and maturity assessments were not obtained from the female subjects.

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Data Collection

Data were collected at the beginning of year 2000 school session (mid-February through early March, 2000), and again at the end of year 2000 school session (mid-October through early November, 2000). Anthropometry, maturity status for boys, and motor performance measures were obtained at the beginning of the school year. Data secured included height, mass, sitting height, skinfolds (for boys), limb circumferences, and the boys' sexual maturity status. Stature and motor performance measures were again administered at the end of the school year. In addition, parents' monthly income and students' academic achievement was gathered from the schools' records, and times spent in sport/physical activities were collected from information provided by the students. Interviews were also conducted with the principal administrator of the sports school and survey questionnaires were distributed to coaches of the sports school during this period.

Data were collected by the teacher-coaches and physical educators of the schools involved under the supervision of the researcher. The researcher's involvement in data collection was in conformity with the prior approval from the Ministry and the schools involved. It should also be noted that this study is part of a five-year evaluation process of the sports school program that is presently being undertaken by the school. The researcher's involvement was to standardize measurements involved between the sport school and the ordinary schools, to train teacher-coaches and physical education teachers in administering the anthropometric and motor performance tests, and to supervise the data collection procedures. Currently, most secondary schools in Malaysia are carrying out a biannual physical fitness testing program which includes sit-ups, pushups, the sit-and-reach, and a 1,500/800 meter run. The sports school conducts a different set of performance tests comprised of the sit-and-reach, a 3 kg ball throw, a 40-meter dash, an 800-meter run, a 10-meter shuttle run, and a vertical jump to evaluate it's athletes. The motor performance test battery employed in this study was similar to that used in the Motor Performance Study conducted by Department of Kinesiology, Michigan State University, except the endurance shuttle run was replaced by the 800-meter run. The reason for this selection was to provide an additional reference for motor performance data of the current study.

One male and one female physical education teacher from each of the ordinary schools, and 10 teacher-coaches from the sports school were involved in the data collection. For anthropometry, physical education teachers in the ordinary schools performed all the measurements, the male teacher assessed the male students and the female teacher assessed the female students. At the sports school, anthropometry was administered by a station approach. Four stations were set up, one each for measuring body mass, stature and sitting height, limb circumferences, and skinfolds. For every station, except for limb circumferences, one teacher performed the measurement while another teacher assisted by being the recorder. For limb circumference measurements, a male teacher measured the male students, while a female teacher measured the female students.

Prior to pretest data collection, coaches and physical educators from the sports and the ordinary schools were briefed and trained by the researcher regarding procedures involved in the measurements at their respective schools. Teachers involved in anthropometry were provided a handout with instructions, guidelines, and pictures for doing anthropometric measurements (Lohman, Roche, & Martorell, 1988). Explanation and demonstration of how to do the measurements, how to use the instruments, and how to determine measurement sites (limb circumferences and skinfolds) was also conducted by the researcher. The teachers then practiced doing the measurements on a few students with the supervision of the researcher. Since most of the teachers were quite familiar with the measurement of stature, sitting height, and body mass, the training was mostly focused on the measurement of limb circumferences and skinfold thicknesses. This was in part due to their involvement in talent identification process conducted by the National Sports Council. While teacher-coaches at the sports school conducted such measurements at the national level, teachers of the ordinary schools are involved at the state level. Moreover, similar measurements had been introduced by the researcher and conducted by the teacher-coaches of the sports school in 1998 as part of the researcher's independent study.

The duration of the training was from five to six days, two to three hours per day. For their training, they were also provided with limits for intra–measurer error which served as guidelines for their competency in doing the measurements. The limits were 0.2 cm for stature (Gordon, Chumlea, & Roche, 1988), 0.3 cm for sitting height (Martin, Carter, Hendy, & Malina, 1988), 0.2 cm for arm and calf circumferences (Callaway et al., 1988), and 1 mm for skinfold thicknesses (Harrison et al., 1988). At the sports school, the teacher-coach who was most competent in skinfold measurements was assigned to do the skinfold measurements. This competency was determined by the ability of the teacher-coaches following instruction and procedures of the measurements, particularly in locating measurement sites and in measurement technique. The teachers' competency in anthropometric measurements was determined through their consistency in performing the measurements. They were assumed competent when three out of five pairs of replicated measures were within the intra-measurer and inter-measurer errors reported in other studies. Inter-measurer errors were determined by comparing the teacher's measurement to the researcher's measurement. The limits for error were 0.3 cm for stature (Gordon et al.,1988), 0.5 cm for sitting height (Martin et al., 1988), 0.2 cm for arm and limb circumferences (Callaway et al., 1988), and less than 2 mm for skinfold thicknesses (Harrison et al., 1988). The researcher also gave supervision while they were performing the measurements on the first few groups of students. Additionally, a second measurement was conducted on 10 percent of the subjects under the supervision of the researcher within a one-week time interval. These replicated measurements were then used to calculate intra-measurer error.

The same teachers and teacher-coaches administered the motor performance tests. They received detailed instructions and training on the administration of the tests. Since all of them were familiar with administering performance tests, training was focused on procedures that were different from those used for frequently administered tests at the respective schools. For the dash, the distance used in the study was 30 yards instead of 40 meters usually administered by the schools, and using a running start instead of a standing start. For the flexed-arm hang, the palms away position was stressed as the students tended to perform otherwise. The researcher also gave supervision while they were administering the tests to the first few groups of students. Additionally, retest scores for 10 percent of the subjects were obtained under the supervision of the researcher within one to two-week time interval for calculation of test-retest reliability.

The respective schools fixed data collection schedules with considerations on time suitability and students' availability to ensure easier participation of the students. Anthropometric measurements and motor performance tests for students at the sports school were collected during their morning physical conditioning session before academic class started, so as not to interrupt the academic lessons and their skill training, which was held in the afternoon. For students at the ordinary schools, data were collected during their physical education classes. This was to ensure full participation of selected students since they did not have to come to school outside normal school hours.

For the beginning of the year data collection, subjects were administered the anthropometric measurements and motor performance tests within a two-week time interval. The first week was allocated for anthropometric measurements and the following week for motor performance tests. All measures, except for the 800-meter run were administered in a multipurpose hall at the school. Motor performance tests were administered on outdoor courts at the ordinary schools. Anthropometry and motor performance test schedules were similar to those of the sports school unless the physical education class was canceled due to rain. In such cases, motor performance tests for students affected were administered the following week. Similar schedules were also used for data collection at the end of the school year. For anthropometry, only stature was measured at this time.

In accordance with the University policy, an approval from the University Committee on Research Involving Human Subjects (UCRIHS), consent from parents (Appendix H), and assent from students (Appendix I) were obtained for the students' participation and the use of existing data gathered from the schools. Verbal informed consents were obtained from the administrator of the sports school before conducting the interview (Appendix J). Coaches' consent was indicated by their willingness to return the survey questionnaire distributed to them (Appendix K).

Procedures

Anthropometric measurements

Body mass, stature and sitting height were measured with the participant attired in sports clothing (track bottom and tee-shirt) and barefooted according to methods described by Gordon et al. (1988) for mass and stature, and Martin et al. (1988) for sitting height. Limb circumferences and skinfold thicknesses were measured according to methods by Callaway et al. (1988) and Harrison et al. (1988). Mass was measured using a Health-o-Meter Professional scale. Due to the unavailability of an anthropometer, stature and sitting height were measured with a locally made portable stadiometer. The use of a portable stadiometer in constructing a sitting height table for measuring sitting height has been reported by Cameron (1982). Skinfolds were taken on the right side of the body using a Lafayette (Model 01127A) caliper. Limb circumferences were taken on the right side of the body using a nonstrechable flexible tape.

Stature. Each participant was asked to stand erect, heels together with weight distributed evenly on both feet, facing away from the vertical board of the stadiometer.

The head was positioned in the Frankfort Horizontal Plane and the arms hanging freely by the sides of the trunk, with the palms facing the thighs. A reading to nearest 0.1 cm was recorded.

Mass. Each participant was asked to stand still over the center of the platform scale with the body weight evenly distributed between both feet. The reading was recorded to the nearest 0.1 kg.

Sitting height: A portable stadiometer was placed on a table for the measurement. The edge of the stadiometer platform was in line with the edge of the table. In cases where the position of the knees exceeded the edge of the platform, a wooden block of the same thickness was placed in front of the platform so that the edge of the wooden block was in line with the edge of the table. The subjects sat on the platform with the legs hanging unsupported over the edge of the table and with the hands resting on the thighs. The knees were directed straight ahead. The backs of the knees were near the edge of the table but not in contact with it. The subject sat as erect as possible, with the head in the Frankfort Horizontal Plane. The measurement was made from the sitting surface to the top of the head to the nearest 0.1 cm.

Upper arm circumference: The subject stood erect, with the arm hanging freely at the sides of the trunk. The measurement was taken at point midway between the acromial and olecranon processes to the nearest 0.1 cm.

Calf circumference. The subject stood with the feet about 20 cm apart and weight distributed equally on both feet. An inelastic tape measure was positioned horizontally around the calf and moved up and down to locate the maximum circumference. The maximum circumference was recorded to the nearest 0.1 cm.

Triceps skinfold. The triceps skinfold was measured in the midline of the posterior aspect of the arm, over the triceps muscle, at a point midway between the lateral projection of the acromion process of the scapula and the inferior margin of the olecranon process. The subject was measured standing, with the arm hanging loosely and comfortably at the subject's side. The triceps skinfold was picked up with the left thumb and index finger, and measurement was recorded to the nearest 0.1 cm.

Suprailiac skinfold. The suprailiac skinfold was measured in the midaxilarry line immediately superior to the iliac crest. The subject stood with feet together in an erect position, with the arms hanging by the side. An oblique skinfold was grasped just posterior to the midaxilarry line following the natural cleavage lines of the skin. The caliper jaws were applied about 1 cm from the fingers holding the skinfold, and the thickness was recorded to the nearest 0.1 cm.

Medial calf skinfold. The subject stood with the foot on a platform or box so that the knee and hip are flexed to about 90^0. The measurement was made at the level of maximum calf circumference on the medial aspect of the calf. The thickness of the fold was measured to the nearest 0.1 cm.

Subscapular skinfold. The subject stood comfortably erect, with the upper extremities relaxed at the sides of the body. To locate the side, the measurer palpated the scapula, running the fingers inferiorly and laterally, along the vertebral border until the inferior angle was identified. The skinfold was picked up on a diagonal, inclined infero-laterally approximately 45^0 to the horizontal plane in the natural cleavage lines of the skin. The thickness was recorded to the nearest 0.1 cm.

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Motor performance

The battery of seven motor performance tests administered for pretest data collection at the beginning of the school year were also administered for posttest data collection at the end of the school year. The tests included in the battery are; flexed-arm hang (FAH), jump and reach (JR), thirty-yard dash (TYR), sit and reach (SR), agility shuttle run (ASR), standing long jump (SLJ), and 800-meter run (ER). Detailed instructions for the administration of these tests are presented in Appendix L. Retest scores for ten percent of the subjects were also obtained under the supervision of the researcher within a two-week time interval. These scores were used for calculating test-retest reliability coefficients of the motor performance tests.

Maturity status

Maturity status was assessed on male students only at the beginning of the school year. Each student was provided with descriptions and diagrams of Tanner's five-stage scales of pubic hair development (Appendix G). They were then required to assign a stage to themselves that most closely resembled the description and diagram provided. The students were allowed to return their response at the end of the school day or the next day in order to allow them to make a more accurate observation of their pubic hair development.

Measurement Reliability and Variability.

Anthropometry was taken by the physical educators and coaches of the schools involved. At each school, intra-observer measurement variability was calculated on replicate measurements of approximately 10% of the sample, taken one week after the first set. The technical error of measurement proposed by Malina, Hamill, and Lemeshow (1973) was used as the indicator of measurement variability.

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

where,

σ_e = technical error of measurement

d = differences between measurements

n = number of pairs

Since the sports school and the ordinary schools are located in different cities and due to the tight work commitments among of the teachers and teacher-coaches, inter-observer measurement variability between teachers and coaches involved could not be administered. Nevertheless, inter-observer measurement variability was calculated for measurements taken by teachers and coaches at the respective schools and measurements taken by the researcher one week apart on approximately 10% of the boys' sample. Intra- and inter-observer technical errors of measurements presented in Table 16 were within ranges observed in other studies.

Within day and between day reliabilities for motor performance tests were calculated on approximately 10% of the sample (Table 17). Correlation between the best and second best trials were used to indicate the within day reliability. Between day reliability was calculated on measurements taken one week apart. Within day and between day reliabilities for both pretest and posttest data were comparable to reliabilities reported by other investigators. Test retest reliability for flexed-arm hang has

been reported as high as .90 (Johson & Nelson, 1979), jump and reach between .75 and.95 (Seils, 1951; Johnson, 1962), agility shuttle run between .59 to .73 (Keogh,

Table 16. Intra- and inter-observer technical errors of measurement for present sample and other studies.

	Intra-observer							Inter-observer					
Study	1a	1b	1c	2	3	4	5	1a	1b	1c	3	4	5
N	24	13	13	42	77	15	32	18	10	10	244	13	50
Mass (kg)	.34	.35	.33	.14	.53	.45		.39	.36	.37		.78	
Stature (cm)	.56 (.43)	.57 (.53)	.58 (.49)	.41	.49	.64	1.28	.63 (.45)	51(.46)	.70(.53)	.68	.11	.82
Sitting Height (cm)	.65	.66	.69	.31	.53	.75	.57	.74	.75	.78	.70	.12	.57
Circumferences (cm)													
Arm, relaxed	.30	.31	.35	.26	.35	.07	.65	.31	.32	.36	.42	.37	1.33
Calf	.31	.29	.36	.24	.30	.24	.85	.53	.35	.45	.34	1.4	.52
Skinfolds (mm)													
N	18	10	10					18	10	10			
Triceps	.45	.50	.59	.46	.80	.19	1.60	1.30	1.26	1.46	1.89	1.14	2.59
Suprailiac	.62	.63	.67	.32	1.87		3.25	2.10	2.37	2.08	1.53		3.90
Subscapular	.54	.59	.59	.29	1.83	.49	2.22	1.58	2.14	2.37	2.45	.95	3.30
Medial calf	.64	.71	.67		1.44	.66	2.72	1.64	2.16	2.19	2.44	3.02	3.92

( ) - posttest measurement error

1a - present study, sports school, one measurer for each measurement except for circumferences which had two measurers; 1b and 1c - present study, ordinary schools A and B, two measurers for each measurement , intra-observer technical errors for boys and girls except for skinfolds(boys only). Inter-observer technical errors for boys only. Replicates taken after approximately one week.

2 - Naidoo (1999), 10 year old South African boys, replicates taken four days after initial measurements.

3 - Johnston, Hamill, & Lemeshow (1972) and Malina, Hamill & Lemeshow (1973), U.S Health Examination Survey, Cycle III, 12 – 17 years, replicates taken within 2 ½ weeks after initial measurements.

4 - Vadocz (1999), North American competitive female figure skaters, 11.5 – 22.3 years, within day replicates.

5 - Chumlea, Guo, Kuczmarski, Johnson & Leahy (1990), U.S Hispanic Health and Nutrition Examination Survey, 12 – 73 years, replicates taken 2 –3 weeks after initial measurements.

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1965), Standing long jump between .77 to .91 (Kane & Meredith, 1952; Keogh, 1965), thirty yard dash ranging from .57 to .86 (Seils, 1961; Keogh, 1965).

Table 17. Within and between day correlations for pretest and posttest motor performance tests

	Pretest		Posttest	
	within day	between day	within day	between day
Flexed arm hang		.95		.92
Jump and reach	.96	.96	.96	.95
Thirty yard dash	.95	.85	.94	.81
Sit and reach	.98	.93	.98	.90
Agility shuttle run	.87	.77	.82	.72
Standing long jump	.92	.93	.97	.91
800 meter run		.94		.93

A physician at the National Sports Council also assessed thirty students from the sports school, ten from each age group, for their pubic hair development. Concordance rate and correlation between the students' and the physician's assessments were calculated to determine reliability of the students' assessment (Table 18). Concordance rate and correlation between students and physician assessments was slightly lower but comparable with those reported in other studies.

Table 18. Concordance rate and correlations between students and physician assessment for status of maturation with comparative data from other studies.

	Present study	Boas et al. (1995)	Neinstein (1982)	Duke et al. (1980)
Concordance rate	76% (23/30)	85% (29/34)	77% (17/22)	91% (21/23)
Correlation	.81		0.87	

Derived Dimensions

Some of the data collected were used to construct the following dimensions:

1. Total subcutaneous fatness was estimated from total skinfolds (sum of the triceps, subscapular, suprailiac, *and* medial *calf* skinfolds)
2. Relative fat distribution was estimated from a trunk/extremity skinfolds ratio (sum of subscapular and suprailiac skinfolds/sum of triceps and medial calf skinfolds).
3. Relative trunk or leg length was estimated from sitting height/stature ratio.

   Sitting height/ stature X 100
4. Arm and calf musculature was estimated using the method of Frisancho (1981):

   i. Arm muscle area (cm^2) = $1/4\pi\ [C_a - \pi T)]^2$

   where: C_a = arm circumference (cm)

   T = triceps skinfold (mm)

   ii. Calf muscle area (cm^2) = $1/4\pi\ [C_a - \pi T)]^2$

   where: C_a = calf circumference (cm)

   T = medial calf skinfold (cm)

5. Nutritional status: Body mass index (BMI) for the whole US population compiled and published by Must, Dallal, & Dietz (1991a, 1991b) and BMI for international population by Cole et al. (2000) was used as the basis for anthropometric indicators of undernourished, overweight, and obesity during adolescence. The cut off points for each nutritional status for each group for boys and girls was earlier presented in Table 13.

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$$BMI = \text{Weight (kg)}/\text{height (m)}^2$$

6. Area of residence: Students' area of residence was classified as rural or urban by comparing their home addresses to a list of rural and urban areas in Malaysia (Department Of Statistics, Malaysia, 1994). Urban areas are defined as follows:

    i. areas gazetted by the local council as urban and adjoining saturated built-up areas,
    ii. the saturated built-up areas must have a population of at least 10000 peoples, with less than 40 percent involved in agricultural activities,
    iii. at least 30 percent of built-up area residence have modern sanitary facilities.

7. Academic achievement: Grade Point Average (GPA) will be used as a measure for academic achievement. The Malaysian school system uses alphabetically scaled grades for students' achievement. So for the purpose of calculating the GPA, an alphabetic grade for each course will be first converted to a point grade score (Table 19).

Table 19. Conversion table for students' academic grade

Alphabet grade	Point grade
A	4.0
B	3.0
C	2.0
D	1.0
E/F	0

Grade Point Average (GPA) = total point score/number of courses

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Standardization of academic achievement

Comparing school-administered academic results between different schools may be confounded by a different degree of difficulty of the examinations. As such, an attempt was made to standardize academic achievement between the schools involved in this study. School-administered examination results, the Lower Secondary School Assessment Trial (PMRT) were compared to the national public examination results, the Lower Secondary School Assessment (PMR). These two examinations covered a similar content and are usually held within a one-month time interval. The number of A's, B's, C's, D's and F's and the means were compared between the two examinations for each school. These differences were then compared between the schools and using the means and standard deviations of each school GPA in both examinations, a new point score was assigned for each alphabetical grade for the respective schools.

$$\text{Grade point score} = \frac{\overline{X} - \overline{X}_{SA}}{SD_{SA}} \times SD_N + \overline{X}_N$$

where $\overline{X}$ = initial alphabetical grade point score

$\overline{X}_{SA}$ = mean for school-administered examination

SD_{SA} = standard deviation for school administered examination

$\overline{X}_N$ = mean of the national public examination for specific school

SD_N = standard deviation of the national public examination for specific school

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The adjusted point score for each alphabetical grade after taking into consideration the differences between the school administered test and the public examination are presented in Table 20.

Table 20. Adjusted point score for alphabetical grade for each school

Alphabet grade	Point grade		
	Sports school	Ordinary school A	Ordinary school B
A	4.39	4.92	4.57
B	3.40	3.56	3.44
C	2.42	2.20	2.31
D	1.43	0.84	1.17
E/F	0.45	-0.52	0.036

Data Analyses

Data analyses were conducted based on the research questions of the study. Analysis of the current status of the sports school was done using a checklist that was developed based on the original plan of the school and on information submitted by administrators and coaches of the school. This checklist was divided into three main areas: program content and policy, privilege and opportunity, and facility and training. The three main areas of the sports program were also assessed for adequacy through responses made by the administrator and teacher-coaches of the sports school. Additionally, problems associated with the program were presented.

The effect of the sports school program on motor performance and academic achievement was statistically determined. Descriptive statistics were calculated for all variables for boys and girls for all age groups. Relevant multivariate and univariate inferential statistics were utilized based on research questions of the study.

Question 1. To what extent does the current status of the sports school meet the original plan of the program?

Using the information gathered from records, reports, and feedback from the administrator and coaches, a profile of the current status of the sports program of the sports school was established. This profile was compared to the original plan of the program using a checklist to determine the extent to which the current status meets the original plan. In addition, feedback from interviews and survey questionnaires distributed to the administrators and coaches of the school were used to determine adequacy and problems associated with the implementation of the school's sports program.

Self-evaluation by the teacher-coaches on the adequacy of the sports program was gathered using a 4-point Likert scale. Numerical weights were assigned to each of the four response categories. Due to the nature of the statements presented in the survey questionnaire, the extent of agreement or disagreement of the respondent with each statement reflects the level of adequacy of the item and the program area assessed (see Appendix E). Except for questions "the policy developed needs revision" and "there is a need for more coordination with various sports organizations", the response for "completely agree", "tend to agree", "tend to disagree", and "completely disagree" were assigned scores of 4, 3, 2, and 1 respectively. Due to the nature of these two questions, the responses were inversely scored. Thus, a higher score indicated greater adequacy of the program.

To determine the level of adequacy of the program, means for each question were computed. Average means for questions related to each of the areas assessed were used to indicate adequacy for the particular area assessed. The rating means were defined as follows:

Highly adequate: mean ratings of 3.51 and above
Moderately adequate: mean ratings of 2.51 and 3.5
Lowly adequate: mean ratings of 1.51 and 2.50
Inadequate: mean ratings of 1.50 and below

Problems associated with conducting the program were ordered through rankings made by the coaches on six problems posed in the survey questionnaire. Rankings for each problem were averaged and the problem with the smallest mean was determined to be the greatest problem faced by the coaches.

Question 2. Are there differences in motor performance between students enrolled in the sport school and in the ordinary schools?

Separate analyses were conducted for boys and girls. Multivariate analysis of variance (MANOVA) was conducted to test the effects of school, age group, and their interaction on the initial (pretest) motor performance. When warranted by a significant MANOVA, specific between age group differences were determined using the Bonferonni post hoc test. Follow up tests, utilizing the multiple regression analysis were also generated for each of the motor performance tests for each age group.

Multivariate analysis of covariance (MANCOVA) was performed to test the effect of school controlling for the covariates on the initial motor performance. For boys, growth status (mass, stature), maturity status, SES (income), proportion (sitting height/stature ratio), body composition (sum of skinfolds; trunk/extremity skinfold ratio), and nutritional status (BMI) were entered as the covariates. For girls, growth status (mass, stature), SES (incom

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SES (income), proportion (sitting height/stature ratio), and nutritional status (BMI) were the covariates. For each age group, follow up tests utilizing multiple regression analysis were performed to examine the effect of school while controlling for the covariates for each of the motor performance variables.

Question 3. Is there an effect of the sport school program on the motor performance of secondary school students in Malaysia?

Separate analyses were conducted for boys and girls. MANOVA was performed to test the effects of school, age group, and their interaction on the posttest motor performance. When warranted by a significant MANOVA, specific between age group differences were determined using the Bonferonni post hoc test. Follow up tests, utilizing the multiple regression analysis were generated for each of the motor performance tests for each age group.

MANCOVA was performed to test the effect of the sports school program on posttest motor performance controlling for the covariates. Posttest scores were entered as the dependent variables, while pretest scores of motor performance were entered as covariates in addition to the covariates listed for analysis in Question 2. Additionally, stature measured at the time of the posttest was included to control for the effect of growth. When warranted by a significant MANCOVA, specific between age group differences were determined using the pairwise comparisons of the estimated marginal means. Follow up tests utilizing multiple regression analysis were performed to examine the effect of school controlling for the covariates for each of the motor performance tests for each age group.

Question 4. Which motor performance tasks, if any, distinguished between students of the sport and ordinary schools?

Separate analyses were conducted for boys and girls. For each age group, a discriminant analysis was performed to determine motor performance scores (posttest) that distinguished between the sport school and the ordinary schools. Further investigation using the classification process of discriminant analysis was conducted to determine the percentage of students that rightly belongs or most closely resembles type of school.

Question 5. Does the effect of the school program on motor performance vary by age group among students of the sports school?

Multivariate analysis of covariance (MANCOVA) was performed to test the effect of age on motor performance among students of the sport school. Posttest scores of motor performance were entered as the dependent variables, while pretest scores of motor performance and posttest stature were entered as covariates, in addition to the covariates listed for analysis in Question 2. When warranted by a significant MANCOVA, specific between age group differences were determined using the pairwise comparisons of the estimated marginal means.

Question 6. Are there differences in academic achievement between students enrolled in the sport school and in the ordinary schools?

An analysis of variance (ANOVA) and analysis of covariance (ANCOVA) were conducted to test the effects of school, gender, age group and their interaction on the initial (pretest) academic achievement. For the ANCOVA, monthly income and place of residence were included as the covariates. When warranted, specific age group differences were determined through pairwise comparisons of the estimated marginal means. Multiple regression analysis was performed to determine the effect of school on academic achievement controlling for the covariates for each age group.

Question 7. Is there an effect of the sport school program on the academic achievement of secondary school students in Malaysia?

ANOVA and ANCOVA were performed to determine the effect of the sport school program on posttest academic achievement. For the ANCOVA, the pretest academic achievement was added as a covariate, in addition to SES and student' place of residence.

Additionally, specific age group differences of posttest academic achievement were determined through pairwise comparisons of the estimated marginal means. Multiple regression analysis was performed to determine the effect of school on academic achievement controlling for the covariates for each age group.

Power for Statistical Analyses

Statistical power in research is determined by four parameters; alpha, power, effect size, and sample size (Cohen & Cohen, 1983). Cohen defined the power of the test as 1 - β (the probability of rejecting the null hypothesis). Cohen (1988) also indicated that in most behavioral and applied research, the appropriate ratio between beta and alpha is 4:1. As such, if alpha is set at 0.05, beta would be 0.2 and power equals to 0.8 (Cohen & Cohen, 1983; Cohen, 1988). He further suggested that effect size for the social and behavioral sciences could be interpreted as 0.8 representing a large effect, 0.5 a moderate effect, and 0.2 as a small effect. Having a power of 0.8 sets the level of error acceptable to the experimenter (Thomas, Lochbaum, Landers, & He, 1997). Stevens (1980, 1986) provided power values for two-group MANOVA for 2 through 7 dependent variables, with group size varying from small to large. Thomas and Nelson (1987) provided a graphic figure to estimate sample size for alpha value 0.05 and 0.01 for different power and effect size.

This study employed MANOVAs and MANCOVAs with 7 dependent variables (motor performance), and ANOVAs and ANCOVAs to determine the effects of the sports school on motor performance and academic achievement. According to Stevens (1980, 1986), at an alpha of 0.05, multivariate analysis with seven dependent variables at a moderate effect size of 0.64 and power of 0.8 requires about 45 subjects per group. According to Thomas and Nelson (1996), if alpha =0.05, power is established at 0.08 and the effect size at 0.06, the sample size required is about 20 for each age group.

Based on the above discussions, the sample size for boys for each age group (N= 51 - 56) in this study is large enough to provide adequate statistical power for the multivariate analysis. However, the sample size for girls was smaller than required for the multivariate analyses. This inadequate sample size may lack the power to detect significant differences in motor performance between the sports school and the ordinary school girls.

CHAPTER 4

RESULTS AND DISCUSSION

The purpose of the study was to determine the current status of the sport component of a sports school program, and to determine the effects of the school program with regard to students' motor performance and academic achievement. The determination of the current status of the sports program was made through three main areas of the program: content and policy; privileges and opportunity; and, facilities and training. Additionally, problems associated with the conduct of the sports program were identified.

Effectiveness of the sports school program was determined by comparing the motor performance and academic achievement of the sports school students to students of ordinary schools who served as a comparison group. Motor performance and academic achievement attained after a one school year were compared controlling for preexisting differences measured at the beginning of the year.

In this chapter, each of the seven research questions of the study will be reviewed. To specifically answer question one, the data relating to this question will be presented and determination of the current status of the sports school program will follow. For questions two through seven, the results of descriptive and inferential statistical procedures will be reported.

Results

Question 1. To what extent does the current status of the sports school meet the original plan of the program?

The data pertaining to question 1 were obtained through an interview with the administrator of the sports school, a survey questionnaire to coaches, and from annual reports of the sports school. A checklist was developed and used to compare the present status of the sports school to its original plan. The evaluation was carried out along three main areas of the school program: program content and policy; privilege and opportunity; and, facility and training.

Program content and policy

Goal and objectives

A comparison between the current and the planned goal and objectives of the sports school program is presented in Table 21. Basically there was no change in the goal and objectives of the program except for one additional objective, to create a strong base of support for scientific research in the field of sports. This objective was proposed by the Sports Division, Ministry of Education, following a reevaluation of the program in 1997 (Ministry of Education, 1997). The need for this objective was due to the lack of sports research in Malaysia, especially on the development of young athletes. With the establishment of the sports school, the ministry realized the need for scientific research to evaluate the performance of young athletes and to establish performance norms which were not available for Malaysian adolescents. This objective was parallel to the

Table 21. Comparison of goal and objectives between the current status and the original plan of the sports school program

	Original plan	Current
Goal	To produce athletes who not only excel in sports but also have strong academic achievement.	To produce athletes who not only excel in sports but also have strong academic achievement.
Objective	To improve athletes' performance in their respective games by providing them with well-equipped sports facilities, highly qualified sports personnel, and systematic training programs.	To improve athletes' performance in their respective games by providing them with well-equipped sports facilities, highly qualified sports personnel, and systematic training programs.
	To create a balance between the need for sports and academic excellence by providing them with a conducive learning environment and sufficient academic assistance.	To create a balance between the need for sports and academic excellence by providing them with a conducive learning environment and sufficient academic assistance.
	To instill and encourage the development of positive moral values through their involvement in sports activities and competition.	To instill and encourage the development of positive moral values through their involvement in sports activities and competition.
	To impart knowledge about careers in the sports industry such as sports administrators, sports psychologists, fitness instructors, sports medical officers, coaches, trainers, and other sports related experts.	To impart knowledge about careers in the sports industry such as sports administrators, sports psychologists, fitness instructors, sports medical officers, coaches, trainers, and other sports related experts.
		To create a strong base for scientific research in the field of sports.

national development of sports research in Malaysia with the establishment of the National Sports Institute, a division that was set up at the National Sports Council.

Activities offered in the sports program

The number of sports offered at the sports school increased from 12 stated in the original plan to 27 in the year 2000 (Table 22). Over the years, new sports were introduced as the intake of students varied in terms of their sports participation. Although the school was planned to offer only 12 sports, its development also had to accommodate the preparation of national athletes for future international sports events. In addition, the schools had to cater to school-aged national athletes who will compete in international competition. These national athletes underwent a special training program under the supervision of national coaches from the National Sports Council but attended their academic lessons at the sports school. For this reason, the type of sports offered and the intake of students varied depending on preparation for major international sports events. Currently, there are 52 national athletes at the sports school who will be competing in the South East Asian games in September, 2001 and in the Asian Games 2002.

Individuals involved in the program

A comparison of the number of individuals involved in the sports school program between the original plan and the current status is presented in Table 23. The number of students currently enrolled at the sports school is 90% of the planned capacity. The ten percent shortage is in boys' enrollment since the girls' enrollment had met the targeted numbers. The current number of 8 to 28 students per class is comparable to the original

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Table 22. Comparison of type of sports offered between the current status and the original plan of the sports school

Original plan	Current
1.Track & Field - boys & girls	1.Track & Field - boys & girls
2. Artistic Gymnastics - boys & girls	2. Artistic Gymnastics - boys & girls
3. Rhythmic Gymnastics – girls only	3. Rhythmic Gymnastics – girls only
4. Squash - boys & girls	4. Squash - boys & girls
5 Archery - boys & girls	5 Archery - boys & girls
6. Swimming - boys & girls	6. Swimming - boys & girls
7. Sepak Takraw – boys only	7. Sepak Takraw – boys only
8. Netball – girls only	8. Netball – girls only
9. Field Hockey - boys & girls	9. Field Hockey - boys & girls
10. Soccer – boys only	10. Soccer – boys only
11. Volleyball - boys & girls	11. Volleyball - boys & girls
12. Basketball - boys & girls	12. Basketball - boys & girls
	13. Cricket – boys only
	14. Golf – boys & girls
	15. Synchronized swimming – girls only
	16. Diving - boys & girls
	17. Weightlifting – boys only
	18. Ping Pong - boys & girls
	19. Silat - boys & girls
	20. Wushu - boys & girls
	21. Rugby – boys only
	22. Tennis - boys & girls
	23. Cycling – boys only
	24. Shooting - boys & girls
	25. Taekwondo - boys & girls
	26. Fencing - boys & girls
	27. Equestrian

plan. More detail information on the number of students per class is presented in Appendix B. The smaller number of students per class is in the higher grade classes (Pre-U and preparation class). It should be noted that this grade level was introduced at the school in June 2000 to accommodate national athletes whose academic achievement did not meet university entrance requirements. This action was taken as a result of a

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Memorandum of Understanding signed by the Ministry of Youth and Sports with the University Putra Malaysia in 1997 to allow national athletes with lower academic achievement to receive a university education.

Table 23. Current number of individuals involved in the sports school program as compared to the original plan

	Original Plan	Current
Students	600	542
	(400 boys, 200 girls)	(344boys, 198 girls)
Number of students per class	25	8-28
Teachers	43	64
Number of classes	20	23
Teacher-class ratio	2:1	2.7:1
Clerical and maintenance staff	9	17
Hostel supervisor	1	2
Fitness instructor	1	0
Medical assistant*		1
Teacher-coaches		23
Nonteacher-coaches		29

*not in the original plan

The number of teachers allocated to the sports school has increased from 43 in the original plan to 67 in the year 2000. As a result, the teacher-class ratio also increased from 2:1 to 2.7:1. Although the teacher-class ratio is higher than the planned ratio, the school is still facing a shortage of three teachers. Only 64 teachers are available out of 67 allocated. Out of these 64 teachers, 23 are teacher-coaches, and one teacher is not involved in academic teaching, as he is the counselor of the school. The current number of supporting staff exceeds the original plan except for a fitness instructor who is still not available at the school. However, a medical assistant has assigned to the school to

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monitor the health and the need of rehabilitation for injured students. As for the number of coaches, apart from the 23 teacher-coaches, 29 non-teacher coaches are involved in the training program.

Selection of students and coaches

A comparison between the original plan and current status pertaining to the selection of students and coaches for the sports school is presented in Table 24. In principle, the decision for the selection of students is still in the hands of the Ministry of Education. However, this responsibility had been almost completely transferred to the school with the coordination of the National Sports Council. This is especially true when the selection is made either through success in age group competition and/or the Talent Identification Process. Although the final decision is the responsibility of the Ministry of Education, their decision is based on the recommendation of the school and the National Sports Council.

The criteria for the selection of students has not changed from the original plan. However, more emphasis is given to sports performance than to academic achievement. Previous attempts in trying to impose strict requirements on academic achievement had faced difficulties in getting students that fulfilled both sports and academic requirements. As a result, more students have been selected despite their low academic achievement. In 1996, 28% of the Form One intake did not meet the academic requirements, and this percentage increased to 33% in 1997, and to 37% in 1999. The current intake had 49% of the students not meeting the minimum academic requirements.

Although the original plan stated that all teachers of the sports school should have at least a bachelor's degree, only 78% of the teachers have the required qualification. The remaining 22% are college-trained teachers with a teaching diploma qualification. All teacher-coaches have the required coaching experience. In terms of coaching certification, only one coach is without certification but has the experience of representing the country in the sports that she coached. Other teacher-coaches have at least Level 1 national coaching certification and 35% have an international level coaching certificate. Selection of non-teacher coaches who are mostly foreigners was made by the National Sports Council and the respective national sports association. Coaches selected are those having at least a coaching diploma and prior experience as a national coach of their respective countries.

Privilege and opportunity

A comparison of privileges and opportunities received by students and teacher-coaches between the original plan and the current status of the sports school is presented in Table 25. According to the original plan, all students selected into the sports school are supposed to be provided with basic necessities including free food and lodging, sports equipment and scholarships. However, as of year 2000, most students have to pay a total fee of about RM 385.00 a year. The largest portion of these fees is for food totaling about RM 270.00, based on a rate of RM1.00 per day. Only national athletes and those under a special development program are exempted from paying their fees or part of their fees since they are funded by the National Sports Council or by the relevant national sports association. Athletes included in the special development program are golf, soccer, cricket and rugby players. While all fees for the golfers and soccer players are paid by their respective sports association, the cricket and rugby players only have their food fees paid.

Table 24. Comparison pertaining to selection of students and coaches between the original plan and current status of the sports school

	Original plan	Current
Decision on selection of students	Ministry of Education	- Ministry of Education - Sports School - National Sports Council
Criteria for selection of students	- Success in age group competition. - Talent identification by the school coach. - Recommendation by state and national sports bodies. - Academic achievement with GPA between 3.0 to 4.0 in National Public Examination	- Success in age group competition. - Talent identification by the school coach. - Recommendation by state and national sports bodies. - Academic achievement with GPA between 3.0 to 4.0 in National Public Examination
Criteria for selection of coaches	- Coaching certification - More than 3 years coaching experience - A bachelor's degree	- Coaching certification - More than 3 years coaching experience - A bachelor's degree
Percentage of students selected meeting academic requirements		51%
Percentage of students selected meeting sports requirements	100%	100%
Percentage of graduate teachers	100%	78%
Percentage of certified teacher- coaches	100%	96%
Percentage of coaches with more than 3 years coaching experience	100%	100%

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Table 25. Comparison of privileges and opportunities received by students and teacher-coaches between the current status and the original plan of the sports school

	Original plan	Current
Amount of food allowance each student receives/day	RM 15.00	RM14.00
Travel expenses for going back home/coming to school	3 times/year	3 times/year
Scholarship for each student per month	RM 50.00	RM 300 per year for low income student
Academic and hostel fees, and sports equipment	Provided	Depending on sports and level of participation
Percentage of students with medical insurance coverage	100%	100%
Percentage of students competed in national/international competition	100%	National = 88% International = 38%
Percentage of teacher-coaches teaching 4-6 periods/week	100%	78%
Percentage of teacher-coaches living in school housing	100%	91%
Percentage of teacher-coaches receiving car loan	100%	0.9%
Percentage of coaches who received professional development courses		43%

Only 21.6% of the students are given scholarships of RM 300.00 a year based on their parents' monthly income, which is less than RM 1000.00 a month. It should be noted that students in ordinary schools with low income but with good academic achievement also have this privilege. Students of the sports school who are not in the special program also have to buy their own basic sports equipment. The school only provided a pair of tracksuits, and three training shirts. Students also have to purchase

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their own medical insurance under a scheme organized by the Ministry of Education, similar to students in ordinary schools.

All students of the sports school had the opportunity to participate in competition through tournaments organized by the Malaysian School Sports Council (MSSC) and various sports bodies during the 2000 school year. Tournaments organized by the MSSC were at the national level where the students represented their respective states, while tournaments organized by various sports bodies were at regional, national and international levels. Eighty-eight percent of the students participated in national level competition while 38% participated at the international level. Those who did not have the chance to participate in either national or international level competition were given the opportunity to participate in open tournaments where the school took part as a team.

Several privileges were designed for teacher-coaches of the sports school in the original plan. They were to be provided with school quarters within the school compound, the loan of a car, less than six teaching periods, and the opportunity to attend professional courses, if needed. Currently, 91% percent or 21 out of 23 teacher-coaches live in the school quarters within the school compound. However, this accommodation was not totally free as the teacher-coaches had to pay the government through a deduction from their housing allowance.

Although all teacher-coaches were supposed to have the privilege of getting the loan of a car, only 0.9% actually received one. It should be noted that all government servants in the professional category (with at least a bachelor's degree), including teachers, in Malaysia are provided with housing allowance and the privilege of getting the loan of a car. Only 78% of the teacher-coaches have less than six teaching periods, and only 43% of them had the opportunity to attend professional courses during the year 2000.

The nonteacher-coaches involved with the sports school program are those employed by the National Sports Council or the respective sports association. Their salaries rang from USD 1000 to USD 6500 a month. In addition, they are provided with housing and travel allowances.

Training and facility

Training schedule

Currently, there is a slight increase in the days of training and the duration of training when compared to the original plan (Table 26). This increase is to accommodate the need for competition and increased training hours for the national athletes. Most students have training five to six days per week for 3 to 6 hours per day. Average training time reported by teacher-coaches and students participating in the study is 15 to 17 hours per week, while the nonteacher-coaches trained their athletes for an average time of 23 hours per week. The differences in training time between teacher-coaches and nonteacher-coaches is probably due to requirements set by the National Sports Council on nonteacher-coaches. Most of the coaches are required to spend 30 hours a week with the sports school athletes.

Only the national athletes receive training during school holidays as their training is an all year commitment. For other students, training during holidays is only provided, if necessary, such as when preparing for a competition. Nevertheless, most of the students were involved in competition during this time except for holidays at the end of the year. School aged competition is a rare occasion during this time because the national public examination is held during the school holidays.

Table 26. Current training schedule of the sports school as compared to the original plan

	Original plan	Current
Training frequency per week	5 days/week	5-6 days/week
Training duration per day	3-4 hours/day	3-6 hours
Training during school holidays	Provided if necessary	Provided to national athletes only

Training facilities

Sports training facilities available within and outside the school are reported in Table 27. The multipurpose hall consists of sepak takraw, basketball, volleyball, and netball courts. Most of the training for these sports is done at this facility. However, other sports also use this facility, especially for physical training. Due to this limited facility, all sports also have their training at the facilities of the National Sports Council and at facilities around the capital city. The distance of these facilities from the school is between 0.5 and 35 kilometers.

As indicated earlier, not all students of the sports school are provided with sports equipment. Eligible students are provided with equipment of international standard. Other students mostly buy their equipment through the school to ensure the quality of the equipment and to get a discounted price.

Table 27. Current training facilities available for sports school athletes as compared to the original plan

	Original plan	Current
Within the school	- Multipurpose hall (1) - Fitness room (1) - Squash court (3) - Demonstration room (3)	- Multipurpose hall (1) - Fitness room (1) - Squash court (3) - Demonstration room (3)
Outside the school	For all sports using facilities at the National Sports Council	For all sports using facilities at the National Sports Council and facilities around the capital city.
Quality of sport equipment provided to students		International standard if provided

Medical services

Comparison of medical services currently received by athletes in the sports school to the original plan is presented in Table 28. Currently, all students at the sports school receive medical attention as originally planned. Students are screened for their medical condition as one of the criteria to be accepted into the sports school. This screening is done by physicians once the students are offered a place at the school, and the results are submitted to the school during registration. A medical history of each athlete is kept by a medical assistant at the school. Injured athletes are referred to physicians at the National Sports Institute and the National University Hospital. Rehabilitation programs for injured athletes are also performed at these facilities.

Table 28. Comparison of medical services currently received by athletes of the sports school with the original plan

	Original plan	Current
Physical examinations for students	100%	100%
Medical history kept for students	100%	100%
Accessibility to physician for injured athletes	100%	100%
Supervision of athletes in rehabilitation program	100%	100%

Adequacy and problems associated with the sports program

Adequacy of the current status of the sports program was evaluated through responses gathered from the administrator and coaches of the sports school. The level of adequacy of the program was determined through an 18-question self-evaluation questionnaire. The questions were grouped into three main categories, which evaluated the three main areas of the sports program; namely, program content and policy, privilege and opportunity, and training and facility.

The evaluations of the respondents were gathered on a four-point Likert scale. Numerical weights were assigned to each of the four responses in such a way that the higher the number the higher the respondents' evaluation of the adequacy of the program. Except for questions "the policy developed needs revision" and "there is a need for more coordination with various sports organizations", the response for "completely agree", "tend to agree", "tend to disagree", and "completely disagree" were assigned scores of 4, 3, 2, and 1 respectively. Due to the nature of these two questions, the responses were inversely scored.

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To determine the level of adequacy of the current status of the program, means of the four-point scale were computed for individual items and for each program area. The rating means were categorized as follows:

Highly adequate: mean ratings of 3.51 and above
Moderately adequate: mean ratings of 2.51 and 3.5
Lowly adequate: mean ratings of 1.51 and 2.50
Inadequate: mean ratings of 1.50 and below

Individual items for each program area were also ranked to determine their level of adequacy relative to each other. The ranking was based on the mean score of the item. The item with the highest mean score was ranked first indicating the highest level of adequacy relative to other items in that particular program area. Consequently, the lowest mean score was ranked last indicating its low level of adequacy.

Severity of problems associated with conducting of the program was determined through rankings made by the coaches on six problems posed in the survey questionnaire. The ranking made by coaches for each problem was averaged and the problem with the smallest mean was determined to be the most severe problem faced by the coaches in running the program.

Adequacy of the program content and policy

Overall adequacy of the sports school program was rated as moderately adequate by the coaches of the school, with a mean score of 2.56 (SD=0.82). The results for the coaches' evaluation of the level of adequacy for each program area are presented in Tables 29,30, and 31.

Adequacy of the program content and policy as evaluated by teacher-coaches and nonteacher-coaches is indicated in Table 29. In general, the program content and policy of the sports school was determined as moderately adequate with an overall mean of 2.52. However, the level of adequacy was rated differently by the teacher-coaches coaches and nonteacher-coaches. While the teacher-coaches rated this area as lowly adequate, the nonteacher-coaches rated it as moderately adequate. The results of the MANOVA also showed similar finding regarding this difference between the teacher-coaches and nonteacher-coaches.

Table 29. Descriptive statistics and MANOVA for rating of adequacy related to program content and policy by teacher-coaches and nonteacher-coaches

	Teacher-coaches (N=23)		Nonteacher -coaches (N=14)		Overall		Rank	Univariate F	Multivariate F
	M	SD	M	SD	M	SD			
The purposes and objectives of the sports school are clearly stated	2.83	0.92	3.43	0.65	3.05	0.87	1	4.55*	2.43*
The purpose of the program is clearly understood by all	2.75	0.90	3.21	0.58	2.92	0.82	2	3.00	
The policy developed needs revision	2.13	1.12	1.71	0.73	1.97	1.00	7	1.51	
There is a need for more coordination with various sports organizations	2.17	0.87	1.36	0.50	1.87	0.84	8	10.15**	
Number of sports offered by the school is adequate	2.88	0.85	2.86	0.53	2.87	0.74	3	0.005	
I am satisfied with the selection process of the students	2.38	0.77	2.93	0.27	2.58	0.68	5	6.70*	
Number of teachers is sufficient	2.71	0.95			2.71	0.95	4		
Number of qualified coaches is sufficient	2.13	0.99	2.29	0.73	2.18	0.90	6	0.28	
Overall	2.49	0.92	2.54	0.57	2.52	0.85			

Highly adequate: 3.51 and above — Moderately adequate: 2.51 to 3.5 — * $p < 0.05$

Lowly adequate: 1.51 to 2.50 — Inadequate: 1.50 and below — ** $p < 0.01$

Overall, none of the items were evaluated as inadequate or highly adequate. Three of the items were evaluated as lowly adequate; namely, "the policy", "coordination with various sports organizations", and "number of qualified coaches". The remaining five items were evaluated as moderately adequate. There were differences between teacher-coaches and nonteacher-coaches in the evaluation of two individual items. The teacher-coaches rated the adequacy of the selection process low, while the nonteacher-coaches rated this item moderately adequate. On the other hand, the nonteacher-coaches evaluated coordination with other sports organization as inadequate, but for teacher-coaches this aspect of the program was lowly adequate. Examination of the univariate F statistics reveals support for the existence of these differences. Additionally, there was a difference in the mean rating scores of the teacher-coaches and non-teacher coaches regarding the clarity and understanding of the purposes and objectives of the sports school.

Ranking of the items indicated that the clarity and understanding of the stated purposes and objectives of the sports school was the most adequate compared to other items in this program area, while coordination with other sports organizations was the least adequate.

Adequacy of privilege and opportunity

The means of the responses and MANOVA results related to the adequacy of privilege and opportunity for students and coaches of the sports school are presented in Table 30. This area of the program was evaluated as lowly adequate with an overall mean of 2.34. Moreover, all of the individual items were rated as lowly adequate.

Table 30. Descriptive statistics and MANOVA for rating of adequacy related to privilege and opportunity by teacher-coaches and nonteacher-coaches

	Teacher-coaches (N=23)		Nonteacher-coaches (N=14)		Overall		Rank	Univariate F	Multivariate F
	M	SD	M	SD	M	SD			
Privileges provided to students are sufficient	2.33	0.76	2.29	0.47	2.32	0.66	3	0.04	4.07**
Privileges provided to coaches are sufficient	2.17	0.87	2.64	0.50	2.34	0.78	2	3.51	
There are sufficient competition opportunities for students	2.63	0.97	2.14	1.17	2.45	1.06	1	1.88	
There are sufficient courses opportunities for coaches	2.58	0.97	1.71	0.61	2.26	0.95	4	9.01**	
Overall	2.43	0.89	2.20	0.69	2.34	0.86			

Highly adequate: 3.51 and above   Moderately adequate: 2.51 to 3.5   * $p < 0.05$
Lowly adequate: 1.51 to 2.50   Inadequate: 1.50 and below   ** $p < 0.01$

Again, there were differences between teacher-coaches' and nonteacher-coaches' evaluations on several of the items assessed. The teacher-coaches rated competition opportunities for students and courses opportunities for coaches as moderately adequate while the nonteacher-coaches rated them as lowly adequate. On the other hand, opposite ratings were found on the sufficiency of privileges provided to coaches.

The MANOVA results indicated that there was a difference between the teacher-coaches and nonteacher-coaches in their ratings of the adequacy of privilege and opportunity. Examination of the univariate statistics revealed that this difference was largely due to difference in their rating scores for the sufficiency of course opportunities provided to coaches.

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Ranking of the items indicated that competition opportunities provided to students was the most adequate while course opportunities was the least adequate item in this program area.

Adequacy of training and facility

The overall rating for adequacy of training and facility was moderately adequate with a mean score of 2.73 (Table 31). All but two of the items were evaluated as moderately adequate. The availability of sports facilities in the school was evaluated as lowly adequate by both groups of coaches, while funding for the sports program was rated the same by the teacher-coaches. Several of the individual items were rated differently by the teacher-coaches and nonteacher-coaches. For the teacher-coaches, accessibility to a sound rehabilitation program for injured athletes was rated moderately adequate, while for the nonteacher-coaches this item was only lowly adequate. On the other hand, funding for the sports program was rated oppositely by the two groups.

The results of the MANOVA indicated that the level of adequacy of this program area was not similarly rated by the teacher-coaches and nonteacher-coaches. Further investigation of the univariate statistics revealed that this difference was largely due to differences in the rating scores between the teacher-coaches and non-teacher coaches for the sufficiency of opportunities for the use of sports facilities outside the school, and for the adequacy of the funding for the sports program.

The opportunity to use outside facilities was ranked the highest among the items in this program area. On the other hand, sports facilities available in the school were ranked last, indicating a poor level of adequacy of this item.

Table 31. Descriptive statistics and MANOVA for rating of adequacy related to training and facility by teacher-coaches and nonteacher-coaches

	Teacher-coaches (N=23)		Nonteacher-coaches (N=14)		Overall		Rank	Univariate F	Multivariate F
	M	SD	M	SD	M	SD			
The time allotted for training is consistent with the demand for competition	2.75	0.90	3.21	0.43	2.92	0.78	2	3.29	2.66*
Sports facilities available in the school are sufficient	2.38	0.71	2.43	0.94	2.39	0.79	6	0.04	
There are sufficient opportunities for the use of sport facilities outside the school	2.63	0.82	3.50	0.52	2.95	0.84	1	12.74**	
Funding for sports program is adequate	2.46	0.88	3.00	0.00	2.66	0.75	4	5.20*	
Injured athletes have sufficient accessibility for prompt medical treatment	2.75	0.68	3.07	0.27	2.87	0.58	3	2.88	
Injured athletes have sufficient accessibility for sound rehabilitation program	2.63	0.77	2.50	0.65	2.58	0.72	5	0.26	
Overall	2.60	0.79	2.95	0.47	2.73	0.74			

Highly adequate: 3.51 and above Moderately adequate: 2.51 to 3.5 * $p < 0.05$
Lowly adequate: 1.51 to 2.50 Inadequate: 1.50 and below ** $p < 0.01$

Problems associated with the program.

The coaches ranked six problems posed to them with the most severe problem ranked first and the least problematic was ranked last (represented by the largest rank number). The coaches' rankings for each problem were averaged and the problem with the lowest mean was considered as the most severe, while the problem with the largest mean was determined as the least severe.

Rankings on the severity of the problems by coaches of the sports school are presented in Table 32. The most severe problem of the sports program of the sports scho

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school was inadequate staffing, followed by students' apathy, students' quality, inadequate facilities, inadequate equipment, and lack of sufficient time. The problem of "students' apathy" was concerned with the attitude of some students towards training and competition. Some of the students lacked seriousness in doing the training and therefore performed below expectation in competition. There was a slight difference in rank order on the severity of the problems between teacher-coaches and nonteacher-coaches for problems ranked first and second, and for problems ranked third and fourth. The problems ranked first (students' apathy) and second (inadequate staffing), and problems ranked third (inadequate facilities) and fourth (students' quality) by teacher-coaches were inversely ranked by the nonteacher-coaches.

Table 32. Ranking of problems associated with the sports program in the sports school

Problem	Teacher-coaches (N=23)			Nonteacher-coaches (N=14)			Overall		
	Means	SD	Rank	Means	SD	Rank	Means	SD	Rank
Lack of sufficient time	5.28	1.31	6	5.50	0.76	6	5.37	1.11	6
Inadequate equipment	4.05	1.56	5	4.64	1.00	5	4.28	1.38	5
Inadequate facilities	3.00	1.58	3	3.93	0.47	4	3.37	1.33	4
Inadequate staffing	2.81	1.40	2	1.43	0.65	1	2.26	1.33	1
Students' apathy	2.71	1.45	1	2.78	1.77	2	2.74	1.56	2
Students' quality	3.14	1.55	4	2.71	1.33	3	2.97	1.46	3

Effects of Sports School on Motor Performance and Academic Achievement

Descriptive statistics

Separate means (M) and standard deviations (SD) for all variables were computed for 13-year-old, 14-year-old, and 16-year-old boys and girls in both the sport and the ordinary schools. These measures are presented in Tables 33 and 34. Additionally, a summary of MANOVA F-ratios for differences between the schools for boys and girls for each age group for variables that constituted the covariates are summarized in Table 35.

For boys, the 13 and the 14 year-old boys in the sports school were significantly older than their counterparts in the ordinary schools. However, there was no difference between age among the girls and boys in the 16-year-old group between the two schools. Boys in the sports school students were significantly taller, heavier, had greater sitting height, bigger arm and calf circumferences, and bigger arm and calf muscle areas than the ordinary school students for all age groups. There was no difference in the sitting height stature ratio between the sports school and the ordinary school boys for each age group, but the overall comparison exhibited a significant difference for this variable. The BMI of the sports school boys was only significantly higher than that of the ordinary school boys among the 14-year-olds. Boys of the ordinary schools tended to have thicker skinfold measurements, but the only significant difference was exhibited in the medial calf skinfold in the 16-year-old group. Consequently, total sum of skinfolds and trunk/extremity skinfold ratio also showed no significant difference between the boys of the two schools. In terms of maturity status, boys of the sports school were more advanced at 13 and 14 years, but not at 16 years. Monthly family income for the sports school boys was lower than that of the ordinary school boys for the 14- and 16-year-old age groups. Means for place of residence indicated that the sports school had more students of rural origin than the ordinary schools for every age group (It should be noted that rural was coded 0, while urban was coded 1 for this variable).

Table 33. Descriptive statistics for boys by school and age group

Table 33. Descriptive statistics for boys by school and age group

	Sports School								Ordinary school							
Age group	13		14		16		Total		13		14		16		Total	
N	51		56		53		160		51		56		53		160	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Age - pretest, years	12.9	0.2	13.8	0.2	15.7	0.3	14.1	1.2	12.6	0.2	13.6	0.3	15.7	0.3	14.0	1.3
Stature - pretest, cm	160.7	9.9	164.4	9.0	171.4	7.4	165.5	9.8	153.1	7.5	157.8	9.4	167.4	4.9	159.5	9.6
Stature - posttest, cm	164.1	9.5	168.3	8.7	173.7	7.4	168.8	9.3	155.9	7.4	161.6	9.2	169.7	4.8	162.4	9.2
Mass , kg	48.8	8.7	54.3	10.3	60.9	6.9	54.7	10.0	43.0	5.8	47.4	8.6	55.5	9.3	48.7	9.5
Body mass Index , kg/m^2	18.8	1.9	19.9	2.3	20.7	1.7	19.8	2.1	18.3	1.7	18.9	2.5	19.9	2.5	19.1	2.3
Sitting Height , cm	83.4	6.0	84.8	5.7	88.8	4.1	85.7	5.7	78.8	4.3	80.8	5.8	86.0	2.9	81.9	5.4
Sitting Height/Stature, %	51.9	1.4	51.6	1.3	51.8	1.5	51.8	1.4	51.5	1.4	51.2	1.5	51.4	1.3	51.3	1.4
Circumferences, cm																
Relaxed arm	24.1	2.3	25.7	2.8	26.8	1.7	25.6	2.5	21.1	2.9	22.8	3.6	24.6	1.9	22.9	3.2
Calf	32.9	2.6	34.8	3.1	35.6	1.8	34.4	2.8	30.7	3.2	31.5	4.0	33.4	2.2	31.9	3.4
Skinfolds, mm																
Triceps	9.1	2.7	9.0	3.2	7.8	2.0	8.6	2.7	9.3	2.9	9.2	3.1	8.1	3.1	8.9	3.1
Medial calf	7.3	2.4	7.6	2.7	6.7	1.9	7.2	2.4	7.7	2.5	7.8	3.1	7.6	2.4	7.7	2.6
Subsacapular	6.1	2.0	6.4	2.2	6.8	1.6	6.5	2.0	6.1	1.6	6.4	1.4	7.1	2.4	6.5	1.9
Suprailiac	6.0	2.3	6.1	2.5	6.6	2.2	6.2	2.4	6.0	1.8	6.2	1.3	7.3	1.7	6.5	1.7
Sum of trunk	12.1	4.2	12.5	4.6	13.5	3.7	12.7	4.2	12.2	3.3	12.6	2.6	14.4	4.0	13.0	3.4
Sum of extremity	16.4	5.0	16.6	5.7	14.5	3.6	15.9	4.9	17.0	5.1	17.0	6.1	15.8	5.3	16.6	5.5
Sum of four (mm)	28.5	9.0	29.1	10.1	28.0	6.8	28.5	8.7	29.1	8.3	29.6	8.4	30.1	9.0	29.6	8.5
Trunk/extremity, mm/mm	0.7	0.1	0.8	0.1	0.9	0.2	0.8	0.2	0.7	0.1	0.8	0.1	0.9	0.1	0.8	0.2

Table 33 (cont'd)

Table 33 (cont'd)

	Sports School								Ordinary school							
Age group	13		14		16		Total		13		14		16		Total	
N	51		56		53		160		51		56		53		160	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Muscle area, cm^2																
Arm	36.4	5.9	42.1	7.8	47.2	6.2	42.0	8.0	26.7	7.2	32.2	10.5	39.0	4.6	32.7	9.3
Calf	74.9	10.7	84.0	12.6	92.2	10.1	83.8	13.1	64.3	13.2	68.3	16.8	76.7	9.2	69.8	14.3
Motor performance pre																
Flexed Arm Hang, sec	26.3	11.7	29.4	17.6	38.3	16.2	31.4	16.2	19.9	9.5	23.4	10.3	30.2	15.7	24.5	12.8
Jump and Reach, cm	42.4	4.4	46.4	8.4	54.2	8.5	47.7	8.8	35.3	5.6	36.6	4.7	43.2	5.1	38.4	6.1
30 Yard Dash, sec	4.1	0.3	4.1	0.4	3.6	0.3	4.0	0.4	4.6	0.4	4.5	0.4	3.9	0.4	4.3	0.5
Sit and Reach, cm	20.4	6.4	22.0	5.7	25.1	7.1	22.5	6.7	19.5	3.7	22.3	5.5	20.1	5.3	20.7	5.1
Standing long jump, cm	196.9	19.8	211.2	24.4	229.0	19.6	212.5	25.0	177.0	22.3	181.0	18.3	200.4	18.5	186.2	22.1
Agility shuttle run, sec	10.2	0.5	10.1	0.5	9.6	0.5	9.9	0.6	10.8	0.7	10.5	0.9	10.0	0.8	10.4	0.9
800-m run, sec	194.1	16.1	183.3	21.9	176.4	18.7	184.4	20.3	247.0	27.8	242.6	28.6	236.7	29.0	242.1	28.6
Motor performance post																
Flexed Arm Hang, sec	32.2	12.4	33.6	16.3	47.0	14.5	37.6	15.9	21.0	8.7	24.3	10.9	31.6	14.3	25.7	12.3
Jump and Reach, cm	49.0	5.9	52.2	9.5	59.4	9.2	53.6	9.4	37.4	6.2	39.0	5.1	45.4	6.6	40.6	6.9
30 Yard Dash, sec	3.8	0.2	3.8	0.3	3.3	0.2	3.6	0.3	4.4	0.4	4.4	0.4	3.8	0.4	4.2	0.5
Sit and Reach, cm	22.4	5.6	24.5	6.1	28.5	7.2	25.1	6.8	20.0	5.2	21.5	5.3	22.8	4.6	21.5	5.1
Standing long jump, cm	208.2	20.7	220.6	26.3	236.8	16.5	222.0	24.4	180.6	23.4	184.6	19.4	203.9	22.2	189.7	23.8
Agility shuttle run, sec	9.9	0.4	9.8	0.4	9.3	0.4	9.7	0.5	10.8	0.7	10.4	1.0	9.9	0.7	10.4	0.9
800-m run, sec	180.4	16.6	172.8	19.1	168.0	16.8	173.6	18.2	241.0	27.9	238.7	27.8	232.6	34.7	237.4	30.3

Table 33 (cont'd)

	Sports School								Ordinary school							
Age group	13		14		16		Total		13		14		16		Total	
	51		56		53		160		51		56		53		160	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Maturity status	3.0	0.7	3.3	0.6	4.2	0.6	3.5	0.8	1.8	0.4	2.3	0.5	4.1	0.6	2.7	1.1
Time spent in sports activities, hr/week	18.4	2.4	17.3	3.5	16.2	3.4	17.3	3.3	6.2	4.2	5.3	2.9	6.6	3.6	6.0	3.6
Monthly income	1427	1277	1232	670	996	294	1216	853	1618	1188	1632	1159	1467	950	1573	1100
Place of residence	0.8	0.4	0.9	0.3	0.8	0.4	0.8	0.4	1.0	0.0	1.0	0.0	0.9	0.3	1.0	0.2
Academic achievement																
Pre	2.8	0.9	2.6	0.6	2.3	0.7	2.5	0.7	2.9	0.7	2.8	0.5	2.1	0.6	2.6	0.7
Post	2.5	0.6	2.6	0.5	1.8	0.6	2.3	0.7	3.2	0.8	3.4	0.6	1.7	0.6	2.8	1.0

Table 34. Descriptive statistics for girls by school and age group

	Sports School								Ordinary school							
Age group	13		14		16		Total		13		14		16		Total	
N	20		21		25		66		20		21		25		66	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Age - pretest, years	12.8	0.3	13.7	0.3	15.8	0.3	14.2	1.3	12.7	0.2	13.6	0.3	15.7	0.3	14.1	1.3
Stature - pretest , cm	159.3	7.5	160.9	6.0	162.8	6.4	161.1	6.7	151.5	5.6	153.6	4.0	158.4	6.6	154.8	6.2
Stature - posttest, cm	161.1	7.0	162.8	5.9	163.8	6.3	162.7	6.4	153.8	5.6	155.8	4.2	159.6	6.5	156.6	6.0
Mass , kg	46.5	8.0	50.3	6.2	55.7	8.3	51.2	8.4	42.6	5.0	43.3	4.3	52.7	10.0	46.6	8.5
Body mass Index , kg/m^2	18.2	2.0	19.4	1.6	20.8	2.3	19.6	2.3	18.5	1.9	18.4	1.9	21.0	3.4	19.4	2.8
Sitting Height , cm	82.0	4.2	82.8	3.4	85.0	3.5	83.4	3.9	77.0	2.7	78.9	3.5	82.5	3.7	79.7	4.0
Sitting Height/Stature, %	51.5	1.5	51.5	1.4	52.2	1.3	51.8	1.4	50.8	1.6	51.4	2.0	52.1	1.6	51.5	1.8
Circumferences, cm																
Relaxed arm	22.2	2.1	23.7	2.3	25.4	2.8	23.9	2.8	21.1	2.3	21.5	2.9	24.0	4.2	22.3	3.5
Calf	31.1	2.1	33.7	2.3	34.2	3.7	33.1	3.1	29.6	3.0	31.3	3.2	32.6	4.6	31.3	3.9
Motor performance pre																
Flexed Arm Hang, sec	10.7	9.4	10.7	7.4	12.9	8.9	11.5	8.6	5.7	4.8	5.0	4.1	5.2	5.5	5.3	4.8
Jump and Reach, cm	33.9	5.2	35.4	5.6	38.8	4.9	36.2	5.6	28.6	10.4	31.4	9.2	31.3	5.3	30.5	8.3
30 Yard Dash, sec	4.6	0.3	4.5	0.4	4.3	0.3	4.5	0.4	5.4	0.8	5.0	0.8	5.3	0.8	5.2	0.8
Sit and Reach, cm	22.3	6.1	24.5	8.1	28.6	6.8	25.4	7.4	18.5	7.0	19.8	2.8	20.7	3.2	19.8	4.6
Standing long jump, cm	161.2	13.5	169.6	21.0	176.4	24.9	169.6	21.4	129.8	16.6	131.5	14.2	137.7	20.1	133.3	17.4
Agility shuttle run, sec	11.2	0.5	10.6	0.8	10.3	0.8	10.6	0.8	12.8	1.0	12.2	0.8	12.2	0.9	12.4	0.9
800-m run, sec	229.1	20.5	219.6	20.6	220.6	14.8	222.8	18.8	279.9	26.0	278.7	37.6	281.3	33.7	280.0	32.4

Table 34 (cont'd)

	Sports School								Ordinary school							
Age group	13		14		16		Total		13		14		16		Total	
N	20		21		25		66		20		21		25		66	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Motor performance post																
Flexed Arm Hang, sec	14.5	9.8	13.0	7.8	16.1	9.7	14.6	9.1	5.9	4.8	5.4	4.8	6.2	6.4	5.8	5.4
Jump and Reach, cm	39.2	4.8	40.2	6.6	44.2	5.3	41.4	6.0	29.2	9.5	33.2	9.8	33.0	5.2	31.9	8.3
30 Yard Dash, sec	4.3	0.3	4.2	0.3	4.0	0.3	4.2	0.3	5.6	0.7	5.1	0.8	5.2	0.8	5.3	0.8
Sit and Reach, cm	25.3	5.8	27.1	7.1	31.4	6.5	28.2	6.9	19.6	6.6	21.0	2.3	21.2	3.1	20.6	4.3
Standing long jump, cm	170.5	13.3	177.2	21.2	183.6	24.8	177.6	21.1	132.9	13.6	134.4	14.4	140.5	19.5	136.2	16.4
Agility shuttle run, sec	10.7	0.5	10.3	0.8	10.0	0.8	10.3	0.8	12.7	0.9	12.3	0.8	12.3	0.9	12.5	0.9
800-m run, sec	218.8	19.8	215.1	20.0	213.9	17.1	215.8	18.7	281.9	22.1	282.9	37.4	287.0	32.8	284.1	31.2
Time spent in sports activities, hr/week	16.0	4.6	15.7	1.7	17.4	2.5	16.4	3.1	3.5	1.1	5.0	3.6	6.2	3.3	5.0	3.1
Monthly income	1465	1863	1513	1357	1141	864	1358	1373	1230	1280	1663	1035	1556	1111	1491	1139
Place of residence	0.9	0.4	0.9	0.3	0.8	0.4	0.9	0.3	1.0	0.0	1.0	0.0	1.0	0.0	1.0	0.0
Academic achievement																
Pre	3.02	0.70	2.40	0.60	2.53	0.80	2.64	0.75	2.69	0.55	2.71	0.69	2.22	0.55	2.52	0.63
Post	2.81	0.69	2.40	0.42	2.05	0.74	2.39	0.70	2.59	0.82	3.15	0.81	2.31	0.61	2.66	0.82

Table 35. F-ratios for between school differences by gender and age group

	Boys				Girls			
Age group	13	14	16	Total	13	14	16	Total
N	102	112	106	320	40	42	50	132
	Multivariate F							
	35.02**	24.65**	16.82**	58.33**	16.43**	13.86**	16.19**	43.53**
	Univariate F							
Age - pretest, years	34.64**	16.75**	1.23	1.4	0.03	1.61	1.79	0.10
Stature - pretest, cm	18.82**	14.25**	10.67**	31.02**	13.75**	21.46**	5.64*	31.49**
Stature - posttest, cm	23.71**	15.91**	11.22**	36.92**	13.48**	19.28**	5.44*	31.23**
Mass , kg	15.51**	14.90**	11.45**	30.60**	3.46	17.85**	1.36	9.51**
Body mass Index , kg/m^2	1.59	4.53*	3.54	8.67**	0.25	3.80	0.02	0.20
Sitting Height , cm	19.78**	13.71**	17.47**	37.42**	19.63**	13.16**	6.08*	28.54**
Sitting Height/Stature, %	2.17	2.01	2.95	7.09**	1.62	0.04	0.06	0.86
Circumferences, cm								
Relaxed arm	33.90**	23.57**	38.15**	69.83**	2.38	7.05*	1.94	7.78**
Calf	14.50**	22.88**	31.09**	54.19**	3.25	7.49*	1.80	8.53**
Skinfolds, mm								
Triceps	0.21	0.07	0.36	0.54				
Medial calf	0.46	0.18	4.76*	2.97				
Subsacapular	0.00	0.01	0.39	0.12				
Suprailiac	0.02	0.06	2.73	1.31				
Sum of trunk	0.01	0.01	1.43	0.62				
Sum of extremity	0.34	0.12	1.87	1.53				
Sum of four (mm)	0.15	0.06	1.81	1.21				
Trunk/extremity, mm/mm	0.32	0.72	0.00	0.01				

* $p < 0.05$ ** $p < 0.01$

Table 35 (cont'd)

	Boys				Girls			
Age group	13	14	16	Total	13	14	16	Total
N	102	112	106	320	40	42	50	132
	Univariate F							
Muscle area, cm^2								
Arm	54.86**	32.19**	60.08**	91.91**				
Calf	19.91**	31.54**	67.86**	82.76**				
Maturity status	104.23**	84.41**	1.61	49.49**				
Monthly income	0.61	4.99*	11.83**	10.50**	0.22	0.16	2.17	0.37
Place of residence	12.20**	7.86**	1.31	16.46**	3.35	2.10	4.57*	10.26**
Time spent on sports activities	318.64**	384.79**	198.75**	851.81**	142.86**	151.01**	186.32**	443.33**

* $p < 0.05$ ** $p < 0.01$

Similarly, girls in the sports school were taller and had greater sitting height than girls in the ordinary schools for all age groups. The sports school girls were heavier and had greater arm and calf circumferences than the ordinary school girls only at age 14 years. There were no differences in BMI, sitting height stature/ratio, and monthly family income between girls in the sports and those in the ordinary schools for all age groups. Means for place of residence indicated that the sports school had more girls of rural origin than did the ordinary schools for all age groups.

Boys and girls in the sports school exhibited better performance scores than their counterparts in the ordinary schools on all motor performance tasks for all age groups. For academic achievement, boys ages 13 and 14 years in the ordinary school had better pre and post achievement than did the sports school students, and vice versa for the oldest age group. Sports school girls had better pre and post academic achievement than did the girls in the ordinary schools among the 13-year-olds, and the opposite was true for the 14-year-olds. Among the 16-year-old girls, students of the sports school exhibited better pre academic achievement but poorer post academic achievement than their peers in the ordinary schools.

Parallel to its status as the sports school, time spent in sports activities by the sports school students was significantly greater than that spent by the ordinary school students. On average, the sport school boys spent 17.3 hours per week while the girls spent 16.4 hours per week in sport activities.

Question 2. Are there differences in motor performance between students enrolled in the sport school and the ordinary school?

Separate MANOVAs and MANCOVAs for boys and girls were conducted to answer this question. The rationale for performing both analyses was to investigate the differences in motor performance between students in the sports school and the ordinary schools, with and without controlling for the covariates. For the MANOVA, pretest motor performance scores were entered as the dependent variables while school (SC) and age group (AG) were entered as the predictors. The variable school was dummy coded (0 = ordinary school, 1 = sports school) and age group was entered as a categorical variable. MANCOVA for boys included stature (ST), mass (MA), sitting height/stature ratio (SHSR), body mass index (BMI), sum of skinfolds (SS), estimated arm and calf musculature (AMA, CMA), maturity status (MS), monthly income (IN), and place of residence (PR) as the covariates. Place of residence was also dummy coded (0 = rural, 1 = urban) for the analysis. For girls, the covariates included were the same as those for the boys but without the skinfolds. In addition, arm (ACR) and calf circumferences (CCR) were substituted for estimated arm and calf musculatures, respectively.

Results of the MANOVA revealed significant differences between the sports school and ordinary school students, and among the age groups for both boys and girls (Table 36). There were no interaction effects between schools and age groups for either gender. Examination of the univariate F statistics to determine differences between the schools for each of the motor performance tasks also indicated that students of the two schools were different in all motor performance tasks. Boys of different age groups were found to be significantly different on all motor performance tasks. However, age groups differences in motor performance for girls were demonstrated only for the JR, SR, SLJ, and ASR.

Table 36. Multivariate analysis of variance (MANOVA) for pretest motor performance by school age group, and gender

	School	Age group	School * Age group
Boys		N=320	
FAH	19.54**	17.75**	0.17
JR	170.32**	67.56**	2.53
TYD	84.45**	75.93**	0.40
SR	6.66*	10.97**	1.11
SLJ	129.61**	49.25**	1.87
ASR	42.93**	33.31**	1.26
ER	449.33**	8.62**	0.70
Multivariate F	77.71**	13.07**	1.47
Eta squared	0.64	0.26	0.03
Girls		(N=132)	
FAH	25.05**	0.36	0.46
JR	23.95**	3.48*	0.49
TYD	52.39**	1.33	1.28
SR	27.52**	5.82**	1.47
SLJ	115.9**	4.13*	0.47
ASR	147.77**	10.19**	0.57
ER	147.83**	0.42	0.41
Multivariate F	37.20**	2.42**	0.55
Eta squared	0.68	0.12	0.03

* $p < 0.05$ ** $p < 0.01$

Results of the Bonferroni post hoc test to determine specific age group differences for each of the motor performance tasks is summarized in Table 37. For boys, the 16-year-olds had better performance than the younger age groups on all tasks except the ER where they were only better than the youngest age group. The 14-year-old boys exhibited better performance in the JR, SLJ, and ASR when compared to the 13-year-old group. Most between age group differences for the girls were found between the oldest and the youngest age groups. The 16-year-old group was significantly better than the 13-year-old group in the JR, SR, SLJ and ASR. However, they were only significantly better than the 14-year-old group in the ASR.

Table 37. Bonferonni post hoc tests of mean differences between age groups for motor performance variables showing a significant MANOVA F-ratio

Variable	Age Group	Age Group	Mean Difference	
			Boys	Girls
Flexed arm hang	13	14	-3.28	
	13	16	-11.13**	
	14	16	-7.85**	
Jump and reach (cm)	13	14	-2.69**	-1.64
	13	16	-9.87**	-3.84*
	14	16	-7.19**	-2.20
Thirty yard dash	13	14	.072	
	13	16	.56**	
	14	16	.48**	
Sit and reach (cm)	13	14	-1.55	-1.72
	13	16	-3.68**	-4.24**
	14	16	-2.21*	-2.52
Standing long jump (cm)	13	14	-9.19**	-5.06
	13	16	-27.75**	-11.56*
	14	16	-18.55**	-6.49
Agility shuttle run (sec)	13	14	.25*	.59**
	13	16	.74**	.76**
	14	16	.48**	.16
800 meter run (sec)	13	14	7.62	
	13	16	13.95**	
	14	16	6.34	

* $p < 0.05$ ** $p < 0.01$

Further investigation to determine the effects of school on each motor performance task for each group was performed using the MANOVA and regression analysis (Table 38). The regression analysis was employed to determine the magnitude and direction of the differences which were not provided by the MANOVA. Overall multivariate effect of school on motor performance indicated that there were differences in motor performance between students of the two schools for all age groups. Effects of school on each motor performance task were indicated by the regression coefficients. As school was dummy coded, the regression coefficients (β) depicted mean differences between the schools. It should be noted that negative values of the regression coefficient for the TYD, ASR, and ER indicated better performance of the sports school students because lower times indicated better performance. For the 16-year-olds, boys and girls of the sports school had better performance on all of the motor performance tasks. The 13-year-old boys and girls, and the 14-year-old boys of the sports school were better than their counterparts on all tasks except the SR. However, for girls of the 14-year-old group, the only task where the sports school girls did not exhibit significantly better performance than their peers was the JR.

Summary of MANCOVA for determination of differences between the schools and among age groups with the presence of the covariates is presented in Table 39. Results of the analysis again revealed significant differences in motor performance between the schools and among the age groups for both boys and girls, even after adjusting for the effects of these covariates. There was no interaction effect of school and age groups for boys' and girls' motor performance.

Table 38. MANOVA and regression analysis for pretest motor performance variables by school for boys and girls for each age group

Age group		13		14		16	
		β	R^2	β	R^2	β	R^2
Boys		N=102		N=112		N=106	
	FAH	6.39**	0.08	6.07*	0.04	8.15*	0.06
Regression analysis	JR	7.10**	0.34	9.78**	0.34	10.98**	0.39
	TYD	-0.41**	0.24	-0.37**	0.22	-0.32**	0.18
	SR	0.81	0.01	1.15	0.01	2.98*	0.05
	SLJ	19.96**	0.19	30.20**	0.33	28.57**	0.36
	ASR	-0.65**	0.22	-0.44**	0.09	-0.37**	0.07
	ER	-52.96**	0.65	-59.31**	0.66	-63.60**	0.58
MANOVA	F	26.88**		26.12**		30.78**	
	Eta squared	0.67		0.64		0.69	
Girls		N=40		N=42		N=50	
	FAH	5.00*	0.11	5.71**	0.19	7.72**	0.22
Regression analysis	JR	5.25*	0.10	4.00	0.07	7.56**	0.36
	TYD	-0.80**	0.30	-0.54*	0.18	-0.94**	0.40
	SR	3.83	0.08	4.69*	0.14	7.85**	0.36
	SLJ	1.35**	0.53	38.07**	0.54	38.65**	0.43
	ASR	-1.68**	0.55	-1.59**	0.51	-1.94**	0.57
	ER	-50.85**	0.55	-59.14**	0.50	-60.68**	0.59
MANOVA	F	12.75**		15.16**		16.58**	
	Eta squared	.74		.76		.73	

* $p < 0.05$ ** $p < 0.01$

Girls in the sports and the ordinary schools were different on all of the motor performance tests, while the boys differed on all tests, but the SR. The analysis also demonstrated the influence of several of the covariates on motor performances of the boys and girls. For boys, the sitting height/stature ratio influenced the SR, sum of skinfolds influenced the JR, TYD, SLJ, and ER, while arm musculature influenced ASR and ER. Girls' sitting height/stature ratio influenced their SR performance. Boys

Table 39. MANCOVA for pretest motor performance by school, age group, and all covariates for boys and girls

	SC	AG	SC*AG	ST	MA	BMI	SHSR	SS	TER	AMA	CMA	MS	IN	PR	R^2
Boys (N=320)															
FAH	19.61**	11.31**	0.16	6.22*	6.07*	2.72	3.27	2.86	0.01	0.62	1.15	1.89	1.07	0.16	0.26
JR	46.69**	7.66**	3.25*	0.14	0.27	0.04	1.41	14.11**	0.45	0.53	0.54	0.75	0.04	0.51	0.56
TYD	19.70**	10.17**	0.15	1.74	0.57	0.64	0.01	13.41**	0.01	1.87	4.16*	3.73	0.44	0.75	0.51
SR	0.41	1.27	0.48	0.23	0.08	0.64	15.73**	1.43	1.98	0.35	0.69	0.15	1.84	0.07	0.18
SLJ	30.85**	2.66	2.66	3.96*	1.02	2.17	3.82	18.99**	0.36	0.04	0.00	0.81	0.34	0.09	0.52
ASR	22.48**	7.94**	1.49	1.14	0.17	0.57	0.69	3.74	0.46	5.40*	1.07	0.01	0.89	0.20	0.31
ER	288.97**	6.30**	0.48	1.39	2.14	1.25	0.08	5.98*	1.24	6.72**	0.82	0.26	4.40*	0.01	0.66
Multivariate F	44.01**	4.27**	1.48	1.96	1.80	1.13	2.92**	3.81**	0.70	2.45*	1.57	1.03	1.33	0.38	
Eta squared	0.51	0.09	0.03	0.04	0.04	0.03	0.06	0.08	0.02	0.05	0.04	0.02	0.03	0.01	
										ACR	CCR				
Girls (N=132)															
FAH	17.24**	2.55	0.35	0.05	1.63	0.10	1.09			0.35	2.28		0.45	6.23*	0.30
JR	5.61*	1.16	0.86	0.01	0.75	0.87	0.10			0.27	0.83		0.20	1.24	0.23
TYD	20.98**	0.54	1.38	2.26	0.45	0.08	3.55			0.07	0.16		3.06	0.79	0.38
SR	14.62**	1.97	2.36	6.52*	6.81*	3.49	8.81**			0.92	0.03		0.16	0.70	0.36
SLJ	67.49**	3.51*	0.93	0.00	0.26	0.94	0.72			0.14	0.59		2.91	0.10	0.53
ASR	105.2**	11.08**	0.37	0.02	0.60	0.75	0.49			0.81	2.16		0.48	0.23	0.60
ER	103.3**	3.23*	0.96	0.37	0.34	1.62	0.75			0.61	0.17		0.33	0.60	0.64
Multivariate F	26.04**	2.37**	0.80	1.41	1.81	1.65	2.65*			0.57	1.27		1.43	1.25	
Eta squared	0.62	0.13	0.05	0.08	0.10	0.09	0.14			0.03	0.07		0.08	0.07	

* $p < 0.05$ ** $p < 0.01$

demonstrated age group differences in the FAH, JR, TYD, ASR, and ER, while girls showed age group differences in the SLJ, ASR, and ER.

Specific age group differences between the age groups for these variables were determined through a pairwise comparison of the estimated marginal means adjusting for the covariates (Table 40). For boys, the 16-year-olds had significantly better performance on the FAH, JR, TYD, and the ASR than the younger age groups. There was no difference in the ER between the 14- and the 16-year-old boys, but both were significantly better than the 13-year-olds. The 14-year-old boys also performed better than the 13-year-olds on the FAH. For girls, the 16-year-old age groups had better performance on the SLJ, ASR, and ER than the 13-year-olds, while the 14-year-old age groups had better performance than the 13-year-olds on the ASR only.

Further analysis to determine between school differences in motor performance for each age group was performed using the MANCOVA. Follow up tests utilizing multiple regression analysis was then performed to determine the effects of school for each motor performance test for each age group. Summaries of these analyses are presented in Tables 41, 42 and 43. The multivariate F-ratios indicated significant differences between the schools for all age groups for both boys and girls. Additionally, significant influences of several covariates on motor performance were revealed by the analysis. However, there were slight differences in the type of covariates with significant effects for boys and girls and for different age groups.

Table 40. Pairwise comparisons of estimated marginal means between age groups for pretest motor performance variables showing a significant MANCOVA F-ratio

Variable	Boys					Girls				
	AG	M[a]	AG	M[a]	Md	AG	M[a]	AG	M[a]	Md
Flexed arm hang	13	21.14	14	25.96	-4.82*					
	13	21.14	16	36.61	-15.47**					
	14	25.96	16	36.61	-10.65**					
Jump and reach (cm)	13	40.65	14	42.04	-1.39					
	13	40.65	16	46.26	-5.61**					
	14	42.04	16	46.26	-4.22**					
Thirty yard dash	13	4.24	14	4.23	0.01					
	13	4.24	16	3.92	0.32**					
	14	4.23	16	3.92	0.31**					
Standing long jump (cm)						13	144.8	14	150.3	-5.5
						13	144.8	16	157.4	-12.9*
						14	150.3	16	157.4	-7.4
Agility shuttle run (sec)	13	10.49	14	10.23	0.26	13	12.09	14	11.36	0.73**
	13	10.49	16	9.85	0.64**	13	12.09	16	11.19	0.90**
	14	10.23	16	9.85	0.38*	14	11.36	16	11.19	0.17
800 meter run (sec)	13	222.87	14	211.86	11.01**	13	260.07	14	251.93	8.13
	13	222.87	16	205.46	17.41**	13	260.07	16	244.12	15.95*
	14	211.86	16	205.46	6.40	14	251.93	16	244.12	7.82

[a] adjusted means   * $p < 0.05$ ** $p < 0.01$

The multiple regression analysis revealed that significant effects of school on several motor performance scores found previously (without the covariates) among the 13-year-olds were eliminated (Table 41). Effects of school among the 13-year-old boys remained significant on the JR, ASR, SLJ and ER, while effects on the FAH, TYD, and SLJ were eliminated after adjusting for the covariates. The sports school boys jumped farther vertically and horizontally, and had shorter time completing the 800-meter run, than their peers in the ordinary schools. The overall multivariate test also found significant effect for sum of skinfolds and arm muscle area on motor performance. While sum of skinfolds had negative effects on the FAH, SR, and JR, arm muscle area had

Table 41. MANCOVA and regression analysis for pretest motor performance by school and the covariates for the 13-year old age group

		SC	ST	MA	BMI	SHSR	SS	TER	AMA	CMA	MS	IN	PR	R^2
Boys (N=102)														
	FAH	3.01	1.99	-2.72	7.88	0.73	-0.54*	-4.40	1.05**	-0.51**	-2.85	0.00	5.88	0.32
	JR	5.67**	0.57	-0.69	2.26	0.51	-0.35*	-3.65	0.22	-0.12	-0.58	0.00	2.27	0.49
Regression	TYD	-0.15	-0.03	0.04	-0.03	-0.04	0.01	0.25	-0.01	0.00	-0.08	0.00	-0.10	0.41
coefficients	SR	1.46	-0.16	0.61	0.16	0.65	-0.30*	12.26**	-0.03	-0.01	-2.20	0.00	2.83	0.30
(β)	SLJ	14.38*	5.11*	-6.87	22.56*	1.96	-1.98**	26.27	1.04	-0.48	-8.00	0.00	6.16	0.48
	ASR	-0.58**	-0.07	0.08	-0.17	-0.06	0.02	-0.92	0.00	0.01	0.03	0.0001*	-0.07	0.39
	ER	-66.98**	-1.00	2.06	-8.72	0.30	0.95	-34.21	1.31	-0.12	0.83	-0.004*	-7.51	0.68
MANCOVA	F	12.92**	1.30	0.99	1.40	0.81	3.72**	2.51*	2.45*	1.74	1.28	1.59	1.08	
Eta squared		0.52	0.10	0.08	0.11	0.06	0.24	0.17	0.17	0.13	0.10	0.12	0.08	
Girls (N=40)														
	FAH	5.50	-0.11	-0.52	-0.10	-1.40			0.96	0.48		0.00	-10.49*	0.39
	JR	4.49	-0.87	0.96	-3.58	-1.15			1.53	0.77		0.00	-5.07	0.24
Regression	TYD	-0.43	-0.13	0.23	-0.39	-0.01			-0.22*	-0.06		0.00	0.42	0.58
coefficients	SR	3.33	4.09**	-6.99**	17.16**	0.86			0.67	0.06		0.00	-0.88	0.52
(β)	SLJ	32.53**	-3.30	5.55	-11.60	2.65			-1.55	-0.89		0.00	-4.23	0.59
	ASR	-1.77**	0.03	0.03	0.03	0.01			-0.24*	-0.01		0.00	0.08	0.69
	ER	-57.02**	0.64	0.13	0.56	5.28			-2.73	0.75		0.00	5.26	0.60
MANCOVA	F	4.80**	3.22*	3.75**	3.26*	1.21			2.31	0.53		0.31	0.84	
Eta squared		0.58	0.48	0.52	0.49	0.26			0.40	0.13		0.08	0.20	

* $p < 0.05$ ** $p < 0.01$

Table 42. MANCOVA and regression analysis for pretest motor performance by school and the covariates for the 14-year old age group

		SC	ST	MA	BMI	SHSR	SS	TER	AMA	CMA	MS	IN	PR	R^2
Boys (N=112)														
	FAH	10.24**	0.10	0.08	-1.69	-0.82	-0.24	-8.05	0.01	-0.10	-2.65	0.00	-5.87	0.27
	JR	6.61**	-0.30	0.93	0.19	0.19	-0.61**	-3.59	-0.36	0.11	0.44	0.00	2.99	0.57
Regression	TYD	-0.28**	0.02	-0.05	0.04	-0.01	0.02**	-0.31	0.03*	-0.01	-0.05	0.00	-0.21	0.43
coefficients	SR	-0.09	-0.19	0.38	-0.46	1.23**	-0.07	-5.67	-0.30	0.14	-0.09	-0.001*	0.01	0.22
(β)	SLJ	17.60**	-0.58	2.22	0.71	1.56	-1.62**	0.64	-1.74*	0.73	4.41	0.00	-0.74	0.57
	ASR	-0.54**	0.08	-0.16	0.22	-0.05	0.04*	0.16	0.03	0.00	0.17	0.00	-0.12	0.21
	ER	-63.57**	3.84*	-7.31**	14.34*	-0.61	1.34**	14.82	2.41*	-0.37	-5.70	-0.01*	-16.66	0.75
MANCOVA	F	17.19**	1.19	1.69	0.97	1.77	4.56**	0.95	2.16*	0.94	0.98	2.03	1.50	
Eta squared		0.56	0.08	0.11	0.07	0.12	0.26	0.07	0.14	0.07	0.07	0.13	0.10	
Girls (N=42)														
	FAH	6.97**	-0.17	-0.09	-1.84	0.44			0.76	-0.29		0.00	-15.70**	0.58
	JR	-2.15	0.32	0.68	-1.66	0.82			0.66	-0.39		0.00	-3.03	0.24
Regression	TYD	-0.38	-0.03	0.02	0.05	-0.07			-0.01	-0.07		0.00	0.17	0.30
coefficients	SR	4.54	0.31	-0.59	0.82	0.91			0.65	-0.04		0.00	4.13	0.29
(β)	SLJ	35.38**	-0.14	0.50	-1.12	2.56			3.10	-2.64		0.01	-15.28	0.64
	ASR	-1.47**	0.00	-0.03	0.03	0.00			0.03	0.01		0.00	0.80	0.53
	ER	-78.90**	0.57	1.49	3.28	-2.35			-0.86	2.14		0.00	7.61	0.64
MANCOVA	F	9.23**	0.90	1.82	0.77	1.05			0.49	0.69		1.40	2.05	
Eta squared		0.71	0.20	0.33	0.17	0.22			0.12	0.16		0.27	0.36	

* $p < 0.05$ ** $p < 0.01$

Table 43. MANCOVA and regression analysis for pretest motor performance by school and the covariates for the 16-year old age group

		SC	ST	MA	BMI	SHSR	SS	TER	AMA	CMA	MS	IN	PR	R^2
Boys (N=106)														
	FAH	11.30**	-0.10	-0.44	0.18	1.90	-0.33	0.24	-0.05	-0.10	-1.38	0.00	-0.13	0.24
	JR	10.83**	-0.91	1.35	-4.95*	0.35	0.03	-2.33	0.22	-0.15	0.46	0.00	-4.67*	0.47
Regression	TYD	-0.26**	-0.01	0.01	-0.01	0.02	0.01	0.16	0.01	-0.01	-0.05	0.00	0.06	0.30
coefficients	SR	2.09	0.02	-0.38	1.31	0.11	0.07	3.16	0.44*	-0.10	0.32	0.00	-1.39	0.27
(β)	SLJ	29.85**	-1.90	2.67	-11.36	0.52	0.07	-4.81	0.99	-0.50	1.17	0.00	-9.10	0.45
	ASR	-0.44*	-0.07	0.09	-0.23	-0.06	-0.01	0.25	0.05*	-0.02	-0.02	0.00	0.07	0.17
	ER	-60.95**	0.88	-0.73	4.34	2.67	0.01	4.38	-0.34	0.03	0.94	0.00	11.36	0.64
MANCOVA	F	15.60**	1.06	1.09	1.23	1.37	0.81	0.23	2.33*	1.67	0.19	0.27	1.09	
Eta squared		0.56	0.08	0.08	0.09	0.10	0.06	0.02	0.16	0.12	0.02	0.02	0.08	
Girls (50)														
	FAH	10.63**	0.55	-1.31	2.79	-1.73*			-0.70	0.93		0.00	3.17	0.36
	JR	8.55**	2.10*	-2.71*	7.00*	-0.32			-0.95	0.53		0.00	2.80	0.55
Regression	TYD	-1.06**	0.07	-0.11	0.32	0.03			0.08	-0.03		0.00	-0.41	0.59
coefficients	SR	9.42*	2.00*	-2.83*	6.64	0.58			-0.02	0.27		0.00	5.82	0.53
(β)	SLJ	46.48**	5.49	-7.72	17.01	-2.95			-0.70	0.75		0.01	21.86	0.58
	ASR	-2.49**	0.03	0.04	-0.12	0.29**			0.00	0.05		0.00	-0.82	0.71
	ER	-58.64**	8.26*	-11.36*	37.07**	4.47*			-2.66	0.35		-0.01*	-4.85	0.84
MANCOVA	F	19.90**	3.12*	3.23**	3.86*	2.74			1.27	0.64		1.07	0.99	
Eta squared		0.80	0.39	0.40	0.44	0.36			0.21	0.12		0.18	0.17	

* $p < 0.05$ ** $p < 0.01$

positive effects on the FAH. For girls of similar age, positive effects of school on motor performance remained significant in the SLJ, ASR, and the ER, while the effect of the FAH was eliminated. There were also significant multivariate effects of stature, mass, and BMI. These effects were due to the significant relationships of these covariates with SR. The SR was positively affected by stature and BMI, but negatively affected by mass.

For the 14-year-old age group, both boys and girls demonstrated significant effect of school on motor performance (Table 42). Additionally, the multivariate test revealed significant effects of sum of skinfolds, arm muscle area, and family income among the boys. However, there was no significant effect of the covariates on the performance of girls in this age group. For boys, the regression analysis indicated that all significant effects of school on motor performance scores found earlier remained significant even after controlling for the covariates. The sports school boys jump vertically higher and farther, had shorter time in the ASR, TYD, and the ER, and had longer hanging time in the FAH than boys in the ordinary schools. Boys with a greater sum of skinfolds had shorter jumping distance (JR, SLJ) and had longer running time in the TYD, ASR, and ER, while boys with greater arm muscle area had shorter long jump distance, and longer running time in the TYD and ER. Additionally, boys with higher family income had better performance on the SR. Among the 16-year-old girls, effects of school on motor performance remained significant for the FAH, SLJ, ASR and ER, while effects on TYD and SR were eliminated after adjusting for the effect of the covariates. The sports school girls had longer flexed arm hang time, had farther jumping distance, and ran faster on the TYD, ASR and ER than the girls in the ordinary schools.

There were also a significant effect of school on motor performance controlling for the effect of covariates for both boys and girls in the 16-year-old age group (Table 43). The effects remained significant for all of the motor performance tasks, except for the SR for boys. The sports school boys and girls jumped higher and farther, had longer flexed arm hang time, greater distance for the SR, and shorter running time on the TYD, ASR, and the ER. There was also significant multivariate effect of arm muscle area for the boys on motor performance. Boys with greater arm muscle area performed better on the SR and ER. None of the covariates showed a significant multivariate effect on the motor performance of the girls.

Question 3. Is there an effect of the sport school program on the motor performance of secondary school students in Malaysia?

Separate MANOVA and MANCOVA analyses were conducted for boys and girls. MANOVA was conducted to test the effects of school, age group, and their interaction term on the posttest motor performance. Bonferroni post hoc test and pairwise comparison of estimated marginal means were performed to determine specific between age group differences for significant MANOVA and MANCOVA results, respectively. Follow up tests, utilizing multiple regression analysis were generated for each of the motor performance tests for each age group with and without controlling for the covariates. Covariates included were the same as those used in the analyses for Question 2, with the addition of the pretest motor performance scores and stature at the time of the posttest.

Results of the MANOVA are presented in Table 44. There were significant differences between the schools and among the age groups for the motor performance scores for both boys and girls. There was no school and age group interaction effect for motor performance for either gender.

Table 44. MANOVA for posttest motor performance by school and age group

	School	Age group	School * Age group
Boys		N=320	
FAH	65.95**	28.00**	1.53
JR	252.04**	44.83**	0.67
TYD	250.43**	91.47**	1.61
SR	36.24**	17.78**	2.08
SLJ	176.11**	39.14**	1.00
ASR	92.98**	35.90**	1.93
ER	522.86**	5.06*	0.33
Multivariate F	107.69**	13.63**	1.63
Eta squared	0.71	0.24	0.04
Girls		N=132	
FAH	43.29**	0.76	0.28
JR	58.65**	4.41*	1.00
TYD	110.89**	3.52*	1.41
SR	58.64**	5.66**	2.43
SLJ	159.37**	3.53*	0.29
ASR	244.45**	6.33**	0.77
ER	222.60**	0.04	0.42
Multivariate F	62.65**	2.18**	1.01
Eta squared	0.79	0.11	0.06

* $p < 0.05$ ** $p < 0.01$

Specific age group differences for each of the motor performance tasks using Bonferonni post hoc test are summarized in Table 45. For boys, the 16-year-olds had better performance than the younger age groups on all tasks except the ER where they were only better than the youngest age group. The 14-year-old boys exhibited better performance on the SR, SLJ, and ASR when compared to the 13-year-old age group. All age group differences in girls were found between the oldest and the youngest age groups. The 16-year-old group was significantly better than the 13-year-old group on the JR, TYD, SR, SLJ and ASR.

Table 45. Bonferonni post hoc tests of mean differences between age groups for posttest motor performance variables showing a significant MANOVA F-ratio

Variable	Age Group	Age Group	Mean Difference	
			Boys	Girls
Flexed arm hang (sec)	13	14	-2.34	
	13	16	-12.71**	
	14	16	-10.37**	
Jump and reach (cm)	13	14	-2.38	-2.55
	13	16	-9.19**	-4.43*
	14	16	-6.80**	-1.88
Thirty yard dash	13	14	0.06	0.27
	13	16	0.55**	0.31*
	14	16	0.48**	0.04
Sit and reach (cm)	13	14	-2.09*	-1.66
	13	16	-4.46**	-3.88**
	14	16	-2.62**	-2.21
Standing long jump (cm)	13	14	-8.16*	-4.12
	13	16	-25.90**	-10.34*
	14	16	-17.74**	-6.22
Agility shuttle run (sec)	13	14	0.24*	0.41
	13	16	0.74**	0.59**
	14	16	0.50**	0.18
800 meter run (sec)	13	14	4.98	
	13	16	10.41*	
	14	16	5.43	

* $p < 0.05$ ** $p < 0.01$

The effect of school on posttest motor performance for each age group was examined by MANOVA and regression analysis and is presented in Table 46. For all age groups, boys and girls in the sports school had better performance on all of the motor performance tasks. They had higher and longer jumping distance, longer flexed arm hang time, and shorter time in the dash, agility run, and 800-meter run when compared to their peers in the ordinary schools.

Table 46. MANOVA and regression analysis for posttest motor performance variables by school for boys and girls for each age group

Age group		13		14		16	
		β	R^2	β	R^2	β	R^2
Boys		N=102		N=112		N=106	
	FAH	11.22**	0.22	9.21**	0.10	15.33**	0.22
Regression	JR	11.67**	0.49	13.25**	0.43	13.96**	0.44
analysis	TYD	-0.63**	0.49	-0.60**	0.44	-0.48**	0.41
	SR	2.89*	0.05	2.95**	0.06	5.70**	0.19
	SLJ	27.60**	0.29	35.92**	0.38	32.95**	0.42
	ASR	-0.88*	0.38	-0.67**	0.16	-0.53**	0.18
	ER	-60.61**	0.64	-65.89**	0.66	-64.60**	0.59
MANOVA	F	42.66		36.28		33.97	
Eta squared		0.76		0.71		0.71	
Girls		N=40		N=42		N=50	
	FAH	8.65**	0.25	7.57**	0.27	9.92**	0.27
Regression	JR	10.00**	0.31	7.09**	0.16	11.19**	0.54
analysis	TYD	-1.27**	0.60	-0.85**	0.33	-1.13**	0.48
	SR	5.70**	0.18	6.11**	0.26	10.24**	0.52
	SLJ	37.57**	0.67	42.76**	0.59	43.14**	0.49
	ASR	-2.03**	0.69	-2.04**	0.63	-2.39**	0.68
	ER	-63.05**	0.70	-67.76**	0.57	-73.12**	0.67
MANOVA	F	20.43**		23.87**		28.41**	
Eta squared		0.82		0.83		0.83	

* $p < 0.05$ ** $p < 0.01$

Summary of MANCOVA results for the determination of differences in posttest motor performances between the schools and among age groups with the presence of the covariates is presented in Table 47. Examination of the multivariate F-ratio again revealed significant differences in motor performance between the schools even after adjusting for the effects of the covariates for both boys and girls. The univariate F-ratios indicated that boys between the schools were different on all motor performance tests, except the SLJ, while the girls differed on all motor performance tasks.

The analysis also demonstrated the influence of several covariates on motor performances of the boys and girls. All pretest motor performances significantly influenced posttest motor performance for both boys and girls. Additionally, the girls' SR performance was influenced by mass and BMI, and their ER performance was influenced by BMI.

Only the boys exhibited differences among age groups in posttest motor performance; specifically, on the FAH and the TYD. Summary of specific age group differences determined by a pairwise comparison of the estimated marginal means of these variables are presented in Table 48. Age group differences were only exhibited between the 14- and the 16-year-old groups.

Further analysis to determine between school differences in motor performance for each age group was performed using the MANCOVA. Follow up tests utilizing multiple regression analysis were then performed to determine the effects of school for each motor performance test for each age group. Summaries of these analyses are presented in Tables 49, 50, and 51. The multivariate F-ratios indicate significant

Table 47. MANCOVA for posttest motor performance by school, age group, and all covariates for boys and girls

	SC	AG	AC*AG	ST^{a}	MA	BMI	SHSR	SS	TER	AMA	CMA	MS	ST^{b}	IN	PR	FAH^{a}	JR^{a}	TYD^{a}	SR^{a}	SLJ^{a}	ASR^{a}	ER^{a}	R^2
<u>Boys</u> (N=320)																							
FAH^{b}	13.74^{**}	5.14^{**}	3.53^{*}	0.16	0.11	0.05	0.01	0.46	0.48	0.38	0.09	0.01	0.28	1.09	5.66^{*}	1058^{**}	1.45	0.49	0.09	2.48	0.29	1.00	0.86
JR^{b}	16.07^{**}	1.09	1.23	0.75	0.03	0.15	2.24	1.53	2.43	0.33	0.11	1.51	0.23	0.24	0.09	1.70	432.86^{**}	3.38	2.71	5.37^{*}	4.29^{*}	0.00	0.87
TYD^{b}	23.80^{**}	3.11^{*}	1.70	0.14	0.71	0.81	0.31	0.63	0.32	0.02	0.58	0.10	0.80	0.51	0.34	2.67	0.04	100.02^{**}	0.84	6.47^{*}	6.45^{*}	0.08	0.77
SR^{b}	7.46^{**}	0.92	1.49	0.02	5.39^{*}	6.10^{*}	4.07^{*}	0.25	1.34	1.00	0.53	0.13	0.85	0.77	0.50	0.01	0.49	1.30	716.16^{**}	6.04^{*}	1.40	0.00	0.79
SLJ^{b}	1.13	1.80	0.42	2.06	0.34	0.43	3.68	1.86	7.42^{*}	0.05	0.01	0.34	3.69	0.17	1.26	1.49	1.39	0.03	2.70	328.71^{**}	1.58	3.47	0.85
ASR^{b}	17.55^{**}	0.96	0.12	0.04	0.01	0.24	0.44	3.61	0.31	0.13	2.19	0.73	0.01	0.62	0.65	0.08	0.00	0.03	1.26	0.27	365.36^{**}	0.81	0.73
ER^{b}	20.44^{**}	1.46	0.67	0.25	1.44	0.74	1.85	0.04	0.11	5.85^{*}	6.64^{*}	1.90	0.00	0.27	1.90	3.79	3.60	0.46	2.15	2.93	0.07	1106^{**}	0.93
Manova F	12.79^{**}	1.89^{*}	1.24	0.60	1.23	1.29	1.63	0.88	1.67	1.18	1.57	0.67	0.97	0.61	1.66	155.35^{**}	62.75^{**}	16.26^{**}	104.04^{**}	48.29^{**}	53.65^{**}	159.52^{**}	
Eta squared	0.24	0.04	0.03	0.01	0.03	0.03	0.04	0.02	0.04	0.03	0.04	0.02	0.02	0.01	0.04	0.79	0.60	0.28	0.72	0.54	0.57	0.79	
										ACR	CCR												
<u>Girls</u> (N=132)																							
FAH^{b}	10.94^{**}	0.96	0.97	0.54	0.85	0.01	0.05			0.61	1.23		0.45	0.01	1.42	717.08^{**}	0.67	0.01	0.03	0.46	0.03	0.99	0.91
JR^{b}	7.28^{**}	0.07	0.61	1.73	0.11	1.48	1.50			0.13	1.68		1.55	0.03	0.21	0.04	314.65^{**}	0.88	0.40	6.97^{**}	0.02	0.81	0.86
TYD^{b}	9.82^{**}	1.83	2.23	0.03	0.35	0.00	0.00			0.73	0.00		0.04	0.05	0.20	0.87	7.67^{**}	140.88^{**}	0.49	4.47^{*}	2.91	2.11	0.83
SR^{b}	7.78^{**}	0.14	0.68	0.11	13.12^{**}	9.89^{**}	0.00			1.78	1.56		1.29	1.85	1.84	0.00	0.96	0.37	553.90^{**}	0.01	0.49	0.33	0.89
SLJ^{b}	10.08^{**}	0.29	0.02	0.45	0.47	0.13	0.45			0.16	0.08		0.20	0.50	0.00	0.00	1.46	1.35	5.27^{*}	566.91^{**}	0.30	2.90	0.94
ASR^{b}	36.87^{**}	0.08	0.24	2.31	0.62	0.63	0.75			1.66	3.13		2.67	0.12	0.26	0.02	0.28	2.45	0.18	0.17	112.26^{**}	1.26	0.88
ER^{b}	25.91^{**}	2.05	0.33	3.64	3.49	5.84^{*}	1.80			0.24	0.14		5.73^{*}	1.90	0.00	0.58	4.69^{*}	2.69	0.07	0.16	0.66	639.10^{**}	0.96
Manova F	13.84^{**}	0.92	0.90	1.16	2.87^{**}	2.61^{*}	0.76			0.69	0.90		1.55	0.73	0.59	102.82^{**}	45.61^{**}	20.19^{**}	80.15^{**}	82.21^{**}	19.20^{**}	97.75^{**}	
Eta squared	0.48	0.06	0.06	0.07	0.16	0.15	0.05			0.04	0.06		0.09	0.05	0.04	0.87	0.75	0.58	0.84	0.85	0.56	0.87	

^{a}pretest ^{b}posttest * $p < 0.05$ ** $p < 0.01$

differences in motor performance between the schools for both boys and girls in all age groups.

Table 48. Pairwise comparisons of estimated marginal means between age groups for selected posttest motor performance variables adjusting for all covariates

Variable			Boys		
	AG	M[a]	AG	M[a]	Md
Flexed arm hang	13	30.69	14	30.16	0.30
	13	30.69	16	34.10	-3.41
	14	30.16	16	34.10	-3.94**
Thirty yard dash	13	3.95	14	3.97	-0.02
	13	3.95	16	3.82	0.14
	14	3.97	16	3.82	0.15*

[a] adjusted means * $p < 0.05$ ** $p < 0.01$

Significant influences of several covariates on motor performance were also revealed by the analysis. All pretest motor performance scores had significant influence on posttest scores for boys and girls in all age groups. Additionally, the 13-year-old girls posttest motor performance was also influenced by income and pretest stature, while the 14-year-old girls' performance was influenced by body mass.

The MANCOVA and the multiple regression analysis revealed that significant effects of school on several motor performance scores found before (without the covariates) were eliminated. Effects of school among the 13-year-old boys remained significant in FAH, ASR, and the ER, while effects on JR, SR, TYD, and SLJ were eliminated after adjusting for the covariates (Table 49). The sports school boys had longer arm hang time, shorter time in the agility run, and completed the 800-meter run faster than their peers in the ordinary schools. All pretest motor performance scores had

Table 49. MANCOVA and regression analyses for posttest motor performance by school and the covariates for the 13-year old group

		SC	ST^a	MA	BMI	SHSR	SS	TER	AMA	CMA	MS	ST^b	IN	PR	FAH^a	JR^a	TYD^a	SR^a	SLJ^a	ASR^a	ER^a	R^2
Boys (N=102)																						
	FAH^b	6.45*	0.28	-0.84	2.56	0.53	-0.29	3.64	-0.05	0.02	0.07	0.17	0.00	1.74	0.82**	0.16	-1.46	0.10	-0.03	1.45	0.01	0.77
Regression	JR^b	3.03	-0.46	0.02	0.51	-0.68	-0.19	-6.14	0.24	-0.04	-0.59	0.54	0.00	2.05	-0.01	0.74**	0.19	0.07	0.02	-1.22	-0.01	0.81
coefficients	TYD^b	-0.22	-0.01	0.00	0.01	0.01	0.00	0.00	0.00	-0.01	0.04	0.01	0.00	0.08	0.00	-0.01	0.31**	0.01	0.00	0.12*	0.00	0.74
(β)	SR^b	2.24	-0.41	-0.07	0.40	-0.16	0.02	1.83	-0.16	0.09	-0.39	0.49	0.00	0.65	0.00	0.03	0.75	0.83**	0.02	-0.82	0.00	0.81
	SLJ^b	8.91	-2.08	-0.60	2.01	-1.35	-0.49	-37.07**	0.21	-0.15	0.39	2.80*	0.00	14.43**	-0.18	0.41	3.69	0.31	0.72**	-2.71	-0.01	0.80
	ASR^b	-0.43*	0.08	-0.03	0.13	0.02	0.00	0.21	0.01	0.01	-0.09	-0.07	0.00	0.03	0.00	-0.01	0.36*	-0.03**	0.00	0.29**	0.00	0.73
	ER^b	-14.56**	-1.94	2.02	-4.50	0.16	-0.08	9.86	0.78*	-0.32	-1.88	0.57	0.00	1.94	-0.22*	0.71*	5.86	-0.23	-0.04	1.27	0.88**	0.93
Manova F		3.03**	0.73	0.28	0.34	0.77	0.76	1.89	1.47	1.60	0.38	1.23	1.10	1.93	24.92**	8.44**	3.42**	28.23**	11.42**	2.62*	41.09**	
Eta squared		0.22	0.06	0.03	0.03	0.07	0.07	0.15	0.12	0.13	0.03	0.10	0.09	0.15	0.70	0.44	0.24	0.72	0.52	0.20	0.79	
									ACR	CCR												
Girls (N=40)																						
	FAH^b	5.12*	0.96	-0.56	1.42	0.07			-0.41	-0.10		-0.76	0.00	-0.53	0.91**	0.05	-1.34	-0.01	0.00	0.51	0.01	0.88
Regression	JR^b	1.50	1.54	-1.83	4.40	-0.26			-0.17	0.15		-0.39	0.00	-5.15*	-0.12	0.79**	-0.03	-0.15	0.07	-1.04	-0.01	0.90
coefficients	TYD^b	-0.18	-0.07	0.06	0.03	-0.04			-0.10	-0.07*		0.04	0.00	0.18	0.01	-0.01	0.54**	0.01	-0.01*	-0.04	0.00	0.87
(β)	SR^b	1.02	1.24	-0.49	0.53	0.31			0.22	0.35		-0.98*	0.00	-0.42	0.05	-0.06	0.42	0.87**	0.03	0.34	0.00	0.93
	SLJ^b	6.38	4.61	-4.76	11.12	0.88			-1.00	1.06		-1.55	0.001	-7.61	0.04	0.02	-0.84	-0.41	0.86**	0.48	-0.02	0.92
	ASR^b	-0.73*	-0.07	-0.06	0.17	-0.11			0.05	-0.01		0.12	0.00	-0.05	0.01	0.00	0.14	0.00	0.00	0.76**	0.00	0.96
	ER^b	-12.74**	-4.49*	2.82	-5.57	-2.69*			-0.27	-0.10		2.46	-0.002*	-8.11	-0.22	0.38*	-4.12	-0.18	0.06	3.12	0.89**	0.97
Manova F		6.04**	4.03**	2.10	1.97	1.76			0.93	1.07		1.93	4.75**	1.32	7.37**	22.21**	3.54**	30.51**	13.20**	6.69**	70.32**	
Eta squared		0.73	0.64	0.48	0.46	0.43			0.29	0.32		0.46	0.68	0.37	0.76	0.91	0.61	0.93	0.85	0.75	0.97	

^{a} pretest ^{b} posttest * $p < 0.05$ ** $p < 0.01$

Table 50. MANCOVA and regression analyses for posttest motor performance by school and the covariates for the 14-year old group

		SC	ST^a	MA	BMI	SHSR	SS	TER	AMA	CMA	MS	ST^b	IN	PR	FAH^a	JR^a	TYD^a	SR^a	SLJ^a	ASR^a	ER^a	R^2
Boys (N=112)																						
	FAH^b	2.56	-1.04	0.67	-1.13	-0.63	-0.01	0.73	-0.24	0.00	1.55	0.74	0.00	4.97*	0.89**	-0.03	0.95	-0.02	0.06	-1.14	0.01	0.85
Regression	JR^b	2.25	0.82	-0.13	0.49	-0.23	-0.05	1.36	-0.04	0.00	0.86	-0.67	0.00	-0.70	0.01	0.87**	3.11*	-0.03	0.08**	-0.21	0.00	0.91
coefficients	TYD^b	-0.47**	0.01	-0.05	0.10	-0.01	0.01	0.04	-0.01	0.01	0.01	0.01	0.00	0.06	0.00	0.00	0.54**	0.01	0.00	0.05	0.00	0.72
(β)	SR^b	0.56	-0.01	-0.27	1.12	-0.23	0.00	-5.63*	0.03	-0.06	0.58	0.19	0.00	-0.33	-0.01	-0.01	1.46	0.85**	0.04	-0.18	-0.01	0.78
	SLJ^b	6.55*	0.58	0.15	0.05	-0.71	-0.02	-5.01	-0.14	-0.04	1.51	-0.62	0.00	-0.19	0.02	-0.12	0.82	0.08	1.05**	-1.72	0.03	0.95
	ASR^b	-0.34*	-0.05	0.07	-0.19	0.02	-0.01	-0.34	-0.01	0.02	-0.18	0.00	0.00	0.17	0.00	0.01	-0.20	0.00	0.00	1.00**	0.00	0.79
	ER^b	-15.63**	0.83	-0.34	1.16	0.42	-0.04	-5.90	0.65*	-0.30	-0.81	-0.86	0.00	-0.02	-0.04	0.14	1.12	0.07	-0.05	0.05	0.82**	0.96
Manova F		6.99**	0.88	1.00	1.17	0.83	0.66	0.99	1.11	1.32	0.93	0.72	0.84	0.91	53.28**	28.62**	5.91**	33.66**	71.19**	50.57**	47.88**	
Eta squared		0.37	0.07	0.08	0.09	0.06	0.05	0.08	0.08	0.10	0.07	0.06	0.06	0.07	0.81	0.70	0.33	0.73	0.85	0.81	0.80	
									ACR	CCR												
Girls (N=42)																						
	FAH^b	4.13*	-0.24	-0.17	-0.50	0.14			0.31	0.06		0.19	0.00	-3.52	0.88**	0.07	-0.98	-0.07	0.01	0.68	0.00	0.91
Regression	JR^b	2.15	0.72	-0.52*	-0.63	0.75			0.38	0.94*		-0.44	0.00	6.99	0.01	1.06**	5.20**	-0.23	0.06	-1.29	0.00	0.85
coefficients	TYD^b	-0.48	-0.01	0.00	-0.03	0.01			0.00	0.02		0.01	0.00	0.00	-0.01	-0.01	0.99**	0.00	-0.01	-0.29*	0.00	0.75
(β)	SR^b	4.07	-0.05	0.27	-0.62	0.07			-0.36	0.32		-0.13	0.00	-1.48	0.08	0.02	0.39	0.74**	-0.01	0.45	0.01	0.74
	SLJ^b	10.81*	-2.59*	0.23	-0.76	1.50*			0.65	-1.40*		2.32*	0.00	5.66	0.33	0.16	-1.34	-0.13	0.88**	-0.70	0.02	0.96
	ASR^b	-1.27*	-0.07	-0.01	-0.15	0.10			0.01	0.12		0.09	0.00	0.08	-0.02	0.01	0.63*	-0.01	0.00	0.40*	0.00	0.81
	ER^b	-18.43*	-0.91	-1.72*	3.12	0.67			1.83	0.13		1.98	0.00	14.56	0.13	0.37	15.68**	-0.06	-0.11	-6.14*	0.83**	0.95
Manova F		5.45**	0.85	2.86*	1.20	2.34			0.56	2.27		0.75	1.14	1.16	11.01**	15.77**	5.64**	7.87**	30.89**	6.05**	27.46**	
Eta squared		0.68	0.25	0.53	0.32	0.48			0.18	0.47		0.23	0.31	0.31	0.81	0.86	0.69	0.75	0.92	0.70	0.91	

[a] pretest [b] posttest * $p < 0.05$ ** $p < 0.01$

Table 51. MANCOVA and regression analyses for posttest motor performance by school and the covariates for the 16-year old group

		SC	ST[a]	MA	BMI	SHSR	SS	TER	AMA	CMA	MS	ST[b]	IN	PR	FAH[a]	JR[a]	TYD[a]	SR[a]	SLJ[a]	ASR[a]	ER[a]	R^2
Boys (N=106)																						
	FAH[b]	9.69**	0.14	-0.12	-0.52	0.27	0.08	-6.37	0.05	-0.03	-0.67	-0.14	0.00	0.95	0.81**	-0.02	3.07	-0.03	0.04	1.12	-0.02	0.87
Regression	JR[b]	4.33*	0.50	0.41	-1.44	-0.10	-0.01	-4.76	0.03	-0.06	-2.03*	-0.66	0.00	-0.05	0.02	0.91**	0.54	0.17*	0.00	-0.90	0.01	0.83
coefficients	TYD[b]	-0.23*	-0.06	0.00	0.01	0.01	-0.01*	0.08	-0.01	0.00	-0.03	0.06	0.00	0.00	-0.004*	0.00	0.57**	0.00	0.00	-0.06	0.00	0.70
(β)	SR[b]	3.70*	0.38	-0.09	0.17	-0.48	0.07	-0.26	0.09	-0.04	-0.59	-0.37	0.00	-0.72	0.01	0.06	-1.02	0.78**	0.01	-0.05	0.01	0.71
	SLJ[b]	-1.10	-2.04	-0.51	0.85	-1.23	0.12	-10.79	0.60	-0.06	-0.52	2.33	0.00	-3.13	0.20*	0.03	-3.99	0.13	0.70**	1.50	-0.10	0.71
	ASR[b]	-0.11	0.05	0.01	-0.07	0.00	0.01	0.14	0.00	0.00	-0.02	-0.06	0.00	0.11	0.00	-0.01	0.00	-0.01	0.00	0.68**	0.00	0.66
	ER[b]	-5.18	1.55	-0.19	0.54	1.40	0.17	-3.13	0.30	-0.19	-2.22	-0.91	0.00	-7.00	-0.05	0.10	-6.54	-0.25	-0.13	0.75	0.97	0.91
Manova F		5.00**	1.17	0.13	0.17	0.98	1.65	0.95	0.36	0.19	1.37	1.83	0.59	0.82	53.07**	21.18**	10.1**	24.75**	8.82**	19.00**	47.23**	
Eta squared		0.31	0.09	0.01	0.01	0.08	0.13	0.08	0.03	0.02	0.11	0.14	0.05	0.07	0.82	0.65	0.47	0.69	0.44	0.63	0.81	
Girls (N=50)																						
	FAH[b]	1.47	-0.65	-0.90	1.96	0.27			0.35	-0.31		1.39	0.00	-1.06	1.06**	0.10	1.66	-0.01	0.01	-1.25*	0.03	0.94
Regression	JR[b]	8.58**	-0.25	0.50	-2.02	-0.32			-0.12	0.26		-0.08	0.00	1.75	-0.03	0.66**	-0.67	-0.01	0.05	0.34	0.06*	0.85
coefficients	TYD[b]	-0.31	-0.14	0.17	-0.46	0.08			-0.01	0.01		0.03	0.00	-0.17	0.01	-0.01	0.97**	0.00	0.00	-0.13	0.01*	0.87
(β)	SR[b]	1.35	-0.36	0.45	-0.57	-0.20			-0.54	0.23		0.08	0.00	-0.22	-0.02	-0.01	-0.43	0.91**	-0.03	0.47	-0.06*	0.92
	SLJ[b]	14.49**	-7.13*	5.36*	-13.79*	-1.12			0.44	-0.04		2.76	0.00	7.89	-0.15	0.68*	-0.08	-0.65*	0.95**	2.74	-0.03	0.95
	ASR[b]	-0.55	0.20	-0.23	0.59	-0.01			-0.02	0.03		-0.04	0.00	0.12	-0.01	-0.02	-0.10	0.00	0.00	0.91**	0.00	0.91
	ER[b]	-21.59**	-4.73	-0.27	2.07	0.91			-1.30	0.62		5.26	0.00	0.47	-0.26	0.11	3.40	0.21	0.07	-0.45	0.88**	0.96
Manova F		5.14**	1.53	2.26	2.06	0.83			0.91	0.40		0.81	2.00	0.48	65.16**	5.50**	10.18**	21.63**	38.08**	8.37**	15.26**	
Eta squared		0.58	0.29	0.38	0.36	0.18			0.20	0.10		0.18	0.35	0.12	0.95	0.60	0.73	0.85	0.91	0.69	0.80	

[a] pretest [b] posttest * $p < 0.05$ ** $p < 0.01$

strong positive relationships with similar performance on the posttest scores. For the girls, only three of the motor performances remained significant; namely, the FAH, ASR, and the ER, after accounting for the covariates.

For the 14-year-old age group, the regression analysis indicated that several significant positive effects of sports school on motor performance scores found earlier were eliminated after controlling for the covariates (Table 50). The positive effects of the sports school for boys remained only in the TYD, SLJ, ASR, and the ER. The sports school boys had farther jumping distance and faster time on all running tasks than the boys from the ordinary schools. Among the 14-year-old girls, effects of school on motor performance remained significant in the FAH, SLJ, ASR, and ER, while effects on other motor performances were eliminated after adjusting for the effect of the covariates. The sports school girls had longer hang time, farther jumping distance, and completed the agility and 800-meter run in shorter time than their peers in the ordinary schools. There were also significant relationships between mass and ER, and between mass and JR for girls in this age group. Heavier girls at the beginning of the study had lower vertical jumping distance but faster 800-meter running time. There were also strong positive relationships between pretest and posttest scores for similar motor performance tests for both boys and girls in this age group.

There was a significant effect of school on several motor performances controlling for the effect covariates among the 16-year-old boys and girls (Table 51). For the boys, the positive effects of sports school on all motor performances exhibited by the previous regression analysis (without the covariates) remained significant only for the FAH, JR, TYD, and SR. The sports school boys had longer hang time, higher vertical jumping distance, faster dash time, and had greater distance in the SR than their peers in the ordinary schools. For the girls, effect of sports school remained significant in JR, SLJ and the ER. The sports school girls jumped higher and farther than the ordinary school girls and ran faster in the 800-m run.

Question 4. Which motor performance tasks, if any, distinguished between students of the sport and ordinary schools?

Separate analyses were conducted for boys and girls. For each age group, a discriminant analysis was performed to determine which posttest motor performance scores distinguished between the sport school and the ordinary schools. Further investigation using the classification process of discriminant analysis was carried out to determine the percentage of sports school students that rightly belongs to the school based on their motor performance.

Results of the discriminant analyses for boys and girls of each age group are presented in Table 52. The eigen values of the first function indicated that this function has a total discriminating power to discriminate students of the two schools for boys and girls in all age groups. Boys and girls between the two schools were found to be discriminated by all motor performance scores for all age groups.

However, the relative contribution of motor performance variables in discriminating students of the two schools were different among the age groups, as indicated by the standardized canonical discriminant function. For the boys at all ages, the JR and ER contributed the most in separating the two schools. For the 13-year-old girls, the three largest contributors separating the schools were the SLJ, ASR, and ER.

Five variables (TYD, SR, SLJ, ASR, and ER), had similar contributions in separating the 14-year-old girls of the two schools. The ASR and ER were the two largest contributors separating the 16-year-old girls in the sports and ordinary schools.

Table 52. Standardized canonical discriminant functions (SCDF) and ANOVA F-ratios for posttest motor performance between sports and ordinary schools.

Age group	13		14		16	
	SCDF	F	SCDF	F	SCDF	F
Boys	N=102		N=112		N=106	
FAH	-0.10	28.16**	0.23	12.39**	-0.01	30.06**
JR	-0.63	95.22**	-0.38	84.25**	-0.45	80.76**
TYD	0.34	94.30**	0.25	85.95**	0.34	71.03**
SR	-0.03	7.30**	-0.09	7.58**	-0.18	23.69**
SLJ	0.41	39.87**	0.23	67.60**	-0.04	66.39**
ASR	0.02	62.10**	0.13	21.62**	0.03	22.72**
ER	0.76	177.86**	0.85	213.35**	0.63	144.26**
First eigen value	3.18		2.44		2.42	
Wilks' lambda	0.24**		0.29**		0.29**	
Girls	N=40		N=42		N=50	
FAH	0.14	12.43**	-0.28	14.42**	0.04	18.05**
JR	0.12	17.83**	-0.06	7.57**	-0.36	56.82**
TYD	0.27	56.26**	0.51	19.77**	-0.22	44.00**
SR	0.10	8.45**	0.65	14.20**	-0.39	51.15**
SLJ	-0.43	78.20**	0.65	58.39**	0.03	46.95**
ASR	0.41	84.67**	-0.66	68.17**	0.61	100.71**
ER	0.49	90.38**	-0.63	53.53**	0.54	97.84**
First eigen value	4.47		4.91		4.74	
Wilks' lambda	0.18**		0.17**		0.17**	

* $p < 0.05$ ** $p < 0.01$

Another purpose to which discriminant analysis was applied was the issue of classification of cases (Rencher, 1995). Results of the analyses indicating number and percentage of the sports school students that rightly belong to the sports school based on their motor performance are presented in Table 53.

Table 53. Classification results of students based on motor performance

Original		Age group 13		Age group 14		Age group 16	
		Predicted group membership		Predicted group membership		Predicted group membership	
		Sports school	Ordinary school	Sports school	Ordinary school	Sports school	Ordinary school
Boys		N=102		N=112		N=106	
Count	Sports school	50	1	52	4	49	4
	Ordinary school	1	50	2	54	5	48
Percentage	Sports school	98.0	2.0	92.9	7.1	92.5	7.5
	Ordinary school	2.0	98.0	3.6	96.4	9.4	90.6
Percentage of original group correctly classified		98.0		94.6		91.5	
Girls		N=40		N=42		N=50	
Count	Sports school	19	1	20	1	25	0
	Ordinary school	2	18	0	21	1	24
Percentage	Sports school	95.0	5.0	95.2	4.8	100	0
	Ordinary school	10.0	90.0	0	100	4.0	96.0
Percentage of original group correctly classified		92.5		97.6		98.0	

For the 13-year-old group, 98% of the boys and 92.5% of the girls were correctly classified. One boy and one girl of the sports school were found not to resemble the motor performance characteristics of the school. The percentage of students correctly classified in the 14-year-old group was 94.6% and 97.6% for the boys and girls, respectively. Four boys and one girl of the sports school were misclassified based on their motor performance scores. For the oldest age group, the percentage of students correctly classified was the lowest for the boys (91.5%), but the highest for the girls (98%) when compared to the younger groups. Four boys but none of the girls of the sports school had motor performance scores that did not resemble the motor performance characteristics of the sports school.

<u>Question 5.</u> Does the effect of the school program on motor performance vary by age group among students of the sports school?

Separate MANOVA and MANCOVA analyses were conducted for boys and girls. The MANCOVA was performed to test the effect of age group on motor performance among students of the sport school adjusting for the covariates. Posttest scores of motor performance were entered as the dependent variables and age group as the predictor. Covariates included were similar those used in Question 3.

Summaries of the MANOVA and the MANCOVA for boys and girls are presented in Table 54. The overall multivariate test of the MANOVA indicated that there were significant differences in posttest motor performance among age groups for both boys and girls of the sports school. The univariate F tests further revealed the effect of age was significant for all motor performances of the boys but only for four of the girls' motor performance, the JR, TYD, SR. and the ASR.

Specific age group differences following the MANOVA were determined by Bonferroni post hoc analysis (Table 55). For boys, the 16-year-olds had better performance than the younger age groups in all tasks except for the ER where they were only better than the youngest age group. The 14-year-olds exhibited significantly better performance than the 13-year-olds in the SLJ only. All between age group differences in

Table 54. MANOVA and MANCOVA for posttest motor performance among age groups for sports school students

	MANOVA	MANCOVA																			
	AG	AG	ST[a]	MA	BMI	SHSR	SS	TER	AMA	CMA	MS	ST[b]	IN	PR	FAH[a]	JR[a]	TYD[a]	SR[a]	SLJ[a]	ASR[a]	ER[a]
Boys (N=160)																					
FAH[b]	16.70**	8.85**	0.80	1.53	0.74	0.03	0.02	0.44	0.05	0.29	0.00	0.12	1.35	4.76*	594.85**	0.49	1.69	0.53	10.69**	8.75**	4.79*
JR[b]	20.69**	2.63	0.02	7.67**	6.07*	1.44	1.21	7.52**	0.52	0.00	0.11	2.54	0.26	0.06	0.60	263.96**	0.04	5.45*	1.26	0.15	1.16
TYD[b]	62.46**	7.63**	0.00	2.16	2.24	0.96	1.55	0.92	0.06	0.17	0.23	0.78	0.67	0.12	0.74	3.93	42.88**	0.08	0.02	2.14	0.06
SR[b]	12.59**	2.92	0.01	2.44	3.39	2.05	0.01	0.08	0.68	0.00	1.42	1.30	0.05	0.40	0.12	0.19	1.18	344.08**	1.75	0.00	0.44
SLJ[b]	22.82**	1.14	1.11	0.41	0.89	0.89	3.04	6.95**	0.07	0.04	0.30	2.88	0.79	4.38*	0.79	3.99	0.38	5.28*	116.58**	0.69	0.02
ASR[b]	28.49**	0.89	0.97	0.37	1.17	1.36	1.36	0.02	0.04	0.64	0.52	1.91	0.23	0.42	0.23	0.00	8.29**	4.44*	0.02	30.01**	1.18
ER[b]	6.56**	1.77	0.78	1.87	3.45	1.85	5.74*	1.81	0.79	0.38	0.57	0.07	1.43	0.90	5.93*	1.12	0.04	0.28	0.06	1.51	390.28**
Manova F	10.54**	3.11**	0.56	2.28*	2.32*	1.08	1.48	1.84	0.33	0.23	0.50	0.98	0.78	1.60	83.73**	41.44**	8.09**	49.36**	19.84**	6.60**	53.98**
Eta squared	0.33	0.14	0.03	0.11	0.11	0.05	0.07	0.09	0.02	0.01	0.03	0.05	0.04	0.08	0.82	0.69	0.30	0.72	0.51	0.26	0.74
Girls (N=66)									ARC	CCR											
FAH[b]	0.66	0.70	0.55	0.17	0.35	0.57			0.27	0.74		0.60	0.07	0.41	282.88**	1.07	0.83	0.08	0.07	2.55	0.44
JR[b]	5.13**	0.55	0.06	0.04	0.86	1.48			0.98	0.32		0.04	0.13	0.37	0.19	77.86**	1.65	0.03	2.44	1.09	0.88
TYD[b]	3.63*	1.23	0.03	2.30	0.08	0.01			0.13	6.78*		0.00	0.04	6.85*	0.76	0.14	44.26**	1.69	4.92*	0.51	0.08
SR[b]	5.42**	0.32	0.01	3.77	1.15	0.29			1.27	1.16		0.24	1.21	0.96	0.25	0.20	0.12	179.60**	0.37	0.49	0.09
SLJ[b]	2.23	0.23	0.39	0.36	0.04	0.30			0.01	0.47		0.47	2.62	0.01	0.24	1.23	0.14	4.47*	149.40**	0.44	0.00
ASR[b]	6.27**	0.41	0.51	0.31	0.87	0.10			0.94	2.02		0.53	0.23	1.51	0.02	3.80	0.73	1.05	0.86	46.35**	0.00
ER[b]	0.39	1.21	0.57	1.06	3.32	0.62			0.25	0.09		1.07	1.89	0.33	0.29	4.07*	0.76	0.10	1.52	1.12	164.82**
Manova F	1.85*	0.58	0.25	1.35	0.87	0.48			0.76	1.16		0.36	0.98	1.38	41.51**	12.39**	9.70**	30.15**	21.31**	8.28**	22.36**
Eta squared	0.19	0.09	0.04	0.19	0.13	0.08			0.12	0.17		0.06	0.14	0.19	0.88	0.68	0.62	0.84	0.78	0.59	0.79

[a] pretest [b] posttest * $p < 0.05$ ** $p < 0.01$

girls were found between the oldest and the youngest age groups. The 16-year-olds were significantly better than the 13-year-olds in the JR, TYD, SR, and ASR. There was no significant difference between the 13- and the14-year-olds, and between the 14- and the 16-year-olds on any of the motor performance scores.

Table 55. Bonferroni post hoc tests of mean differences between age groups for posttest motor performance showing a significant MANOVA F ratio among sports school students

Variable	Age Group	Age Group	Mean Difference	
			Boys	Girls
Flexed arm hang	13	14	-1.33	
	13	16	-14.76**	
	14	16	-13.43**	
Jump and reach (cm)	13	14	-3.17	-1.09
	13	16	-10.33**	-5.03*
	14	16	-7.16**	-3.94
Thirty yard dash	13	14	0.04	0.06
	13	16	0.47**	0.24*
	14	16	0.42**	0.18
Sit and reach (cm)	13	14	-2.13	-1.87
	13	16	-6.12**	-6.15**
	14	16	-3.99**	-4.28
Standing long jump (cm)	13	14	-12.32*	
	13	16	-28.57**	
	14	16	-16.25**	
Agility shuttle run (sec)	13	14	0.13	0.41
	13	16	0.56**	0.76**
	14	16	0.43**	0.35
800 meter run (sec)	13	14	7.62	
	13	16	12.41**	
	14	16	4.79	

*p < 0.05 **p < 0.01

The MANCOVA indicated that the effect of age on motor performance of the sports school students remained significant among the boys only. However, the effects of age on several motor performances of the boys exhibited in the MANOVA were eliminated after adjusting for the covariates. Only two motor performance scores were significantly influenced by age group, the FAH and TYD.

Specific age group differences for boys following the MANCOVA were determined by pairwise comparison of the estimated marginal means adjusting for the covariates (Table 56). The 16-year-olds had significantly better performance in the FAH and TYD than the younger age groups who did not differ significantly from each other.

Table 56. Pairwise comparisons of estimated marginal means between age groups for posttest motor performance showing a significant MANCOVA F ratio among sports school students

Variable	AG	M^a	AG	M^a	Md
Flexed arm hang	13	36.80	14	34.33	2.47
	13	36.80	16	41.75	-4.95*
	14	34.33	16	41.75	-7.42**
Thirty yard dash	13	3.69	14	3.70	-0.01
	13	3.69	16	3.50	0.19**
	14	3.70	16	3.50	0.20**

[a] adjusted means * $p < 0.05$ ** $p < 0.01$

<u>Question 6.</u> Are there differences in academic achievement between students enrolled in the sports school and in the ordinary schools?

To answer this question, analysis of variance (ANOVA) and analysis of covariance (ANCOVA) were conducted to test the effects of school, gender, age group and their interaction on the initial (pretest) academic achievement. For the ANCOVA, monthly income and place of residence were included as the covariates.

Summaries of the ANOVA and ANCOVA for pretest academic achievements are presented in Table 57. There was no difference in pretest academic achievement between the students of the sports school and the ordinary schools and between gender groups with and without controlling for the covariates. However, both analyses revealed significant differences among students of different age groups, as well as significant school and age group interaction effects. Additionally, the ANCOVA revealed a significant effect of income on academic achievement.

Table 57. ANOVA and ANCOVA for pretest academic achievement by school, gender and age group

Independent/covariates	ANOVA		ANCOVA	
	F	R^2	F	R^2
	N=452		N=452	
School	0.05	0.00	0.43	0.00
Gender	0.09	0.00	0.05	0.00
Age group	27.13**	0.11	25.99**	0.11
School * gender	2.02	0.00	1.68	0.00
School * age group	5.79**	0.03	6.04**	0.03
Gender * age group	2.35	0.01	2.31	0.01
Income			6.87**	0.02
Place of residence			0.77	0.00

* $p < 0.05$ ** $p < 0.01$

Bonferonni post hoc test following the ANOVA and pairwise comparison of adjusted means following the ANCOVA to determine specific age group differences indicated that the younger age groups performed significantly better than the older age groups (Tables 58 & 59). The 13-year-olds had better academic achievement than the 14- and the 16-year-olds, while the 14-year-olds had better academic achievement than the 16-year-olds.

Table 58. Bonferonni post hoc tests of mean differences between age groups for pretest academic achievement

	Age group	Means	Age group	Means	MD
Academic achievement	13	2.87	14	2.65	0.22*
GPA	13	2.87	16	2.23	0.64**
	14	2.65	16	2.23	0.42**

* $p < 0.05$ ** $p < 0.01$

Table 59. Pairwise comparisons of estimated marginal means between age groups for pretest academic achievement

	Age group	Means[a]	Age group	Means[a]	MD
Academic achievement	13	2.86	14	2.61	0.25**
GPA	13	2.86	16	2.28	0.58**
	14	2.61	16	2.28	0.33**

[a] adjusted means * $p < 0.05$ ** $p < 0.01$

The interaction effect of school and age group on pretest academic achievement is depicted in Figure 1. Among the 13- and the 16-year-olds, the sports school students exhibited better academic achievement than the ordinary school students, but for the 14-year-olds, the situation was reversed.

A regression analysis was conducted to further analyze the effect of school on pretest academic achievement for each age group (Table 60). There were significant effects of school on academic achievement for the 14- and the 16-year-old age groups either controlling or not controlling for the covariates. However, the direction of the relationship was not similar between the two groups. The sports school had a positive effect on academic achievement in the older age group, but negative effect on the younger age group. In other words, the sports school students had better academic achievement than the ordinary school students among the 16-year-olds, but vice versa among the 14-year-olds. For the 14-year-old group, there was also a significant positive effect of income on the academic achievement. Higher income students had better academic achievement than lower income students.

Figure 1. Adjusted means for the interaction of school and age group on pretest academic achievement

Table 60. Regression coefficients (β) for pretest academic achievement by school and gender with and without controlling for the covariates

Independent / covariates	Without covariates						With covariates					
	Age group						Age group					
	13 N=142		14 N=154		16 N=156		13 N=142		14 N=154		16 N=156	
	β	R^2	β	R^2	β	R^2	β	R^2	β	R^2	β	R^2
School	-0.01	0.00	-0.28*	0.06	0.22*	0.03	0.02	0.00	-0.24*	0.04	0.23*	0.03
Gender	-0.02	0.00	-0.13	0.01	0.21	0.02	-0.004	0.00	-0.15	0.01	0.20	0.02
Income							.00005	0.03	0.0001*	0.04	0.00001	0.00
Place of residence							0.17	0.01	0.07	0.00	0.07	0.00

* $p < 0.05$ ** $p < 0.01$

Question 7. Is there an effect of the sport school program on the academic achievement of secondary school students in Malaysia?

ANOVA and ANCOVA were performed to determine the effect of the sport school program on posttest academic achievement. For the ANCOVA, the pretest academic achievement was added as a covariate, in addition to income and the student's place of residence. Specific age group differences in posttest academic achievement were determined through pairwise comparisons of the estimated marginal means. Additionally, a regression analysis was performed to determine the effects of school on posttest academic achievement.

Summaries of the ANOVA and ANCOVA are presented in Table 61. The ANOVA showed significant differences in posttest academic achievement between the schools, among age groups, and significant interaction effects of school and age groups, gender and age groups, and school, gender, and age groups. However, the effect of school and the interaction effect of school and age groups were eliminated after controlling for the covariates. Additionally, the ANCOVA revealed a significant effect of income and pretest academic achievement on the posttest academic achievement.

Table 61. ANOVA and ANCOVA for posttest academic achievement

Independent/covariates	ANOVA		ANCOVA	
	F	R^2	F	R^2
	N=452		N=452	
School	4.09*	0.01	3.74	0.01
Gender	2.95	0.01	3.15	0.01
Age group	59.75**	0.21	35.91**	0.14
School * gender	0.30	0.00	0.17	0.00
School * age group	5.39**	0.02	1.49	0.01
Gender * age group	8.90**	0.04	6.54**	0.03
School * gender * age group	6.09**	0.03	6.02**	0.03
Income			4.94*	0.01
Place of residence			3.73	0.01
Pre academic achievement			205.92**	0.32

* $p < 0.05$ ** $p < 0.01$

Bonferroni post hoc analysis following the ANOVA and pairwise comparison of adjusted means following the ANCOVA indicated that the 13-year-olds and the 14-year-olds performed significantly better than the 16-year-olds (Tables 62 & 63). No significant differences were exhibited between the 13- and the 14-year-old age groups although the 14-year-olds had a slightly higher GPA.

The interaction effects of gender and age group indicated by the ANCOVA are depicted in Figure 2. Among the 13- and the 16-year-olds, the girls exhibited higher academic achievement than the boys, and vice versa for the 14-year-olds. Figure 3 depicts the school, gender, and age group interaction effects. The 16-year-old boys and the 13-year-old girls of the sports school had higher academic achievement than their counterparts in the ordinary school, but the opposite was true for the 13- and 14-year-old boys, and the 14- and 16-year-old girls.

Table 62. Bonferonni post hoc tests of mean differences between age groups for posttest academic achievement

	Age group	Means[a]	Age group	Means[a]	MD
Academic achievement	13	2.69	14	2.77	-0.08
GPA	13	2.69	16	1.94	0.75**
	14	2.77	16	1.94	0.83**

* $p < 0.05$ ** $p < 0.01$

Table 63. Pairwise comparisons of estimated marginal means between age groups for posttest academic achievement

	Age group	Means[a]	Age group	Means[a]	MD
Academic achievement	13	2.55	14	2.69	-0.14
GPA	13	2.55	16	2.18	0.37**
	14	2.69	16	2.18	0.51**

[a] adjusted means * $p < 0.05$ ** $p < 0.01$

Figure 2. Adjusted means for the interaction of gender and age groups on posttest academic achievement

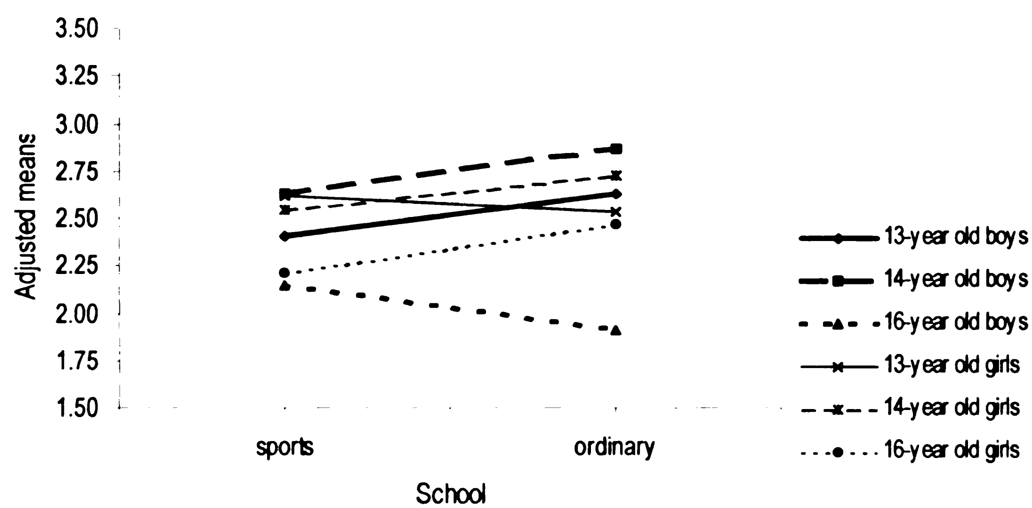


Figure 3. Adjusted means for interaction of school, gender, and age group for posttest academic achievement.

Results of regression analyses showing the effects of school and gender on posttest academic achievement with and without controlling for the covariates for each age group are presented in Table 64. There was a significant effect of school only for the 14-year-old group after either controlling or not controlling for the covariates. Students of the ordinary schools had better academic achievement than the sports school students. The 16-year-old age group exhibited gender differences where boys demonstrated better academic achievement than girls. In addition, income had positive effect on posttest academic achievement among the 14- and the 16-year-old age groups. Students with higher income tended to have better academic achievement than those with lower income.

Table 64. Regression coefficients (β) for posttest academic achievement by school and gender with and without controlling for the covariates

Independent/ covariates	Without covariates						With covariates					
	Age group						Age group					
	13 N=142		14 N=154		16 N=156		13 N=142		14 N=154		16 N=156	
	β	R^2	β	R^2	β	R^2	β	R^2	β	R^2	β	R^2
School	-0.18	0.02	-0.41**	0.14	0.15	0.02	-0.15	0.02	-0.19**	0.06	0.16	0.02
Gender	0.04	0.00	-0.17	0.02	0.44**	0.11	0.05	0.00	-0.09	0.01	0.35**	0.09
Income							0.00	0.00	0.00006*	0.03	0.0001*	0.03
Place of residence							0.14	0.01	0.15	0.01	0.18	0.01
Pre academic achievement							0.63**	0.44	0.63**	0.49	0.30**	0.12

* $p < 0.05$ ** $p < 0.01$

Discussion

Current status of sports program of the sports school

The extent to which the current status of the sports school program meets its original plan varies according to the areas being evaluated. While the implementation of some areas of the program exceeded what had been planned, some areas still have not met the original plan. In general, program content and policy has been implemented as planned. In fact, there has been an addition to the objectives as a result of a re-evaluation of the function of the sports school. Presently, the sports school also fills the needs for strong base of scientific research in the field of sports. This addition was appropriate for more accurate prediction of the future success of these athletes and to determine the effectiveness of the program. Furthermore, research on these young athletes may provide insight and greater understanding of the development of sports performance and its relation to the growth and maturation of Malaysian adolescents.

Although there was still a small shortage in the number of boys enrolled in this school, there was a tremendous increase in the number of sports offered at the sports school. Presently, there are 27 sports offered at the sports school compared to only 12 in the original plan. Nevertheless, 82% of the students are involved in the 12 sports stated in the original plan. Despite the tremendous increase in the number of sports offered in the sports school, this item is only evaluated as moderately adequate by the coaches. The exact explanation for such evaluation is beyond the scope of this study. It may due to the lower number of sports offered at the sports school compared to the number of sports offered at major international sports event. As mentioned earlier, the sports school accommodates the preparation of national athletes for international sports events. Generally, major sports events such as the South East Asian Games, the Asian Games, and the Commonwealth Games have 36 sports for competition.

Although there was an increase in sports offered in the sports school, not all sports are represented by the students enrolled at age 13. As such, there was an unequal distribution of students by sports among the age groups in the school (see Tables 9 & 10). Basically, the sports offered in the original plan, except for soccer, are represented every year provided that there are qualified students to be selected into the program. Soccer players are in a special development program funded by the Football Association of Malaysia (FAM). Due to recent changes in the development plan of FAM, soccer players now will not be enrolled in the sports school until they reach age 16. Recently, rugby has been added in the school sports program due to a newly introduced development program organized and partly funded by the Malaysian Rugby Union (MRU). The selection of students are selected in other sports in any particular year is largely dependent on the need to prepare athletes for specific future major sports events set by the National Sports Council. In addition, preference in the selection process is given to athletes in sports where there is good potential for winning models. For example, over the next few years, the selection of athletes will focus on badminton, field hockey, bowling, and squash.

It is important to note that the enrollment of girls (36.6%) in the sports school is much lower than that of the boys (63.4%) despite the fact that women account for about one-half of the Malaysian population (Malaysia, 1996). One of the reasons for this situation is due to the type of sports offered in the sports school. Comparatively, there are more "all-boy" sports than "all-girl" sports offered at the sports school. Moreover, the "all-boy" sports such as soccer and rugby have more players per team, thus, resulting in more players from those sports selected into the sports school. This unequal boy-girl enrollment may also be attributed to several other factors. The participation rate of Malaysian women in sports is very low, either in high performance sports or general mass participation in sport activities (Salman, 1997). Salman further revealed that the participation of women in sports is influenced by structural constraints (policy, provision, facilities), cultural constraints (notions about what women can and should do), and personal constraints such as family obligations, lack of time, and lack of mobility. The lower number of girls compared to boys in the sports school perhaps also reflects the government's lack of promotion and implementation of women sports, especially at grassroots level (Salman, 1997).

Although the National Sports Policy clearly specifies that all Malaysians have equal opportunity to participate in sports (National Sports Council, 1988), the ethnic composition of the sports school enrollees is not the same as the ethnic composition of the country (Table 65). The percentages of Chinese and Indians in the sports school are much lower than their national percentages. In contrast, there is a higher percentage of Malay boys enrolled when compared to their national representation. An apparent reason for this situation may due to ethnic affinities for particular sports among the Malaysians and the sports offered in the sports school. In other words, the sports school enrollment is a reflection of these ethnic-sports affinities in the country. The sports participation of Malays is closely linked to soccer, rugby, and sepaktakraw, while the Chinese are associated with sports such as basketball, table tennis, and wushu. However, the usual domination of the Indians in hockey and cricket is not depicted by the sports school ethnic composition. Since sports linked to the Malays have more players per team, there is also tendency for more Malays to be selected into the sports school. For girls, the ethnic composition of the sports school students is more representative of the Malaysian population. Ethnic linked sports (netball with the Malays, basketball with the Chinese) have an equal number of players per team, thus, ethnic differences in enrollment are largely due to other sports which reflect the ethnic composition of the country.

Table 65. Ethnic group representation in the sample, total sports school, and the National level

Ethnic group	Sample (%)			Total sports school (%)			National (%)*
	Male	Female	Total	Male	Female	Total	Total
Malay	86.9	77.3	84.1	78.4	62.1	72.5	61.7
Chinese	9.4	16.7	11.5	16.6	32.3	22.4	27.3
Indian	3.8	6.1	4.4	3.2	4.5	3.7	7.7
Others				1.7	1.0	1.5	0.3

Note: indigenous groups are categorized as Malays (Malaysia, 1996)
* based on 1991 population consensus (Malaysia, 1996)

Criteria for the selection of students have been implemented according to the plan with all of the students selected meeting the requirements of the sports. However, not all of the students selected have met the criteria for academic achievement. Over the years, the number of students selected meeting academic requirements has become less and less. According to the school, to obtain students with equally good sports and academic qualifications is quite difficult. Therefore, priority for the selection of the students is mainly based on their sports performance. Moreover, most of the coaches tend to agree with the current process for selecting the students.

The number of supporting staff and the teacher-class ratio also showed an increase from the original plan. The teacher-class ratio increased from 2:1 in the original plan to 2.7: 1 in the current status. Despite this increase, there was difficulty in getting a fitness instructor for this school and the number of teachers is three less than the number allocated by the Ministry of Education. Only 78% of the teachers had the required bachelor's degree for academic qualification. The remainder, although not meeting the academic requirement, were all certified and qualified teachers. It is normal practice in the Malaysian school system to have teachers with such qualifications to teach students at the lower secondary level.

Currently, there are 23 teacher-coaches and 29 nonteacher-coaches involved in the sports program. All but one are certified coaches and all have the required coaching experience. However, most coaches felt that the number of qualified coaches was still insufficient, especially the teacher-coaches. In general, all sports had the services of qualified experienced coaches although some sports had the services of better and more experienced foreign coaches. To get teacher-coaches with qualifications and experience similar to those of the nonteacher- coaches is almost impossible because their participation and involvement in coaching was restricted by their position as teachers. In contrast, all nonteacher-coaches were full time coaches specifically hired by the National Sports Council.

The overall adequacy of the policy and content of the sports program was evaluated as moderately adequate by the coaches of the school. However, the three biggest problems faced by coaches in running the sports program were related to this area of the program; namely, inadequate staffing, quality of the students, and apathy of the students. Despite the greater number of support staff compared to the original plan, the number of teacher-coaches is still insufficient. Additionally, there is very limited support staff in the management of sports training and in sports competition. Currently, most of the administrative duties are also the responsibility of the teacher-coaches. The coaches have to do most of the preparation pertaining to sports training and competition such as arranging for transportation, booking venues, and assisting with purchase of the sports equipment for the students, in addition to their coaching duties. Some of the teacher-coaches also have to give extra classes to the students. This has become an extra burden for the teacher-coaches.

Although all the students met the sports requirement of the sports school, evaluation by the teacher-coaches indicated that there is a need for better quality students to be selected into the school. The selection process also depends on recommendations from the various state sport councils. In some cases, a state was reluctant to have its best athletes enroll in the sports school because the services of these athletes would be lost for inter-state national competition. However, a measure has been taken to overcome this problem. The sports school athletes will have the priority to represent their respective states in national competition. The result of this measure is presently unknown because it has just been implemented. Rankings by the coaches also indicated that there is a need for more coordination with various sports organizations, especially in terms of the selection of students and the use of outside training facilities.

Problems of student apathy are mostly concerned with the students' attitude towards training. There were indications that some of the athletes are not trying their best in training, thus resulting in a lack of achievement in sports competition. These athletes apparently felt that their place in the sports school was secure after being selected into the sports school. Consequently, the school has recently decided to expel students with discipline problems and those who fail to show expected performance improvement.

There is still a lot to be implemented in terms of privileges and opportunity, for students and the teacher-coaches, if the sports program is to meet the original plan. Evaluation by the coaches is also in agreement with this conclusion because this area of the program was rated as "lowly adequate" and ranked last in terms of adequacy.

Most students of the sports school still have to pay school fees, buy their own sports equipment, pay their own medical insurance, and do not automatically received monthly scholarships. For lower income students, although provided with scholarships, a large portion of their scholarships is used to pay their school fees. In the end, they are left with limited financial resources to buy their own sports equipment.

Although most of the students have the chance to compete in national and international competitions, this opportunity is still considered as insufficient by the coaches, especially those at the international level. The coaches felt that the students should be given more opportunities for competing at the international level through test matches to gain more experience in their related games. Presently, only those selected to represent the country have the opportunity for international level competition. To date, opportunity of students to compete at the international level twice a year, as stated in the original plan, has not been yet implemented.

There is no coaching allowance provided to the teacher-coaches and there are still teacher-coaches teaching more than six periods a week. It should be noted that ordinary school teacher-coaches who are assigned to sports development projects in their various states are paid RM 250.00 a month. Although most of the coaches are provided with housing within the school area, this facility is not actually a privilege since they do not receive their housing allowance. In other words, there is no difference between teachers and teacher-coaches of the school, or between the teacher-coaches and teachers at other schools in terms of housing privilege. Some teachers at ordinary schools are also provided with housing facilities.

Only 43% of the coaches attended professional development courses during the year 2000. This aspect of opportunity was assessed by the teacher-coaches as "lowly adequate" and ranked last in term of adequacy for this area of the program. Among the reasons cited by teacher-coaches for this inadequacy are heavy commitments with the school program and lack of relevant courses offered.

Comparatively, the most adequate area of the program was the training and facility area. The current training schedules are run according to what is stated in the original plan. Most of the coaches tended to agree regarding the sufficiency of time allotted for training and the demand for competition.

There are very limited training facilities within the school. The location of the school within the vicinity of various training facilities of the National Sports Council did not seem to justify such limited facilities. The number of sports offered in the sports school is more than the number that can be accommodated by the facilities available at the National Sports Council. For some sports, the training has to be carried to venues up 35 kilometers from the school. Additionally, the facilities available are mostly training venues while the need for more training equipment still exists. There were also requests by coaches for additional training facilities, and especially for specific training equipment for each type of sport.

Among the various aspects of training and facilities, opportunities for the use of facilities outside the school was ranked as the most adequate. Most of the coaches tended to agree on this opportunity and rated it as moderately adequate. However, there are problems faced by coaches in using these outside facilities. Transportation, long traveling times, and clashes with other teams for using these facilities were among the problems cited by the coaches.

Generally, medical services rendered to students are implemented according to the original plan. Medical screening is done prior to enrollment and medical histories are kept by the school. All injured athletes have accessibility to prompt medical treatment and rehabilitation programs. However, the adequacy of a sound rehabilitation program was ranked fifth out of six items listed in this program area.

Characteristics of the sports school students

Young athletes are usually defined by success on interscholastic or agency teams, in national and international competitions, and in selected club and age groups competitions (Malina et al., 1982). Students in the sports school were young athletes according to this definition. They were a highly select group based on their success in national and international age-group competition.

The criteria for the selection of the sports school students indicated that the selections were ordinarily based on skills and physical performance. However, among adolescents, physical performance is also influenced by size and physique due to variation in maturity status (Malina, 1975; Malina, 1988b; Jones et al., 2000). Numerous reviews by Malina (1982,1988a, 1988b, 1994a, 1998) indicate that athletes of both sexes in team sports, have statures that equal or exceed reference medians. In the present study, comparison of anthropometric dimensions between the sports school and the ordinary school students demonstrated a similar finding. The sports school students were found to be taller, heavier, and had larger arm and calf circumferences and thinner skinfolds than the ordinary school students. Consequently, sports school boys demonstrated larger arm and calf muscle areas as a result of the larger circumferences and thinner skinfold measurements.

Comparison with the Malaysian national population and other populations from various studies also demonstrated that students of the sports school were taller, heavier, and had larger arm and calf circumferences, especially among the boys (Table 66). However, it is interesting to note the pattern of differences in height when comparisons are made between the sports school students and the Asians, and between the sports school boys and the American and Europeans over increasing age. There is a tendency for the size advantage of the sports school students to diminish when they are compared to the Americans and the Belgians over increasing age, while height differences between the sports school boys and the Asians over increasing age are rather consistent. This

Table 66. Comparison of physical characteristics of the sports school students with other populations

Study	1			2			3			4			5			6		
Age Group	13	14	16	13	14	16	13	14	16	13	14	16	13	14	16	13	14	16
Boys																		
Mass (kg)	48.8	54.3	60.9	44.95	50.77	62.10	39.2	43.8	51.1	49.9	52.9	57.3	41.2	46.1	58.4	43.7	49.4	
Stature (cm)	160.7	164.4	171.4	156.5	163.1	173.5	149.8	155.9	162.7	158.1	162.8	167.8	151.3	157.4	171.6	153.8	161.2	
Sitting Height (cm)	83.4	84.8	88.8										77.9	80.8	88.2	69.3	78.7	
Circumferences (cm)																		
Arm, relaxed	24.1	25.7	26.8	24.7	25.3	27.8	20.6	21.3	23.3	23.8	24.2	25.9						
Calf	32.9	34.8	35.6				30.5	31.4	33.4	33.2	33.6	35.1	29.8	31.0	33.9			
Skinfolds (mm)																		
Triceps	9.1	9.0	7.8	10	9	8	6.9	6.4	5.9	10.9	9.6	9.0	8.7	8.2	7.3			
Suprailiac	6.0	6.1	6.6				5.7	6.0	7.2	9.9	8.7		4.5	5.0	6.5			
Subscapular	6.1	6.4	6.8				6.1	6.2	7.2	9.4	8.9	8.4	5.8	6.1	6.7			
Medial calf	7.3	7.6	6.7				8.6	8.7	6.1	16.4	13.8		7.2	7.2	7.7			
Girls																		
Mass (kg)	46.5	50.3	55.7	48.10	50.28	55.88	40.5	44.1	48.3	46.3	49.4	50.4				42.9	45.3	
Stature (cm)	159.3	160.9	162.8	157.1	160.4	162.4	148.7	152.1	154.3	154.0	154.9	156.2				151.8	155.4	
Sitting Height (cm)	82.0	82.8	85.0													78.0	80.2	
Circumferences (cm)																		
Arm, relaxed	22.2	23.7	25.4	24.3	25.2	25.8	20.8	22.2	23.6	22.6	24.0	25.1						
Calf	31.1	33.7	34.2				31.7	32.4	33.5	32.2	33.2	34.2						

Note: based on mean values
1 - sports school students, present study
2 - American population, NCHS, height and weight for American population (Hamill et al.,1979); arm circumference and triceps skinfold for American whites (Frisancho,1981)
3 - Northeastern Thailand, rural and urban population (Ohsawa et al.,1995)
4 - Japanese population, Kanto (Ohsawa et al.,1995)
5 - Belgian secondary schoolboys, mass, stature, sitting height, & calf circumference (Beunen et al., 1988); skinfolds, estimated from graphs (Ostyn et al., 1980)
6 - Malaysian population (National Sports Council, 1998)

finding may provide an explanation for the adult size differences between Malaysians and Americans or Europeans. Perhaps this trend is similar to what had been cited by Eveleth and Tanner (1990) when comparing the height of Indonesian-Malays to Europeans. The size advantage at younger ages was due to earlier maturation, and consequently, they stopped growing at an earlier age with a final adult height lower than that of Europeans.

Because the sports school students are selected to be groomed for international sports competition, the diminishing size advantage over increasing age, and as adults, when compared to other populations may provide one important consideration. This finding suggests a limitation for future international success in sports where size is also a determinant factor. The most successful athletes are those with the appropriate body structure to perform their events; and, world championship athletes represent the optimum combination of genetic and environmental influences to produce maximum performance (Carter, 1984; Borms & Hebbelinck, 1984). In various sports, especially contact and combative sports, having a bigger size is an advantage. As well as being directly related to potential for strength and power movements, larger size also serves to create greater momentum and obstacles for opponents. This feature justifies the cliché, "a good big athlete will always beat a good small athletes" (Shephard, 1978).

As indicated by the descriptive statistics, students of the sports school had better motor performance than the ordinary school students. Further comparison with adolescents of similar ages who participated in the Motor Performance Study (MPS) conducted at Michigan State University is presented in Table 67. As shown by the table, the motor performance of the sports school boys is better than that of the MPS male participants. However, the sports school girls are only better than the MPS female participants in the JR, TYD, and ASR. Noting that the participants of the MPS arenot a highly selected group, the poorer performance of the sports school girls on several of the tasks may suggest a further implication. Their poor motor performance could be a major setback for international sports success.

Table 67. Comparison of motor performance between the sports school students and participants in MPS at Michigan State University

	Present study			Motor Performance Study, MSU*		
Age group	13	14	16	13	14	16
Boys						
Flexed Arm Hang, sec	32.2	33.6	47.0	21	28	39
Jump and Reach, cm	49.0	52.2	59.4	36.8	40.6	49.5
30 Yard Dash, sec	3.8	3.8	3.3	4.4	4.2	3.9
Sit and Reach, cm**	22.4	24.5	28.5	17.8	19.1	22.9
Standing long jump, cm	208.2	220.6	236.8	182.9	193	214.6
Agility shuttle run, sec	9.9	9.8	9.3	10.4	10.1	9.5
Girls						
Flexed Arm Hang, sec	14.5	13.0	16.1	15	17	22
Jump and Reach, cm	39.2	40.2	44.2	34.3	36.8	38.1
30 Yard Dash, sec	4.3	4.2	4.0	4.5	4.4	4.3
Sit and Reach, cm**	25.3	27.1	31.4	26.7	29.2	31.8
Standing long jump, cm	170.5	177.2	183.6	172.7	179.1	182.9
Agility shuttle run, sec	10.7	10.3	10.0	10.8	10.6	10.3

* 50^{th} percentile score
** A value of 15 cm been added to this score

The present study also revealed significant differences in maturity status between boys of the sports school and the ordinary schools for the 13-year-old and the 14-year-old groups, but not for the 16-year-old group. This finding suggests that students selected into the sports school were early maturers. It has been shown in previous studies that children who differ in maturity status also differ in size, physique, body composition, strength, and motor performance (Malina, 1975; Malina, 1988b). The data also showed that maturity status is significantly correlated with various measures of anthropometry and motor performance (Table 68). Except for body mass and skinfolds, results of this correlational analysis are generally in agreement with those obtained in previous studies (Espenchade, 1940; Clarke 1971; Malina, 1975; Beunen et al., 1981;Beunen, Malina et al., 1997; Jones et al., 2000). In the present study, the detrimental effects of body weight and skinfold thicknesses on motor performance are not consistently exhibited. However, it should be noted that half of the samples are young athletes and greater weight may reflect bigger muscle size. Furthermore, maturation and body dimensions, body composition, and body proportion are confounded in their effect on performance (Malina, 1975).

The size advantage of the sports school boys is not merely due to maturity status especially in the oldest group. Among the 16-year-old students, the sports school boys continue to exhibit size advantage although their maturity status is similar to that of the ordinary school boys. The catch-up growth of late maturing boys during the high school years that reduced the size differences so apparent in early adolescence as cited by Malina (1998), is not depicted in this study. However, such catch-up growth may not occur until the later teen years. Since most of the athletes are selected during early adolescence, it can be assumed that their larger size is not only a function of accelerated growth rate and maturation but also likely reflects hereditary influence.

The superior performance of the sports school girls may also be accounted for by their size advantage as indicated by descriptive statistics and the correlational analyses. However, whether these advantages are also due to maturity status cannot be

Table 68. Correlation between pretest motor performance with anthropometric characteristics and maturity status

Boys Age group	13 (N=102)								14 (N=112)								16(N=106)							
	FAH	JR	TYD	SR	SLJ	ASR	ER	MS	FAH	JR	TYD	SR	SLJ	ASR	ER	MS	FAH	JR	TYD	SR	SLJ	ASR	ER	MS
Stature	.33*	.37*	-.41*	.22	.42*	-.32*	-.19	.73*	-.04	.48*	-.37*	.16	.47*	-.20	-.28*	.58*	-.14	.24*	-.22	-.08	.23	-.07	-.22	.39*
Mass	.23	.21	-.25*	.28*	.28*	-.14	-.10	.62*	-.26*	.45*	-.28*	.14	.40*	-.15	-.14	.61*	-.27*	.15	.01	.12	.06	.01	-.16	.16
Body mass Index	.01	-.09	.08	.22	-.01	.16	.09	.17	-.39	.23	-.05	.07	.16	-.01	.08	.38*	-.23	.00	.16	.21	-.09	.05	-.05	-.06
Sitting Height	.34*	.38*	-.41*	.31*	.43*	-.29*	-.19	.68*	-.06	.47*	-.37*	.27*	.49*	-.21	-.28*	.62*	.00	.29*	-.15	.04	.26*	-.13	-.22	.28*
Sitting Height/Stature	.14	.14	-.14	.29*	.17	-.03	-.05	.10	-.10	.15	-.13	.37*	.23	-.10	-.11	.32*	.21	.11	.08	.16	.09	-.11	-.03	-.12
Circumferences																								
Relaxed arm	.25*	.19	-.27*	.18	.23	-.07	-.18	.53*	-.27*	.35*	-.17	.08	.29*	-.04	-.08	.54*	-.10	.27*	-.09	.29*	.23	-.04	-.36*	.07
Calf	.15	.13	-.23	.24	.22	-.05	-.07	.43*	-.27*	.37*	-.21	.12	.33*	-.05	-.10	.55*	-.14	.22	-.07	.24*	.18	-.05	-.31*	.07
Skinfolds																								
Triceps	-.12	-.29*	.19	-.01	-.31*	.32*	.24*	.02	-.35*	-.09	.19	.03	-.14	.15	.25*	.12	-.26*	-.11	.21	.05	-.18	-.02	.09	-.03
Medial calf	-.07	-.23	.21	-.03	-.25	.29*	.29*	-.04	-.41*	-.12	.24*	.04	-.16	.16	.31*	.12	-.37*	-.17	.35*	.03	-.25*	.10	.26*	.02
Subsacapular	-.10	-.23	.16	.13	-.14	.18	.19	.02	-.39	-.06	.14	-.02	-.10	.13	.23	.15	-.27*	-.09	.28*	.17	-.20	.04	.10	-.08
Suprailiac	-.09	-.23	.18	.12	-.16	.24*	.21	.08	-.39*	-.07	.10	.01	-.11	.12	.25*	.14	-.27*	-.21	.30*	.07	-.23	.05	.22	.01
S um of trunk	-.10	-.24	.18	.13	-.15	.22	.21	.05	-.40*	-.07	.12	-.01	-.11	.13	.24*	.15	-.29*	-.16	.31*	.13	-.22	.05	.17	-.04
Sum of extremity	-.10	-.27*	.21	-.02	-.29*	.32*	.27*	-.01	-.39*	-.10	.22	.04	-.15	.16	.29*	.12	-.33*	-.15	.29*	.04	-.22	.03	.18	-.01
Sum of four	-.10	-.27*	.20	.05	-.24	.28*	.25*	.02	-.41*	.09	.19	.02	-.14	.15	.28*	.14	-.32*	-.16	.31*	.08	-.23	.04	.18	-.03
Trunk/extremity	.01	.02	-.02	.33*	.24	-.20	-.14	.10	.02	-.03	-.13	-.18	-.01	-.02	-.02	-.07	.08	-.01	.04	.13	.00	.04	-.01	-.09
Muscle area																								
Arm	.31*	.33*	-.38*	.22	.37*	-.20	-.28*	.60*	-.22	.42*	-.23*	.09	.36*	-.09	-.15	.59*	.00	.35*	-.18	.31*	.33*	-.03	-.44*	.11
Calf	.18	.21	-.31*	.27*	.30*	-.12	-.15	.48*	-.22	.45*	-.28*	.12	.40*	-.10	-.18	.59*	.00	.31*	-.22	.27*	.28*	-.13	-.45*	.07
MS	.30*	.50*	-.51*	.08	.42*	-.43*	-.49*		-.04	.56*	-.44*	.20	.59*	-.20	-.52*		-.09	.14	-.17	-.04	.13	-.06	-.09	

*$p < 0.01$

Table 68 (cont'd)

Girls Age group	13 (N=40)							14 (N=42)							16 (N=50)						
	FAH	JR	TYD	SR	SLJ	ASR	ER	FAH	JR	TYD	SR	SLJ	ASR	ER	FAH	JR	TYD	SR	SLJ	ASR	ER
Stature	-.10	.12	-.26	.04	.32	-.29	-.35	.37	.35	-.36	.31	.39*	-.48*	-.42*	.04	.40*	-.32	.25	.32	-.08	-.29
Mass	-.14	.14	-.26	.16	.19	-.26	-.18	-.08	.32	-.16	.16	.44*	-.38	-.11	-.09	.11	.06	.07	-.02	.04	.19
Body mass Index	-.10	.09	-.14	.25	-.06	-.10	.07	-.21	.11	-.06	.16	.25	-.18	.09	-.14	-.11	.30	-.07	-.23	.12	.44*
Sitting Height	-.11	.12	-.40*	.25	.47*	-.45*	-.32	.37	.35	-.43*	.41*	.38	-.41*	-.39*	-.05	.36	-.28	.36	.25	.02	-.14
Sitting Height/Stature	-.04	.01	-.31	.39*	.30	-.33	-.01	.11	.10	-.21	.24	.10	-.04	-.08	-.14	-.03	.05	.20	-.09	.20	.20
Circumferences																					
Relaxed arm	.03	.25	-.51*	.41*	.15	-.44*	-.18	-.12	.18	-.12	.19	.34	-.23	.00	-.04	-.05	.20	.08	-.06	-.02	.11
Calf	.08	.28	-.37	.26	.12	-.31	-.19	-.09	.17	-.22	.23	.27	-.25	-.02	.01	.06	.13	.15	-.04	.04	.15

*p < 0.01

determined since the girls' maturity status was not assessed. Numerous studies have shown that female athletes, except for swimmers, tend to be average or late in biological maturation (Malina. 1998). It also appears that average and late maturing girls persist in sport in later adolescence. Taking this into consideration, the size advantage of the sports school girls likely reflects the demand of the sports.

Motor performance of students enrolled in the sports school

Based on the discussion above regarding the interrelationships between growth status, maturity status and motor performance, the significant differences in motor performance between the sports school and the ordinary school students favoring the sports school students are indeed expected. If these were the only variables that account for these differences, then one would expect the elimination of the school effect after the influence of these variables is controlled. Nevertheless, all motor performances (except for the SR) for boys continue to exhibit the effect of the sports school even after controlling for these variables and other variables related to socioeconomic status. This finding suggests that these residual differences could be due to the training received and to the active sports participation of the sports school students. However, motor performances that reflect significant differences between the sport and the ordinary schools are not exactly the same among different age groups because there are variations on the covariates among the different age groups (Table 69). An apparent trend depicted by this finding is that the older age groups have more motor performance variables that remain significant after controlling for the covariates. For the boys in older age groups, the effects of the sports school on motor performance remain significant for all variables except the SR, while at age 13, only performances on the JR, SLJ, ASR, and ER remain significant. For the girls, the effect of the sports school remains significant in all motor performances for the 16-year age group, while for the younger groups only performances on the SLJ, ASR, and ER remain significant. In this context, it is important to note that the sports school students in older age group have been in the school for more years than the younger age groups.

Table 69. Summary of effects of sports school on pretest motor performances controlling for the covariates by age groups

Gender	Age group	Motor performance
	13	JR. SLJ, ASR, ER
Boys	14	FAH, JR, TYD, SLJ, ASR, ER
	16	FAH, JR, TYD, SLJ, ASR, ER
	13	SLJ, ASR, ER
Girls	14	SLJ, ASR, ER
	16	FAH, JR, TYD, SR, SLJ, ASR, ER

Arguably, comparing the sports school and the ordinary school students among the 14- and 16-year-old age groups does not necessarily demonstrate the performance characteristics of the students selected into the sports school. The motor performances of the sport school students at these ages are also influenced by the number of years they have been in the sports school. Perhaps, a better indication of the motor performance characteristics of students selected into the sports school is displayed by the youngest age group. These students had been in the school for about a month when this study was begun.

Effects of the sports school program on motor performance

Bearing in mind that there are pre-existing differences between the sports school and the ordinary school students, the effect of the sports school program on motor performance over a one school year is determined by controlling for these differences. Additionally, stature measured during the posttest is included as additional covariate to control for the effect of growth. This is due to the fact that physical training may induce changes in the same direction and approximately the same magnitude as expected by growth changes (Bailey et al., 1986).

The MANCOVA of the posttest motor performance revealed the significant effect of the sports school program on overall motor performance for both boys and girls. Specifically, the sports school program had a significant effect on all motor performances except for the boys' SLJ. Examination of the effect of sports school program on the motor performance of each age group revealed a significant effect for boys and girls in all age groups. However, the motor performance variables affected are not consistent among the age groups (Table 70).

Table 70. Motor performances significantly affected by the sports school program by gender and age group

Gender	Age group	Motor performance
	13	FAH, SR, ASR, ER
Boys	14	TYD, SLJ, ASR, ER
	16	FAH, TYD, SR
	13	FAH, ASR, ER
Girls	14	FAH, SLJ, ASR, ER
	16	JR, SLJ, ER

Thus far, it has been shown that the sports program of the sports school has beneficial effects on motor performance, particularly on the variables listed in Table 70. This finding indicates the ability of the program to cause positive effects on these motor tasks. Available information on the sports school suggests that these effects can be primarily attributed to the selection process and to the school's training program. The significant effect of pretest motor performance on posttest motor performance, particularly in the youngest age group, reflects the effectiveness of the selection process. On the other hand, the significant effect of the sports school program on posttest performance after controlling for the covariates which includes pretest motor performance and growth, reflects the effects of the training program. Training-induced changes during growth can be identified after giving consideration to biologic age and developmental factors such as stature and body mass (Bar-O, 1989). Within this context, the training stimulus provided to the sports school students seems to induce greater positive effects on motor performance than do growth factors alone.

The significant effect of the sports school on motor performance may also reflect the systematic training program of the sports school. As suggested by Willmore and Costill (1994), the frequency, intensity, and duration of training are important factors in a training program. Also, it has been shown that the sports school students spend more time spent on sports activities than the ordinary school students. However, merely increasing time in physical activities may not influence performance (Beunen et al., 1992; Andersen, 1994). The physical activities also have to qualify as training which refers to regular, systematic practice of specific physical activities (Malina & Bouchard, 1991).

Several studies have reported effects of intensive training on aerobic and anaerobic performance by comparing young athletes with non athletes (Nikolic & Ilic, 1992; Sady et al., 1994; Tharp et al., 1984). Other studies have reported the significant influence of enhanced or intensified instructional programs on motor performance (Elnashar & Mayhew, 1984; Shephard & Lavallee, 1994). Perhaps, the sports program at the sports school is a combination of the two, an enhanced instructional program with intensive training.

Improved performance as a result of training is usually attributed to numerous physiological adaptations, such as increased in glycolytic enzyme activity and oxidative enzymes (Fournier et al., 1982). These adaptations in turn are specific to the mode of training which should be sports specific, emphasizing the energy system used for the particular sport (Malina & Bouchard, 1991). Taking these facts into consideration, the variations in the effect of the sports school program on motor performance among age groups can be explained. Since the proportion of athletes for each sport is not equal across age groups, there are variations in the modes of training for the age groups. These variations result in different types of physiological adaptation which are manifested by differences in motor performance. Additionally, physiological differences among different age groups and maturity status can also contribute to these variations.

Results of the discriminant analysis parallel the results of the MANOVA on the posttest motor performance. The motor performances distinguish between students of the sports and ordinary schools across all age groups. Nevertheless, the relative contributions of motor performance variables in discriminating students of the two schools are not consistent across age groups.

Despite the significant effect of the sports school program on motor performance, the classification process shows that 8 boy and 3 girls in the sports school do not resemble the motor performance characteristics of sports school students. Surprisingly, for the boys, the number is greater in the older age group. Since the students are a highly selected group, provide with systematic training, and had been longer in the sports school compared to the younger age groups, this finding warrants further investigation by coaches of the sports school.

The effect of the sports program on different age groups was further investigated by comparing posttest motor performance between different age groups among the sports school students. There were no differences in the effect of the sports program on motor performance among the girls of different age groups, and between the 13- and 14-year-old boys. However, for the girls, the number of students in each group may be too small to statistically detect significant differences between the different age groups. As such, the non-significant difference among age groups for the girls may be partly or entirely due to this factor.

The 16-year-old boys are significantly better than the younger boys on the FAH and TYD. The exact explanations for such differences are beyond the scope of this study. However, they may due to differences in type of training, training adaptation, and/or limited physiological capacities of the younger boys. Trainability in adolescents has been linked to the intrinsic properties of the muscle, substantial growth in cardiorespiratory system, and hormonal changes (Naughton et al., 2000).

In summary, the sports school students had better motor performance than the ordinary school students on both the pretest and posttest measures. These findings reflect the effectiveness of the selection process identifying students with high performance (pretest performance of the 13-year-olds), and the effectiveness of the training program in successfully enhancing motor performance of the students (posttest performance). However, it is important to note that some of these differences can be attributed to differences in the physical characteristics of students between the two schools. The effects of the sports school program on several motor performance variables are eliminated after controlling for the physical characteristics of the sample. Available reviews indicate that these findings might be due to two main factors. First, the training program being conducted in the sports school fails to induce greater positive effects on several performance variables than do growth factors alone. Second, there may be physiological limitations among adolescents that prohibit further improvement on some of the motor performance tasks. Nevertheless, the exact explanation for these findings has yet to be investigated. For the time being, the sports school coaches should try to design training programs that will improve motor performance on tasks on which the current program had no significant effect.

The ultimate goal of the sports school is to produce future sport champions through the identification of talented children at young ages and then providing them with a systematic training program. Within the limitations of this study, this aspect of the program's effectiveness cannot be determined. It requires a longitudinal study involving continuous evaluation of the students' physical performance and their performance in sports competition.

Although superior motor performance can be consistent with success in many sports activities, it is not the only factor that determines success in sports competition.

The results of this study have triggered one important question; to what extent is the basic motor performance of the students related to performance in actual sports competition? If there is a substantial relationship, the motor performance of the students may be used to help predict success in sports competition. Conversely, students whose motor performance does not resemble the motor performance characteristics of the students in the sports school are likely to perform poorly in sports competition. Additionally, the coaches may be able to determine which of the motor performance tasks, if any, makes the greatest contribution to success in sports.

Effects of the sports school program on academic achievement

In general, the ANOVA and ANCOVA of the pretest academic achievement shows no significant differences in academic achievement between the students enrolled in the sports school and students in the ordinary school. However, comparisons among the age groups indicate that the 14-year-old sports school students have lower academic achievement than their counterparts in the ordinary schools, but the reverse is true for the 16-year-old group. Similarly, the ANOVA and ANCOVA of the posttest academic achievement shows that there is no significant effect of the sports school program on academic achievement. Moreover, there is a negative effect of the sports school program on the academic achievement of the 14-year -old students. The study also shows that income and pretest achievement are predictors of academic achievement.

Since income, pre-academic achievement, and place of residence are controlled in the analyses, the non-significant effect of the sports school can be explained by comparing the academic programs of the schools. Among the strategies adopted by the sports school to boost academic achievement is having a sufficient number of qualified teachers, smaller class sizes, flexible academic schedules, high teacher-class ratios, and sufficient academic assistance. A comparison of these resources between the sports school and the ordinary school is presented in Table 71.

Table 71. Comparison of academic resources between the sports and the ordinary school

Resources	Sports school	Ordinary school
Weekly class hours	19 hours	26 hours
Number of student per class	8-28	19 - 41
Teacher-class ratio	2.7:1	2.0:1
Percentage of graduate teachers	78%	75%
Scholarship	Provided to low income students	Provided to low income students with strong academic achievement

The similarity in academic resources between the sports and the ordinary school could be a factor contributing to non-significant effect of the sports school on academic achievement. Generally there are no differences in academic resources between the sports and the ordinary school, except for the number of students per class, which is smaller in the sports school. The fewer class hours per week in the sports school is supplemented by six hours of preparatory class per week. During this preparatory class, students are given academic assistance by teachers of the school. The higher teacher-class ratio in the sports school is actually due to the presence of the teacher-coaches.

It seems that the smaller class size at the sports school has no significant impact on the students' academic achievement. The literature on the impact of small class size on academic achievement is mixed (Mosteller, 1995; Hanushek, 1999). A recent study by Johnson (2000) using the National Assessment of Educational Progress (NAEP) data indicated that class size has little or no effect on academic achievement. Children in the smaller classes (20 or fewer per class) do not score higher than students in the largest classes (31 or more per class).

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine the current status of the sports school and to determine the effectiveness of the sports school program with regard to motor performance and academic achievement. The current status of the sports component of the sports school program was assessed by comparing it to the original plan. The effect of the sports school on motor performance and academic achievement was determined by comparing the motor performance and academic achievement of the sports school students with students in ordinary schools.

Based on the two main purposes of the study, the research process was divided into two major parts. The first part was concerned with the determination of the current status of the sports school program. The extent to which the current status of the program met the original plan was assessed through three primary areas of the program; namely, program content and policy, privileges and opportunity, and training and facilities. Additionally, the adequacy of each program area and problems associated with conducting the sports program were determined through responses from the administrator and coaches of the sports school. Thirty-seven coaches comprised of 23 teacher-coaches and 14 nonteacher-coaches participated in the study.

A checklist was developed and used to compare the present status of the sports school program to its original plan. Responses from the coaches regarding the adequacy of the program were numerically assigned and the rating means for each item and each program area were categorized into four levels of adequacy: highly adequate; moderately adequate; lowly adequate; and inadequate. Further, individual items for each program area were ranked to determine their relative level of adequacy. Rankings made by coaches on six problems posed to them were used to determine the severity of these problems with regard to the program.

With a few exceptions, the current program content and policy is similar to that of the original plan. Although there is still shortage in the number of boys enrolled, there was a tremendous increase in the number of sports offered at the sports school. The number of support staff and the teacher-class ratio also showed an increase from the original plan. Criteria for selection of the students had been implemented according to the original plan with 100% of the students selected meeting the sports requirement. However, some of the students selected did not meet the criterion for academic achievement. Only 78% of the teachers had the required bachelor's degree for academic qualification. The others, although not meeting the academic requirement, were all certified and qualified teachers.

There is still a lot to be implemented in term of privileges and opportunity, for the students and for the teacher-coaches, if the program is to meet the original plan. Most students still have to pay school fees, buy their own sports equipment, and do not automatically receive monthly scholarships. Although most of the students had the chance to participate in national and international competitions, only 38% of them had the opportunity to compete at international level. For the teacher-coaches, some are still teaching more than six periods a week (22 %), and no coaching allowance is provided to them. Only one (0.9%) of the teacher-coaches receives the loan of a car and only 43% of the teacher-coaches were able to attend professional development courses during the year 2000.

The only program area that fully met the original plan is training and facilities. Training facilities are available as stated in the original plan. Nevertheless, training facilities available within the school area are very limited and the use of outside facilities is faced by problems such as transportation, long travelling time, and clashes with other teams. There is a slight increase in the frequency and duration of training, from 5 days a week to 5-6 days a week, and from 3-4 hours per day to 3-6 hours per day. Training during school holidays is provided to national athletes since their training is a year round program. For the others, training is provided only if necessary, i.e. when they are preparing for a competition.

All students in the sports school receive medical attention as originally planned. They are screened for their medical condition upon being selected into the sports school. Injured athletes are referred to physicians for treatment and rehabilitation. Nevertheless, sufficient accessibility to sound rehabilitation programs still needs further attention.

In terms of adequacy, the sports program of the sports school was evaluated as moderately adequate. None of the items or the program areas were assessed as highly adequate or inadequate. Among the three program areas evaluated, training and facilities was assessed as the most adequate, while privileges and opportunities was rated the least adequate. Two of the program areas; program content and policy, and training and facilities, were assessed as moderately adequate. The privileges and opportunity area of the program was assessed as lowly adequate

For program content and policy, five items were rated as moderately adequate, and the remaining three as lowly adequate. The more adequate items are the clarity of the purposes and objectives, understanding of the objectives, the number of sports offered, and the selection process of the students, while the less adequate items are the number of qualified coaches, policy, and coordination with various sports organizations.

For training and facilities, all but one item were rated as moderately adequate. Items receiving higher ratings are opportunities for the use of sports facilities outside the school, time allotted for training, and accessibility for prompt medical treatment, while those rated lower are funding, accessibility for sound rehabilitation for injured athletes, and availability of sports facilities inside the school. For privileges and opportunities, all four items were assessed as lowly adequate. The privileges provided coaches and competition opportunities for students are the more adequate items, while the privileges provided to students and course opportunities for coaches were less adequate.

The three biggest problems faced by coaches of the sports school in conducting the sports program are inadequate staffing, the apathy of students, and the quality of students. There is an insufficient number of qualified coaches, especially among the teacher-coaches. Additionally, there is a need for more support staff, especially in the area of team management and supporting services. Inadequate facilities, although ranked fourth in the order of severity, need to be given special attention. The training facilities available at the sports school are limited and the use of outside facilities presents transportation problems, lost practice time due to travel, and clashes in practice schedules with other teams. Perhaps these problems are linked to the need for more coordination with various sports organizations.

The second part of the study was concerned with the determination of the effectiveness of the sports school program with regard to motor performance and academic achievement. One hundred and sixty boys from nine sports and 66 girls from six sports in the sports school were included in the study. The students were comprised of three age groups; 13-year-old, 14-year-old, and the 16-year-old. Similar numbers of students matched for gender, age group, and ethnicity were selected from two ordinary schools.

The motor performance scores and academic achievement of sports school students attained over a one school year were compared to those of a comparison group comprised of students from ordinary schools. Motor performance tests included were the FAH, JR, TYD, SR, SLJ, ASR, and ER, while examination results were used as a measure of academic achievement. Other variables were measured and used as covariates to control for pre-existing differences among the subjects. These variables measured at the beginning of the school year were characteristics of growth status, maturity status (for boys only), socioeconomic indicators, nutritional status, and the initial status of motor performance and academic achievement of the subjects. Additionally, stature measured at the end of the school year was included to control for growth change.

Means and standard deviations on all variables measured were computed for school, gender, and age group. Additionally, the MANOVA F-ratios were computed to determine the significance of differences in the covariate variables between the sports and the ordinary school students for each gender and age group. The significance of the differences in motor performances between the subjects was determined by MANOVA for school and age group, and differences in academic achievement by ANOVA for school, gender, and age group. MANCOVA procedures were used to determine the influence of the sports school on motor performance and academic achievement, controlling for the covariates.

Results of the study indicated that students of the ordinary school were different in several measures of physical characteristics and maturity status (boys only). Boys and girls of the sports school were taller, heavier, and had greater sitting height than the ordinary school students. The sports school boys had larger arm and calf circumferences than the ordinary school boys. However, there were no differences in skinfold thicknesses between the boys of the two schools. Consequently, boys of the sports school had larger arm and calf muscle areas than boys of the ordinary school. In terms of maturity status, the sports school boys were more advanced than the ordinary school boys among the 13-year-olds and 14-year-olds, but not the 16-year-olds.

In terms of socioeconomic influences, the families of 14- and the 16-year-old boys in the sports school had significantly lower income than their counterparts in the ordinary schools. There were no differences in girls' family monthly income between the two schools. The sports school had also more students of rural origin when compared to the ordinary schools. The BMI between the subjects of the two schools was only different among the14-year-old boys, where the sports school boys had a larger BMI.

Results of the MANOVA for pretest motor performance revealed the existence of school and age group differences for both boys and girls. These differences remained significant even after controlling for the covariates. However, differences on several motor performance tasks were eliminated. The 16-year-old boys continued to demonstrate better performance than the younger age groups on the FAH, JR, TYD, and ASR, and better performance than the 13-year-olds on the ER. The 14-year-old boys were better than the 13-year-olds on the FAH and ER. The 16-year-old girls were better than the 13-year-olds on the ASR and ER. The 14-year-old girls were better than the 13-year-old girls on the ASR only.

Analysis of the pretest motor performances revealed preexisting differences in motor performance between students enrolled in the sports school and students attending the ordinary schools. These differences continued to exist even after controlling for the covariates. The 14- and the 16-year-old boys in the sports school had better performance than their counterparts in the ordinary schools on all motor performance tasks except for the SR. Among the 13-year-old boys, sports school students had better performance than students in the ordinary schools on the JR, SLJ, ASR, and ER. Similarly, the sports school girls had better performance than the ordinary school girls on all tasks among the 16-year-olds; and on the SLJ, ASR, and ER among the 13- and the 14-year-olds.

Results of the MANOVA for posttest motor performance demonstrated school and age group differences. Additionally, the analyses revealed that the pretest motor performances were most influential variables in predicting motor performance attained at the end of the year. The sports school students had better performance than the ordinary school students on all of the motor performances. The 16-year-old boys had better performance than the younger age groups on all motor tasks, except for the ER where they were only better than the youngest age group. The 14-year-old boys had better performance than the 13-year-olds on the SR, SLJ, and ASR only. Age group differences for the girls were only demonstrated between the oldest and the youngest age groups for the JR, TYD, SR, SLJ, and ASR.

The MANCOVA and the multiple regression analyses of the posttest motor performance revealed the effectiveness of the sports school program in enhancing performances on several motor tasks. However, there were age group variations in the motor tasks affected by the sports school. Among the boys, the sports school significantly enhanced performance on the FAH, SR, ASR, and ER of the 13-year-olds; the TYD, SLJ, ASR, and ER of the 14-year-olds; and the FAH, TYD, and ASR of the 16-year-olds. Among the girls, the sports school significantly enhanced FAH, ASR, and ER of the 13-year-olds; FAH, SLJ, ASR, and ER of the 14-year-olds; and JR, SLJ, and ER of the 16-year-olds.

Results of the discriminant analyses indicated that all motor performance scores distinguished between the sports school students and the ordinary school students, a finding similar to the results of the MANOVA of the posttest motor performance scores. Further analyses revealed that the motor performance of 8 boys and 3 girls in the sports school did not resemble the motor performance characteristics of remaining sports school students.

Comparisons within the sports school revealed age group variations in the effects of the sports program on motor performance among the boys only. The 16-year-old boys had better performance than the younger age groups on FAH and TYD. There were no differences in the effects of the sports school program on the 13- and 14-year-old boys.

Overall, there were no between school or gender differences in the academic achievement of the students at the beginning of the school year. However, there were differences between the sports school students and the ordinary schools students for the 14- and 16-year-old age groups. The 14-year-olds of the sports school had lower academic achievement than students in the ordinary schools. The reverse is true for the 16-year-olds. Inter-age group differences found in the study were due to the lower academic achievement of the 16-year-olds compared to the younger age groups. Monthly family income accounted for small but significant proportions of the variance in academic achievement.

Results of the statistical analyses for posttest academic achievement were similar to the results exhibited in the pretest analyses. The non-significant effect of school on academic achievement attained at the end of the year indicated that the program of the sports school was no more effective than the ordinary schools in improving academic achievement. In fact, the 14-year-old students of the sports school had lower academic achievement than their counterparts in the ordinary schools.

Conclusions

Based on the research questions, the following conclusions are drawn from the results of the study:

1. The current status of the sports school program does not completely meet the original plan of the program.

2. Among the three program areas assessed, privileges and opportunities provided to teacher-coaches and students had the least conformity with the original plan.

3. In term of adequacy of the sports school program, the program content and policy, and training and facilities, were rated as moderately adequate, while privileges and opportunities was rated as lowly adequate. Comparatively, the most adequate area of the program is training and facility, followed by program content and policy, while the privileges and opportunities provided to students and coaches is the least adequate.

4. The following characteristics of the sports program of the sports school were rated as lowly adequate (in rank order, the least adequate is presented first):

   i. coordination with various sports organizations,
   ii. policy of the sports school,
   iii. number of qualified coaches,
   iv. course opportunities for coaches,
   v. privileges provided to students,
   vi. privileges provided to coaches,
   vii. sports facilities available in the school,
   viii. competition opportunities for students.

5. The three biggest problem associated with conducting the sports program of the sports school are:

   i. inadequate staffing,
   ii. apathy of students,
   iii. quality of students.

6. There were differences in pre-existing (pretest) motor performance scores between the sports school students and the ordinary school students, with or without controlling for the covariates. However, the motor performances that reflect significant differences are not exactly the same among different age groups, except for the 13- and the 14-year-old girls.
7. The sports school program had a significant effect on motor performance for all age groups. However, the motor performance tasks affected are not consistent among the age groups.
8. Performance on all motor tasks distinguished between the sports school and the ordinary schools students.
9. Among the sports school students, the effects of the sports school program on motor performance varied among the boys only. Performance on the FAH and TYD by the boys in the oldest group was significantly enhanced when compared to that of the boys in the younger age groups.
10. There were no differences in pre-existing (pretest) academic achievement between the sports school students and the ordinary school students, with or without the inclusion of covariates, except for the 14-year-old age group. The sports school students had poorer academic achievement than the ordinary school students.
11. The sports school program had little differential effect on academic achievement, except for the 14-year-old age group. The sports school program had a negative effect on the academic achievement of students in this age group when compared to that of students in the ordinary schools.

Recommendations

In light of the findings and conclusions of this study, the following recommendations are made: 1) for the improvement of the sports school program, and 2) for further research.

Improvement of the sports school program

1. It is necessary to review the policy of the sports school. There are indications that some problems in conducting of the sports program such as an insufficient number of teacher-coaches, and inadequate staffing are associated with teachers' and staff' allocation policy of the school. With an increase in number of sports offered at the sports school, it is necessary that the allocation of teacher-coaches also increase. Additionally, teacher-coaches duties' should be more confined to coaching responsibilities, without the burden of school and student administrative duties.
2. The number and type of sports offered should be based on the availability of training facilities and training equipment inside the school and within the vicinity of the school. Alternatively, training facilities and equipment should be made available in the school, or adequate transportation services should be made available for training sessions outside the school.
3. In light of the growing international interest for the participation of women in sports, and for successful implementation of the Malaysian National Sports Policy, the number of girls in the sports school should be increased. The present status of the sports school indicates lack of promotion and implementation by the

government to provide equal opportunity for women to participate in sports, even at the grassroots level.

4. The privileges and opportunities provided to students and teacher-coaches should be implemented according to the original plan.
5. There should be more coordination for those involved in the sports school program with other sports organizations. Such coordination could facilitate the selection of students, provide more competitive opportunities for students, provide more course opportunities for coaches, and provide for use of training facilities outside the schools. Additionally, coordination with sports research institutions, such as the universities, should be established to facilitate sports research and evaluation on athletes in the sports school.

Recommendations for further research

1. While several motor performance tasks are significantly affected by the sports school program, other tasks and academic achievement are not affected. The aspect of the program that contributed to these strengths and weaknesses have yet to be identified.
2. The ultimate goal of the sports school program is to produce successful young athletes. Although a superior motor performance can be consistent with success in many sports activities, the relationship between motor performance and sports success among the sports school students is still unknown. Further studies on this issue should be conducted to determine the importance of motor performance for sports success.

3. The effectiveness of the talent identification process and the training program in producing future sports champion is still undetermined. Therefore, a longitudinal study should be conducted where changes in motor performance from ages 13 to 17 and performance in sports competition are evaluated on an annual basis.
4. The comparison group in this study was limited to students from ordinary schools located in an urban area. A similar study with a more diverse comparison group, or with participants from other sports development programs should be conducted to provide more information on the effectiveness of the sports school program.
5. Each sport in the school program undergoes a different training program under different coaches. A follow-up study should be conducted to compare the relative effects of the sports program on athletes in selected sports.

APPENDICES

Appendix A

Normative data for selected motor performance of Malaysian children

Boys

Age (years	Motor Performance	5	10	20	30	40	50	60	70	80	90	95
		Percentile										
11	Weight throw (m)	2.7	3.1	4.0	4.6	5.0	5.5	5.9	6.3	6.9	7.8	8.3
	Vertical jump (cm)	13.3	16.6	23.4	27.4	30.8	33.9	37.1	40.5	44.5	51.3	54.6
	40-meter dash (sec)	9.27	8.98	8.38	8.03	7.73	7.46	7.18	6.89	6.53	5.94	5.65
	Agility hexagon	30.2	28.59	25.1	23.06	21.3	19.72	18.11	16.37	14.32	10.84	9.17
	800-meter run (sec)	357.	343.0	312.	295.1	280.	266.2	252.3	237.3	219.5	189.4	174.9
12	Weight throw (m)	3.2	3.6	4.6	5.1	5.6	6.0	6.4	6.9	7.4	8.4	8.8
	Vertical jump (cm)	16.0	18.6	23.9	27.0	29.7	32.1	34.6	37.3	40.4	45.7	48.3
	40-meter dash (sec)	9.06	8.77	8.18	7.83	7.54	7.27	6.99	6.70	6.35	5.76	5.48
	Agility hexagon	28.8	27.3	24.0	22.05	20.4	18.87	17.34	15.69	13.74	10.44	8.85
	800-meter run (sec)	365.	348.7	313.	292.9	275.	259.2	242.9	225.4	204.6	169.6	152.7
13	Weight throw (m)	3.2	3.7	4.8	5.5	6.1	6.6	7.1	7.6	8.3	9.4	9.9
	Vertical jump (cm)	18.5	21.2	26.8	30.1	32.8	35.9	38.0	40.8	44.1	49.6	52.3
	40-meter dash (sec)	8.51	8.24	7.7	7.37	7.10	6.84	6.59	6.32	5.99	5.44	5.18
	Agility hexagon	27.1	25.74	22.7	20.97	19.4	18.08	16.7	15.2	13.43	10.43	8.99
	800-meter run (sec)	330.	315.7	285.	267.6	252.	238.5	224.6	209.5	191.2	161.4	146.8
14	Weight throw (m)	3.3	3.9	5.1	5.8	6.4	7.0	7.5	8.1	8.8	10.0	10.6
	Vertical jump (cm)	19.6	22.8	28.6	32.1	35.1	37.8	40.5	43.5	47.0	52.8	55.7
	40-meter dash (sec)	9.07	8.74	8.06	7.65	7.31	6.99	6.67	6.33	5.93	5.24	4.91
	Agility	29.0	27.51	24.3	22.51	20.9	19.49	18.03	16.46	14.60	11.46	9.94
	800-meter run (sec)	332.	319.9	293.	277.1	263.	251.2	238.7	225.2	209.3	183.4	169.4

Source: National Sports Council, Malaysia (1998)

Girls

Age (years)	Motor Performance	5	10	20	30	40	50	60	70	80	90	95
	Weight throw (m)	2.2	2.6	3.2	3.6	3.9	4.2	4.5	4.9	5.3	5.9	6.2
	Vertical jump (cm)	12.8	15.5	21.1	24.4	27.3	29.9	32.5	35.3	38.6	44.2	46.9
11	40-meter dash (sec)	9.98	9.7	9.12	8.78	8.49	8.22	7.96	7.67	7.33	6.75	6.47
	Agility hexagon (sec)	35.7	33.67	29.3	26.71	24.5	22.50	20.47	18.28	15.69	11.32	9.22
	800-meter run (sec)	378.	363.8	332.5	314.0	298.4	283.9	269.4	253.8	235.3	204.0	188.9
	Weight throw (m)	2.3	2.7	3.5	3.9	4.3	4.7	5.1	5.5	6.0	6.8	7.2
	Vertical jump (cm)	13.8	16.2	21.0	23.9	26.3	28.6	30.8	33.3	36.1	41.0	43.3
12	40-meter dash (sec)	9.93	9.64	9.02	8.65	8.34	8.06	7.77	7.46	7.09	6.48	6.18
	Agility hexagon (sec)	31.05	29.33	25.73	23.61	21.81	20.15	18.49	16.69	14.56	10.97	9.24
	800-meter run (sec)	407.6	389.7	352.5	330.4	311.8	294.6	277.3	258.7	236.6	199.4	181.5
	Weight throw (m)	2.1	2.5	3.3	3.9	4.3	4.7	5.1	5.5	6.0	6.8	7.3
	Vertical jump (cm)	13.7	16.0	20.8	23.7	26.1	28.1	30.6	33.0	35.8	40.6	43.0
13	40-meter dash (sec)	9.75	9.45	8.82	8.45	8.14	7.85	7.56	7.25	6.88	6.26	5.96
	Agility hexagon (sec)	30.05	28.41	25.0	22.98	21.28	19.7	18.13	16.42	14.4	11.0	9.36
	800-meter run (sec)	384.3	368.6	336.2	316.9	300.7	285.7	270.7	254.5	235.3	202.8	187.3
	Weight throw (m)	2.2	2.6	3.5	4.0	4.4	4.8	5.1	5.6	6.0	6.9	7.3
	Vertical jump (cm)	13.6	16.1	21.3	24.4	27.0	29.3	31.7	34.3	37.4	42.6	45.0
14	40-meter dash (sec)	10.19	9.85	9.14	8.72	8.36	8.04	7.71	7.35	6.93	6.22	5.88
	Agility hexagon(sec)	30.9	29.31	26.03	24.08	22.44	20.92	19.39	17.75	15.8	12.52	10.94
	800-meter run (sec)	390.6	374.7	341.7	322.2	305.7	290.4	275.2	258.7	239.2	206.2	190.3

Source: National Sports Council, Malaysia (1998)

Appendix B

Sports school enrollment for boys by form, sports and ethnicity for the year 2000

	Form 1					Form 2					Form 3					Form 4					Form 5					Pre-U					Grand
Sports	M	C	I	O	T	M	C	I	O	T	M	C	I	O	T	M	C	I	O	T	M	C	I	O	T	M	C	I	O	T	Total
Soccer					0	13		1		14	12				12	25				25	13				13					0	64
Sepak Takraw	7		1		8	4				4	9			2	11	4				4	6				6					0	33
Track & Field	4	1			5	8	3			11	7				7	5		1		6	5		1		6	5				5	40
Volleyball	2		1		3	3				3	7	2			9	4	1			5	2	1			3					0	23
Basketball					0		3			3		4	1		5		4			4		5			5					0	17
Field Hockey	5		1		6	7				7	6				6	9				9	7				7					0	35
Squash	1				1	6	1			7	5	1		1	7	2	1		1	4		1			1					0	20
Gymnastics	3				3	3	1			4		4			4	4				4	2	2			4	1	1			2	21
Archery					0	1				1					0	1	1			2	2				2					0	5
Swimming					0					0		2			2	1	1			2		3		1	4	1				1	9
Cricket	4				4	9		3		12					0					0					0					0	16
Golf	2				2					0		1			1	1				1	3				3			1		1	8
Diving					0					0					0	1	2			3		3			3					0	6
Table Tennis					0					0					0		1			1		4			4					0	5
Wushu					0					0		1			1					0					0		1			1	2
Equestrian	1				1	2				2					0					0					0					0	3
Weightlifting	2			1	3	1				1					0					0					0	2				2	6
Rugby	24				24					0					0					0					0					0	24
Silat					0					0					0					0					0	1				1	1
Tennis					0					0					0					0					0		1			1	1
Cycling					0					0					0					0					0	2				2	2
Shooting					0					0					0					0					0	2				2	2
Total	55	1	3	1	60	57	8	4	0	69	46	15	1	3	65	57	11	1	1	70	40	19	1	1	61	14	3	1	0	18	343

M: Malay C: Chinese I: Indian O: Other races T: Total

Sports school enrollment for girls by form, sports and ethnicity for the year 2000

	Form 1					Form 2					Form 3					Form 4					Form 5					Pre-U					Grand
Sports	M	C	I	O	T	M	C	I	O	T	M	C	I	O	T	M	C	I	O	T	M	C	I	O	T	M	C	I	O	T	Total
Netball	5		1		6	6	1			7	4				4	9		1		10	7				7	2				2	36
Track & Field	4	1	1		6	2		1		3	1	3			4	5	1			6	4				4	5				5	28
Volleyball	2	1			3	1	1			2	4	1			5		1			1		8			8					0	19
Basketball					0		2			2		4			4		4			4		4			4					0	14
Field Hockey	3				3	7				7	11				11	5				5	9				9	1				1	36
Squash	2				2					0	3		1		4					0					0		1			1	7
Archery					0	1				1					0					0	1				1	1				1	3
Artistic Gymnastics	3	1			4	2	2			4				1	1	1	1			2					0					0	11
Rhythmic Gymnastics	1	2			3	2	1			3				1	1	1	5	1		7					0		1	1		2	16
Swimming					0		1			1		2			2		1			1					0					0	4
Golf	1				1			1		1					0	1				1	1				1			1		1	5
Synchronized Swimming					0					0					0					0	1	1			2					0	2
Diving					0	1				1					0		2			2	1				1					0	4
Table Tennis					0					0		1			1		4			4		1			1					0	6
Wushu					0					0					0		1			1					0		1			1	2
Equestrian					0					0					0	1				1					0					0	1
Tennis					0					0					0					0					0		1			1	1
Taekwondo					0					0					0					0					0		1			1	1
Shooting					0					0					0					0					0	1				1	1
Fencing					0					0					0					0					0		1			1	1
Total	21	5	2	0	28	22	8	2	0	32	23	11	1	2	37	23	20	2	0	45	24	14	0	0	38	10	6	2	0	18	198

M: Malay C: Chinese I: Indian O: Other races T: Total

Appendix C

CHECKLIST FOR EVALUATION OF THE CURRENT STATUS OF THE SPORTS SCHOOL PROGRAM

A. PROGRAM CONTENT AND POLICY

1. **Goals and objectives of the sports school program.**

	Original plan	Current
Goal	To produce athletes who are not only excel in sports but also have strong academic achievement.	
Objective	1. To improve athletes' performance in their respective games by providing them with well-equipped sports facilities, highly qualified sports personnel, and systematic training programs. 2. To create a balance between the need for sports and academic excellence by providing them with a conducive learning environment and sufficient academic assistance. 3. To instill and encourage the development of positive moral values through their involvement in sports activities and competition.	

2. Activities offered in the sports program.

Original plan	Current
Track & Field - boys & girls	
Artistic Gymnastics - boys & girls	
Rhythmic Gymnastics – girls only	
Squash - boys & girls	
Archery - boys & girls	
Swimming - boys & girls	
Sepak Takraw – boys only	
Netball – girls only	
Field Hockey - boys & girls	
Soccer – boys only	
Volleyball - boys & girls	
Basketball - boys & girls	

3. Individuals involved in the program

	Original Plan	Current
1. Number of students	400 boys, 200 girls	
2. Number of students per class	25	
3. Number of teachers	43	
4. Number of classes	20	
5. Teacher-class ratio	2:1	
6. Number of clerical and maintenance staff	9	
7. Hostel supervisor	1	
8. Fitness instructor	1	
9 Number of teacher-coaches		
10. Number of nonteacher-coaches		

4. Selection of students and coaches.

	Original plan	Current
1. Who decides on the selection of students	Ministry of Education	
2. Criteria for selection of students	1. Success in age group competition. 2. Talent identification by the school coach. 3. Recommendation by state and national sports bodies. 4. GPA between 3.0 to 3.5	
3. Criteria for the selection of coaches	1. Coaching certification 2. More than 3 years coaching experience 3. A bachelor's degree	
2. Percentage of students meeting academic requirements		
3. Percentage of students meeting sports requirements	100%	
4. Percentage of graduate teachers	100%	
5. Percentage of certified coaches	100%	
6. Percentage of coaches with more than 3 years coaching experience	100%	

B. PRIVILEGE AND OPPORTUNITY

5. **Privileges and opportunities to students and coaches.**

	Original plan	Current
1. Amount of food allowance each student receives/day	RM 15.00	
2. Travel expenses for going back home/coming to school	3 times/year	
3. Scholarship for each student per month	RM 50.00	
4. Academic and hostel fees, and sports equipment	Free	
5. Percentage of students with medical insurance coverage	100%	
6. Percentage of students competed in national/international competition	100%	
7. Percentage of teacher-coaches teaching 4-6 periods/week	100%	
8. Percentage of teacher-coaches living in school housing	100%	
9. Percentage of teacher-coaches receiving car loan	100%	
10. Percentage of coaches who received professional development courses	100%	

C. TRAINING AND FACILITY

6. **Training**

	Original plan	Current
1. Training frequency per week	5 days/week	
2. Training duration per day	3-4 hours/day	
3. Training during school holidays	provided	

7. **Facilities available for training.**

	Original plan	Current
1. Sport facilities within the school	Multipurpose hall (1)	
	Fitness room (1)	
	Squash court (3)	
	Demonstration room (3)	
2. Sport facilities outside the school	Track & Field	
	Artistic Gymnastics	
	Rhythmic Gymnastics	
	Squash	
	Archery	
	Swimming	
	Sepak Takraw	
	Netball	
	Field Hockey	
	Soccer	
	Volleyball	
	Basketball	
3. Quality of sport equipment provided to students		

8. **Medical services.**

	Original plan	Current
1. Physical examinations for students	100%	
2. Medical history kept for students	100%	
3. Accessibility to physician for injured athletes	100%	
4. Supervision of athletes in rehabilitation program	100%	

D. ADEQUACY AND PROBLEMS OF THE PROGRAM

1. Adequacy

Areas evaluated	Reference	Adequacy
1. Program content and policy a. policy, goal, and objective b. individuals involved	Interview schedules: question 4. Survey questionnaire: question 9. Self-evaluation questionnaire: questions 1, 2, 3, 4, 5, 6, 11, and18.	
2. Privilege and opportunity a. privilege to students and coaches b. opportunity to students and coaches	Interview schedules: questions 7 and 8. Survey questionnaire: questions 16 and 21. Self-evaluation questionnaire: questions 7, 8, 9, and 10.	
3. Training and facility a. training b. facility	Interview schedules: questions 11, 13, 15, 16, and 17. Survey questionnaire: questions 18 and 20. Self-evaluation questionnaire: questions 12, 13, 14, 15, 16, and 17.	

2. Major problems in administering the sports program.

	Rank
Lack of sufficient time	
Inadequate equipment	
Inadequate facilities	
Inadequate staffing	
Apathy of students	
Quality of students	

Appendix D

Interview Schedules
Respondent: Administrator of the Sports School

PROGRAM CONTENT AND POLICY

1. What are the purposes and objectives of the school sports program?

2. What sport activities are now offered in the program?
   -ask for list of sport activities

3. What are the components of the school program?

   a. Number of students: Boys________ Girls ________
      -ask for breakdown according to grade level and sports

   b. Number of teachers: Men _______ Women _______

   c. Number of teacher-coaches: Men _______ Women _________
      -ask for breakdown according to sports

   d. Number of non teacher-coaches : Men _______ Women _______
      -ask for breakdown according to sports

   e. Number of support staff : Men _______ Women _________
      -ask for breakdown according to job description.

4. Who decides on the number of students to be selected into the school?

5. What criteria are used for the selection of students?

   a. academic:

   b. sports:

6. How are the coaches appointed?

   a. teacher-coaches

   b. non teacher-coaches

PRIVILEGES AND OPPORTUNITIES

1. What kind of aids do the students receive from the school?

Aids	Yes	No	Amount (where applicable)	Adequate yes/no
Monthly allowance				
Hostel				
Food				
Training equipment				
Training apparel				
Medical insurance				
Home travel expenses				

Other, please specify: ____

____

2. What privileges do the coaches receive?

Privilege	Yes	No	Amount and/or number received (where applicable)
Allowance			
Housing			
Car loan			

Other, please specify ____

____

3. Are opportunities for National competition available?
   -ask for number of students who competed in National competition.

4. Are opportunities for courses available for coaches?
   -ask for number of coaches attending courses

TRAINING, FACILITY, AND SERVICES

1. What are the schedules for sports training of the school?
   -ask for schedule

   Is the time allotted for training consistent with the demand for competition? If no, why?

2. What facilities are available for sports training/practice inside the school?

Facility	Adequate for Program (yes/no)	Maintained Adequately (yes/no)

3. Which sports activities, if any, receive the highest priorities for use of training facilities? Why?

4. Are additional facilities needed? If yes, please specify.

5. What facilities are available for sports training/practice outside the school?

Facility	Location	Distance from school (km)

6. What are the school priorities for use of outside facilities? (mark where appropriate)

Facility	1st priority user	2nd priority user	3rd priority user

7. Are the priorities for use of facilities satisfactory? If no, why?

8. How is the sports program of the school funded? List all resources.

1. ______________________________

2. ______________________________

3. ______________________________

Is funding adequate? YES NO

Is additional funding available? If yes, specify sources.

8. Are physical examinations provided for athletes?

9. Is a medical history file kept for athletes?

10. Do injured athletes normally have access to a physician? If no, why?

11. Do injured athletes normally have access to, and are they normally supervised in a sound rehabilitation program? If no, why?

SELF-EVALUATION OF PRESENT PROGRAM

Check the box that corresponds to your answer for the following statements

	Completely disagree	Tend to disagree	Tend to agree	Completely agree
The purposes and objectives of the sports program are clearly stated	☐	☐	☐	☐
The purpose of the program is clearly understood by all	☐	☐	☐	☐
The policy developed needs revision	☐	☐	☐	☐
I am satisfied with the selection process of the students	☐	☐	☐	☐
Number of teachers is sufficient	☐	☐	☐	☐
Number of qualified coaches is sufficient	☐	☐	☐	☐
Privileges provided to students are sufficient	☐	☐	☐	☐
Privileges provided to coaches are sufficient	☐	☐	☐	☐
There are sufficient competitive opportunities for students	☐	☐	☐	☐
There are sufficient course opportunities for coaches	☐	☐	☐	☐
Number of sports offered by the school is adequate	☐	☐	☐	☐
Time allotted for training is consistent with the demand for competition	☐	☐	☐	☐
Sport facilities available in the school are sufficient	☐	☐	☐	☐
There are sufficient opportunities for the use of sport facilities outside the school	☐	☐	☐	☐
Funding for sports program is adequate	☐	☐	☐	☐
Injured athletes have sufficient accessibility for prompt medical treatment	☐	☐	☐	☐
Injured athletes have sufficient accessibility for sound rehabilitation program	☐	☐	☐	☐
There is a need for more coordination with various sports organizations	☐	☐	☐	☐

Please rank the major problem areas when administering the sports program

	Rank
Lack of sufficient time	
Inadequate equipment	
Inadequate facilities	
Inadequate staffing	
Apathy of students	
Quality of students	

Appendix E.

Survey Questionnaire
Respondent: Coaches

1. What is your age? ________ years
2. Are you a ☐ male ? ☐ female?
3. Are you a teacher of the school? ☐ Yes ☐ No
4. Do you live in the school quarters? ☐ Yes ☐ No
5. Do you receive a car on loan? ☐ Yes ☐ No
6. What sports do you coach?

   ____

7. How many athletes do you coach? male ____________ female ______________
8. Are you satisfied with the quality of athletes selected for your sport? ☐ Yes ☐ No
9. Are you a certified coach? ☐ Yes ☐ No
10. What coaching certification do you have?

    ____

11. Your coaching experience ☐ less than 3 years ☐ more than 3 years
12. Have you attended any coaching course this year? ☐ Yes ☐ No
13. How much allowance, if any, do you receive per month? RM __________________
14. How many hours per week do you train your athletes? __________ hours
15. What facilities are available in the school for your training program?

    ____

16. What additional facilities would you like to have in the school?

    ____

17. Are you satisfied with the privileges that you received? ☐ Yes ☐ No

18. What facilities are available outside the school for your training program?

_______________________________ Location/distance: __________________

19. What difficulties, if any, have you had in scheduling training outside the school?

____

20. Are you satisfied with the number and quality of equipment provided to your athletes?

☐ Yes ☐ No

21. How many of your athletes take part in competition this year?

National: _________ International: ____________

22. Do injured athletes normally have access to physician? ☐ Yes ☐ No

23. Do injured athletes have access to a supervised rehabilitation program?

☐ Yes ☐ No

SELF-EVALUATION OF PRESENT PROGRAM

Check the box that corresponds to your answer for the following statements

	Completely disagree	Tend to disagree	Tend to agree	Completely agree
The purposes and objectives of the sports program are clearly stated	☐	☐	☐	☐
The purpose of the program is clearly understood by all	☐	☐	☐	☐
The policy developed needs revision	☐	☐	☐	☐
I am satisfied with the selection process of the students	☐	☐	☐	☐
Number of teachers is sufficient	☐	☐	☐	☐
Number of qualified coaches is sufficient	☐	☐	☐	☐
Privileges provided to students are sufficient	☐	☐	☐	☐
Privileges provided to coaches are sufficient	☐	☐	☐	☐
There are sufficient competitive opportunities for students	☐	☐	☐	☐
There are sufficient course opportunities for coaches	☐	☐	☐	☐
Number of sports offered by the school is adequate	☐	☐	☐	☐
Time allotted for training is consistent with the demand for competition	☐	☐	☐	☐
Sport facilities available in the school are sufficient	☐	☐	☐	☐
There are sufficient opportunities for the use of sport facilities outside the school	☐	☐	☐	☐
Funding for sports program is adequate	☐	☐	☐	☐
Injured athletes have sufficient accessibility for prompt medical treatment	☐	☐	☐	☐
Injured athletes have sufficient accessibility for sound rehabilitation program	☐	☐	☐	☐
There is a need for more coordination with various sports organizations	☐	☐	☐	☐

Please rank the major problem areas when administering the sports program

	Rank
Lack of sufficient time	
Inadequate equipment	
Inadequate facilities	
Inadequate staffing	
Apathy of students	
Quality of students	

Appendix F.

SUBJECT INFORMATION

Subject No: __________

Identity card number: _________________ Form: 1 2 4 (circle one)

Date of birth: ____ /_____/____ Gender: male / female (circle one)

(day /month/year)

School: ____

Type of sport involved : ______________________ ______________________________

Level of participation before entering present school: /District/State/National/International

Level of participation now: /District/State/National/International

Average time spent on physical or/and sport activities per week _________ hours

Anthropometric measures

Stature : ___________ cm	Sitting height : _________cm
Body mass : ________ kg	Upper arm circumference: ______cm
Calf circumference : ______cm	

Skinfold thickness (boys only)

Triceps: ______mm	Calf (medial): _____mm
Subscapular: _____mm	Suprailiac: ______mm
Maturity status: _______	

Date:________________

Motor Performance Tests

Subject No: __________

Identity card number: ________________ Form: 1 2 4 (circle one)

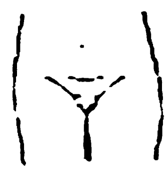
Test	Original position	Trial		
		1	2	3
Flexed arm hang	XXXXXXXXXX		XXXXXXXXXX	XXXXXXXXX
Jump and reach				
30 yard dash	XXXXXXXXXX			XXXXXXXXX
Sit and reach	XXXXXXXXXX			
Agility shuttle run	XXXXXXXXXX			XXXXXXXXX
Standing long jump	XXXXXXXXXX			
800 meter run	XXXXXXXXXX		XXXXXXXXXX	XXXXXXXXX

Date: ________________

Appendix G

<u>Stages of Pubic Hair Development</u>

<u>Instruction;</u> Please read each description corresponding to the diagram presented opposite. Then mark (X) in the corresponding box to assign a stage to yourself. You may wish to use a mirror to help assign the correct stages

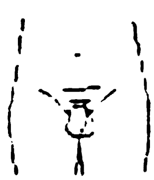


1 ☐

- *No pubic hair*

2 ☐

- *There is sparse, long, slightly colored hair that is straight or slightly curled.*
- *It is at the base of the penis or on the scrotum.*



3 ☐

- *The pubic hair is considerably darker, coarser and more curled.*
- *The hair is around the base of the penis.*

4 ☐

- *The hair is darker(similar to cranial hair), coarse, and curled.*
- *The hair covered more area but does not extend over the folds where the thighs join the stomach*

5 ☐

- *The hair spreads to the inner surfaces of the thighs where the thighs join the stomach.*
- *It covers a triangular area* ▽ *with a straight upper margin*

Appendix H

INFORMED CONSENT FORMS (PARENTS)

We are conducting a study aimed at evaluating the current status, and assessing the program effectiveness with regard to motor performance and academic achievement of the National Sports School, Malaysia. This study will form the dissertation component of Saidon Amri's doctoral program at Michigan State University, East Lansing, Michigan, USA.

To conduct this study, students of the sports school and a few ordinary schools will be selected as participants. Your son/daughter has been chosen as a participant for this study as he/she is a student enrolled in schools listed in the letter of approval to conduct the study by the Ministry of Education Malaysia dated February 10, 2000. In addition, the principal of the school has been informed and permission to conduct the study has been granted. Participation in this study is voluntary, and your son/daughter is free to withdraw (you also can choose to withdraw your son/daughter) during any portion of the study without penalty.

If you allow your son/daughter to participate in this study, he/she will be tested for motor performance using a battery of motor performance tests. Tests included are the flexed-arm hang, jump and reach, thirty yard dash, sit and reach, standing long jump, thirty-foot agility shuttle run, and 800 meter run. For your information, all these tests are similar to those tests usually conducted in your son's/daughter's physical education classes or school sport training. Although your son/daughter will be expected to work very hard, none of these tests are dangerous and every effort will be taken to ensure that no harm comes to him/her.

These tests will be administered during your son's/daughter's physical education classes or during his/her school sport training session, thus, in no way will affect your son/daughter academic lessons. Administration of these tests will involve a total time of approximately 90 minutes, or two sessions of your son/daughter's physical education class.

Additionally, the researcher will get several existing information about your family and your son/daughter from his/her school's record. This information includes your family monthly income, your son/daughter's growth status (height and weight), your son's body measures (arm and calf circumferences, skinfold thicknesses) and maturity status, and your son/daughter's academic achievement.

Although the main aim of this study is to evaluate the physical abilities of students of the sports school, students of the ordinary schools will also benefit from involvement in this study. Your son/daughter will gain information regarding his/her nutritional status and to a certain extent his/her physical fitness status as several tests involved can also determine physical fitness levels.

Your son/daughter's participation in this study will not incur any financial costs to you and your family. All materials needed for the testing will be provided by the researcher and the school.

All information and data gathered will be treated with the strictest confidence and will not be used except for the purposes stated above. Your son's/daughter's privacy will be protected to the maximum extent allowable by law and he/she will remain confidential in any report of the research findings. On request and within these restrictions results may be made available to you.

If your son/daughter is injured as a result of his/her participation in this research project, the Ministry of Education through the school will provide emergency medical care if necessary. You will not be held responsible for any medical expenses as a result of this injury. All such medical expenses incurred by you as a result of this injury shall be paid by Takaful Insurance, a health insurance plan provided by the Ministry of Education to every school student in the country.

If you have any question regarding this study, please feel free to contact Saidon Amri at Physical Education Unit, Faculty of Educational Studies, University Putra Malaysia, 43400, Serdang, Selangor (Phone: 03-9486101 ext. 2439), or Dr. John Haubenstricker at Institute for the Study of Youth Sports, Michigan State University, East Lansing, Michigan 48825 (Phone: 517- 355-4741).

If you have any concern regarding your son's/daughter's role and rights as a subject of this study, you may contact Dr. David E. Wright, Chair, University Committee on Research Involving Human Subjects, Michigan State University, East Lansing, MI 48824 (Phone: 517-355-2180).

Please sign and return the attached form if you allow your son/daughter to participate in this study.

Sincerely yours,

____

(Saidon Amri)

INFORMED CONSENT FORM

Parent/Legal Guardian,

Your signature here indicates that, having read the above information, or having had someone read the information, you have decided to allow your child to participate in the study. You and your child will be offered a copy of this form to keep.

______________________________ ______________________________

( ) Date

Signature of Parent/Legal Guardian

______________________________ ______________________________

( ) Date

Signature of Investigator

If you would like a personal report of the tests taken, please provide your address below.

____

____

____

____

Appendix I

ASSENT FORM FOR STUDENT

You are invited to participate in a study that will evaluate your motor performance and academic achievement. This study has been explained to your father/mother/guardian and that she/he has given his/her permission for you to participate in this study. Your participation is this study is voluntary and you are free to withdraw during any portion of the study without penalty.

If you agree to participate in this study, you will be asked to perform several motor performance tests during your physical education classes or during your sport training session. These tests will involve a total time of approximately 90 minutes, or two sessions of your physical education class.

Additionally, the researcher will have access to your personal and family information (academic achievement, height, weight, body measurements, maturity status – for boys only, and your family's monthly income) through records provided by the school.

Your signature below indicates that this page was read to (or by) you and that you are agreeing to participate in this study.

____________________________ __________________

( ) Date

Signature of student

Appendix J

INFORMED CONSENT FORM (ADMINISTRATOR)

(Verbal Script)

We are conducting a study aimed at evaluating the current status, and assessing the program effectiveness with regard to motor performance and academic achievement of the National Sports School, Malaysia. This study will form the dissertation component of Saidon Amri's doctoral program at Michigan State University, East Lansing, Michigan, USA.

For that matter, I hope to get some information from you regarding the sports school and problems in running the sports program of the school. To get this information, I hope to have an interview session with you and where possible and relevant, to have access to certain documents of the school. The interview session will take approximately one to two hours.

Your participation is voluntary and you may chose not to participate or not to answer certain questions during the interview without penalty. You may also discontinue the interview at any time.

Your response and other information provided to me will be treated with the strictest confidence and will only be used for the purposes stated earlier. Your privacy will be protected to the maximum extent allowable by law and your personal identity will remain confidential in any report of the research findings. On request and within these limitations results may be made available to you.

If you choose to participate, the interview can be administered now or at some other time most convenient to you. I can be contacted at Faculty of Educational Studies, UPM, Serdang (Phone: 03-89486101 ext. 2439).

If you need more information regarding the study please feel free to ask (me), or you can contact Dr. John Haubenstricker at Institute for the Study of Youth Sports, Michigan State University, East Lansing, Michigan 48825 (Phone: 517- 355-4741).

If you have any concern regarding your role and rights as a subject of this study, you may contact Dr. David E. Wright, Chair, University Committee on Research Involving Human Subjects, Michigan State University, East Lansing, MI 48824 (Phone: 517-355-2180).

Thank you

Appendix K

INFORMED CONSENT FORM (COACHES)

(Face sheet to a written questionnaire)

Dear Sir/Miss/Madam

We are conducting a study aimed at evaluating the current status, and assessing the program effectiveness with regard to motor performance and academic achievement of the National Sports School, Malaysia. This study will form the dissertation component of Saidon Amri's doctoral program at Michigan State University, East Lansing, Michigan, USA.

You are selected to give your response to this questionnaire as you are one of the coaches of the sports school. This questionnaire aims to determine the current status of the sports program of the school and to identify problems associated with running the program. It will take you approximately 30 minutes to response completely to the questionnaire. Participation is this study is voluntary and you may choose not to participate or not to answer certain questions without penalty.

Your response to this questionnaire will be treated with the strictest confidence and will not be used except for the purposes stated above. Your privacy will be protected to the maximum extent allowable by law and your personal identity will remain confidential in any report of the research findings. On request and within these restrictions results may be made available to you.

If you have any question regarding this study, please feel free to contact Saidon Amri at Faculty of Educational Studies, UPM, 43400, Serdang, Selangor (Phone: 03-9486101 ext. 2293), or Dr. John Haubenstricker at Institute for the Study of Youth Sports, Michigan State University, East Lansing, Michigan 48825 (Phone: 517- 355-4741).

If you have any concern regarding your role and rights as a subject of this study, you may contact Dr. David E. Wright, Chair, University Committee on Research Involving Human Subjects, Michigan State University, East Lansing, MI 48824 (Phone: 517-355-2180).

You indicate your voluntary agreement to participate by completing and returning questionnaire. If you decide to return this questionnaire, please do so during my visits to your school or you can mail it to me at the above address before November 9, 2000.

Thank you.

Saidon Amri

Appendix L

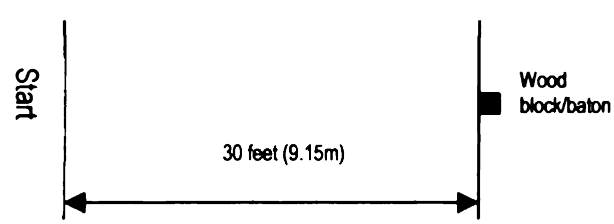
MOTOR PERFORMANCE TESTING

Directions for Administration of Tests

FLEXED ARM HANG: Adjust the bar so it is approximately six inches above the performer's height. Position in a bent arm hang with the elbows flexed at greater than 90^0. Hands should be in the reverse curl or pronated grip (palms away). The score is the time to the nearest whole second from the moment the performer hangs unaided until his chin rests on the bar or his elbows assume a position of less than 90^0 flexion. Record one trial unless the performer does not receive a fair chance, i.e. if less than one or two seconds is recorded on the first trial, give an additional trial.

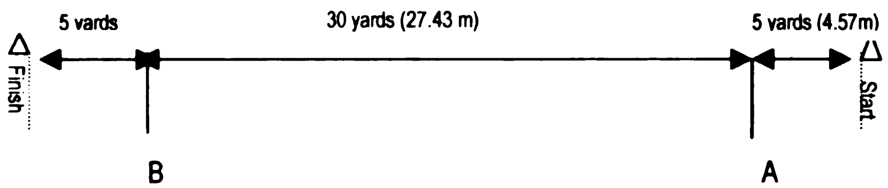
JUMP AND REACH: The performer stands with the right or left side to the wall and fully extends the elbow and shoulder vertically. Record the point where the distal most part of third digit contacts the tape. The performer then jumps (without an approaching step) and contacts the tape. The score is the difference between the height attained on the jump and touch and the score of the initial reach. Instructions to the performer: Be sure to bend the knees when getting ready to jump and swing your arms to help you get up higher. Record three trials.

AGILITY SHUTTLE RUN: Two blocks are placed on a line 30 feet (9.15 m) from the starting line. The performer takes a position with toes behind the starting line. Examiner's commands are: To your mark, Get set, Go. Performer runs to the 30-foot mark, picks up one block and places it on the starting line, then returns to the 30-foot mark for the other block, picks it up and runs past the starting line with it in his hand. The time is recorded to the nearest 1/10 second. Record two trials.



STANDING LONG JUMP: The performer begins with toes behind the restraining line. Take-off and landing must be on two feet. The score is the distance (to the nearest ½ cm) in centimeters from the take-off line to the point where the body touches nearest to the take-off line. Record three trials.

30 YARD (27.43 m) DASH: The performer begins the run with a five (5) yard (4.57m)running start. The starter's commands are: To you mark, Get set, Go. As the performer reaches the starting line, the starter gives a hand signal for the timer to start the watch. The performer reports his name to the timer, who records the time to the nearest 1/10 second. Instructions to the runner: "When I say 'Go' you are to run as fast as possible to...." (The designated spot should be five (5) yards beyond the actual finish line, because young children will tend to stop on the finish line.) Record two trials.



1. Start stop watch when performer pass line A
2. Stop stop watch when performer pass line B

WELLS SIT AND REACH: The performer sits on the floor with the soles of the feet in contact with the bench. Knees should be fully extended and remain in this position during the test. The performer moves both hands forward, one on top of the other, reaching as far beyond the toes as possible. The performer is asked to slowly "bob and reach" three times and to "hold" on the fourth reach. The score is plus or minus the distance (to the nearest ½ centimeter) reached in relation to the vertical surface of the bench. Record three trials.

800 METER RUN: The performer run two (2) laps on a 400 meter course. Performers are asked to continue walking if they cannot finish the race at a run. The time is recorded to the nearest second. Instruction to the runner: Be sure to run so that you will be able to finish the entire distance at a run. Record one trial.

BIBLIOGRAPHY

Acheson, R. M., & Dupertuis, C. W. (1957). The relationship between physique and rate of skeletal maturation in boys. Human Biology, 29, 167 - 193.

Adam, A. W. (1991). Social issues in sports development: The Malaysian perspective. Unpublished paper. Ministry of Youth and Sports, Kuala Lumpur.

Andersen, L. B. (1994). Changes in physical activity are reflected in changes in fitness during late adolescence. A 2-year follow-up study. Journal of Sports Medicine and Physical Fitness, 34, 390 - 397.

Arshat, H. (1986). District level differences in maternal, infant, and toddler mortality rates, Peninsular Malaysia. Kuala Lumpur: National Population and Family Development Board.

Ashcroft, M. T., & Lovell, H. G. (1964). Height and weights of Jamaican children of various racial origin. Tropical Geographical Medicine, 4, 346 - 353.

Bailey, D. A., & Mirwald, R. L. (1988). The effects of training on the growth and development of the child. In R. M. Malina (Ed.). Young athletes: Biological, psychological and educational perspective (pp. 33 - 47). Champaign, IL: Human Kinetics Books.

Bailey, D. A., Malina, R. M., & Mirwald, R. L. (1986). In F. Falkner & J. M. Tanner (Eds.), Human growth: A comprehensive treatise (2nd ed., pp. 147 - 164). New York: Plenum Press.

Bale, P. (1991). Anthropometric, body composition and performance variables of young elite female basketball players. Journal of Sports Medicine and Physical Fitness, 31, 173 - 177.

Bale, P., Mayhew, J. L., Piper, F. C., Ball, T. E., & Willman, M. K. (1992). Biological and performance variables in relation to age in male and female adolescent athletes. Journal of Sports Medicine and Physical Fitness, 32, 142 - 148.

Ball, T. E., Massey, B. H., Misner, J. E., Mckeown, B. C., & Lohman, T. G. (1992). The relative contribution of strength to running and jumping performance of boys 7 – 11. Journal of Sports Medicine and Physical Fitness, 32, 364 - 371.

Bar-Or, O. (1983). Pediatric sports medicine for the practitioner: From physiologic principles to clinical applications. New York: Springer-Verlag.

Bar-Or, O. (1989). Trainability of the prepubescent child. The Physician and Sportsmedicine, 17, 65 - 81.

Bar-Or, O. (1993). Physiological perspectives. In B. R. Cahill & A. J. Pearl (Eds.), Intensive participation in children's sports (pp. 127 - 132). Champaign, IL: Human Kinetics.

Baxter-Jones, A. D., Helms, P., Maffulli, N., Baines-Preece, J. C., & Preece, M. (1995). Growth and development of male gymnasts, swimmers, soccer and tennis players: A longitudinal study. Annals of Human Biology, 22, 381 - 394.

Berryman, J. W. (1996). The rise of boys' sports in the United States, 1900 – 1970. In F. L. Smoll & R. E. Smith (Eds.), Children and youth in sport (pp. 4 - 14). Chicago: Brown & Benchmark Publishers.

Beunen, G. P., Malina, R. M., Renson, R., Simons, J., Ostyn, M., & Lefevre, J. (1992). Physical activity and growth, maturation and performance: A longitudinal study. Medicine and Science in Sports & Exercise, 24, 576 - 585.

Beunen, G. P., Ostyn, M., Simons, J., Renson, R., & Van Gerven, D. (1981). Chronological and biological age as related to physical fitness in boys 12 to 19 years. Annals of Human Biology, 8, 321 - 331.

Beunen, G., & Malina, R. M. (1988). Growth and physical performance relative to the timing of adolescent spurt. Exercise and Sport Sciences Review, 16, 503 - 540.

Beunen, G., & Malina, R. M. (1996). Growth and biological maturation: relevance to athletic performance. In O. Bar-Or, The child and adolescent athlete. Volume VI. The encyclopedia of sports medicine, An IOC Medical Commission Publication (pp. 3 - 24). Oxford: Blackwell Scientific Publication.

Beunen, G., Malina, R. M., Ostyn, M., Renson, R., Simon, J. & Van-Gerven, D. (1982). Fatness and skeletal maturity of Belgian boys 12 through 17 years of age. American Journal of Physical Anthropology, 59, 387 - 392.

Beunen, G., Malina, R. M., Lefevre, J., Claessens, A. L., & Renson, R. (1994). Adiposity and biological maturity in girls 6 - 16 years of age. International Journal of Obesity and Related Metabolic Disorders, 18, 542 - 546.

Beunen, G., Malina, R. M., Lefevre, J., Claessens, A. L., Renson, R., Simons, J., Maes, H., Vanreusel, B., Lysens, R. (1994). Size, fatness and relative fat distribution of males of contrasting maturity status during adolescence and as adults. International Journal of Obesity and Related Metabolic Disorders, 18, 670 - 678.

Beunen, G., Malina, R. M., Lefevre, J., Claessens, A. L., Renson, R., Kanden, E. B., Vanreusel, B., & Simons, J. (1997). Skeletal maturation, somatic growth and physical fitness in girls 6-16 years of age. International Journal of Sports Medicine, 18, 413 - 419.

Beunen, G., Malina, R. M., Van't Hof, M. A., Simons, J., Ostyn, M., Renson, R., Van Gerven, D. (1988). Adolescent growth and motor performance: A longitudinal study of Belgian boys. Champaign, IL: Human Kinetics Books.

Beunen, G., Ostyn, M., Simons, J., Renson, R., Claessens, A. L., Kanden, E. B., Lefevre, J., Vanreusel, B., Malina, R. M., & Van't Hof, M. A. (1997). Development and tracking in fitness components: Leuven longtudinal study on lifestyle, fitness and health. International Journal of Sports Medicine, 18 (Suppl 3), S171 - 178.

Bielicki, T., Koniarek, J., & Malina, R. M. (1984). I nterrelations among certain measures of growth and maturation rate in boys during adolescence. Annals of human Biology, 13, 1 - 11.

Billewicz, W. Z., Fellowes, H. M., & Thomson, A. M. (1981). Pubertal changes in boys and girls in Newcastle upon Tyne. Annals of human Biology, 8, 211 - 219.

Boas, S. R., Falsetti, D., Murphy, T. D., & Orenstein, D. M (1995). Validity of self-assessment of sexual maturation in adolescent male patients with cystic fibrosis. Journal of Adolescent Health, 17, 42 - 45.

Boileau, R. A., & Lohman, T. G. (1977). The measurement of human physique & its effect on physical performance. Orthopedic Clinics of North America, 8, 563 - 581.

Borms, J., & Hebbelinck, M. (1984). Review of studies on Olympic athletes. In J. E. L Carter (Ed.), Physical structure of Olympic athletes Part II: Kinanthropometry of Olympic athletes (pp. 7-27). New York: Basel-Karger.

Bouchard, C., Malina, R. M., & Perusse, L. (1997). Genetics of Fitness and Physical Performance. Champaign, IL: Human Kinetics.

Branta, C., Haubenstricker, J., & Seefeldt, V. (1984). Age changes in motor skills during childhood and adolescence. Exercise and Sport Sciences Reviews, 12, 467 - 520.

Callaway, C. W., Chumlea, W. C., Bouchard, C., Himes, J. H., Lohman, T. G., Martin, A. D., Mitchell, C. D., Mueller, W. H., Roche, A. F., & Seefeldt, V. D. (1988). Circumferences. In T. G. Lohman, A. F. Roche & R. Martorell (Eds.), Anthropometric standardization reference manual (pp. 39-54). Champaign, IL: Human Kinetics.

Cambell, D. T., & Stanley, J. C. (1963). Experimental and quasi-experimental designs for research. Boston: Houghton Mifflin Company.

Cameron, N. (1982). A portable sitting height table for field studies. Annals of Human Biology, 9, 377 - 379.

Cameron, N., Kgamphe, J. S., Leschner, K. F., & Farrant, P. J. (1992). Urban-rural differences in the growth of South African black children. Annals of Human Biology, 19, 23 - 33.

Carron, A. V., & Bailey, D. A. (1974). Strength development in boys from 10 to 16 years. Monograph of the Society for Research in Child Development, 39, Serial No. 157.

Carter, J. E. L. (1984). Morphological factors limiting human performance. In D. H Clarke & H. M. Eckert (Eds.), Limits of human performance: Fifty-sixth annual meeting, Eugene, Oregon, July 19-26, 1984 (pp. 106 - 117). Champaign: Human Kinetics.

Chee, H. L. (1990). Health and health care in Malaysia. Kuala Lumpur: University of Malaya.

Chen, S. T. (1976). Comparative growth of Malay, Chinese, and Indian schoolchildren in Malaysia. Southeast Asian Journal of tropical Medicine and Public Health, 5, 58 - 89.

Chen, S. T. (1977a). Longitudinal study of physical growth of primary school children in Malaysia. Medical Journal of Malaysia, 32, 17 - 21.

Chen, S. T. (1977b). Prevalence of protein-calorie malnutrition in a group of Malaysian school children. Medical Journal of Malaysia, 31, 266 - 269.

Chen, S. T. (1990). Secular trend of growth in Malaysian children. The Journal of the Singapore Paediatric Society, 32, 102 - 107.

Chong, Y. H., & Lim, R. K. H. (1975). The prevalence of malnutrition amongst Malay pre-school children - comparative assessment by anthropometric indicators. Journal of Tropical Pediatric, 21, 19 - 21.

Chong, Y. H., Mckay, D. A., & Lim, R. K. H. (1972). Some results of recent nutrition survey in Malaysia. Bulletin of Public Health Society, 66, 55 - 61.

Chumlea, W. C., Guo, S., Kuczmarski, R. J., Johnson, C. L., & Leahy, C. K. (1990). Reliability for anthropometric measurements in the Hispanic Health and Nutrition Examination Survey (HHANES 1982-1984). American Journal of Clinical Nutrition, 51, 902S - 907S.

Clarke, H. H. (1971). Physical and motor tests in the Medford Boys' growth study. Englewood Cliffs, New Jersey: Prentice Hall.

Cohen, J., & Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral sciences. Hillsdale, NJ: Lawrence Erlbaum.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (3rd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: International survey. British Medical Journal, 320, 1240 - 1243.

Department of Statistics, Malaysia. (1994). Yearbook of statistics Malaysia. Kuala Lumpur: Department of Statistics.

De With, C., Kusin, J. A., & Kardjati, S. (1985). Anthropometry of children in rural areas in East Java. 1. Cross sectional growth curves. Paediatrica Indonesiana, 25, 1 - 12.

De Knop, P., Engstrom, L. M., Skirstad, B. (1996). Worldwide trends in youth sport. In P. De Knop, B. Skirstad, L. M. Engstrom, & M. R. Weiss (Eds.), Worldwide trend in sport (pp. 276 - 281). Champaign IL: Human Kinetics.

De Knop, P., Skirstad, B., Engstrom, L. M., Theeboom. M., & Wittcock, H. (1996). Sport in a changing society. In P. De Knop, B. Skirstad, L. M. Engstrom, & M. R. Weiss (Eds.), Worldwide trend in sport (pp. 8 - 14). Champaign IL: Human Kinetics.

Demirjian, A., Buschang, P. H., Tanguay, R., & Patterson, D. K (1985). Interrelationships among measures of somatic, skeletal, dental, and sexual maturity. American Journal of Orthodontics, 88, 433 - 438.

Docherty, D., & Gaul, C.A. (1991). Relationship of body size, physique, and composition to physical performance in young boys and girls. International Journal of Sports Medicine, 12, 525-532.

Donnelly, P. (1993). Problems associated with youth involvement in high-performance sport. In B. R. Cahill & A. J. Pearl (Eds.), Intensive participation in children's sports (pp. 95 - 126). Champaign, IL: Human Kinetic Publishers.

Duke, P.M., Litt, I. F., & Gross, R.T. (1980). Adolescents' self-assessment of sexual maturation. Paediatrics, 66, 918 - 920.

Educational Planning and Research Division. (1994). A study on drop-out low achievement in selected primary schools in Malaysia. Kuala Lumpur: Ministry of Education, Malaysia.

Educational Planning and Research Division. (1989). Effective schools study: a study of the school climate in effective and non-effective secondary schools in Peninsular Malaysia. Kuala Lumpur: Ministry of Education, Malaysia.

Ellis, J. D., Carron, A. V., & Bailey, D. A. (1975). Physical performance in boys from 10 to 16 years. Human Biology, 47, 263-281.

Elnashar, A. M. & Mayhew, J. L. (1984). Physical fitness status of Egyptian children aged 9-18 years. British Journal of Sports Medicine, 18, 26 - 29.

Eriksson, B. O. (1972). Physical training, oxygen supply and muscle metabolism in 11-13- year old boys. Acta Physiologica Scandinavica, Suppl. 384.

Espenschade, A. S. (1940). Motor performance in adolescence including the study of relationships with measures of physical growth and maturity. Monographs of the Society for Research in Child Development, 5, (Serial No. 24).

Eveleth, P. B. (1978). Differences between populations in body shape of children and adolescents. American Journal of Physical Anthropology, 49, 373 - 382.

Eveleth, P. B., & Tanner, J. M. (1990) Worldwide variation in human growth (2ed). Cambridge: Cambridge University Press.

Faigenbaum, A. D. (2000). Strength training for children and adolescents. Clinical Sports Medicine, 19, 593 - 619.

Fillippson, R., & Hall, K. (1976). Correlation between dental maturity, height development and sexual maturation in normal girls. Annals of Human Biology, 3, 205 - 210.

Forbes, G. B. (1986). Body composition in adolescence. In F. Falkner & J. M. Tanner (Eds.), Human growth: a comprehensive treatise (2nd ed., pp. 119 - 145). New York: Plenum Press.

Fournier, M., Ricci, J., Taylor, W., Ferguson, R.J., Monpetit, R.R., & Chairman, B. R. (1982). Skeletal muscle adaptation in adolescent boys: sprint and endurance training and detraining. Medicine and Science in Sports and Exercise, 14,453-456.

Frisancho, A. R. (1981). New norms of upper limb fat and muscle areas for assessment of nutritional status. American Journal of Clinical Nutrition, 34, 2540 - 2545.

Geithner, C. A., Woynarowska, B., & Malina, R. M. (1998). The adolescent spurt and sexual maturation in girls active and not active in sport. Annals of Human Biology, 25, 415 - 423.

Ghesquiere, J., & Eeckels, R. (1984). Health and physical fitness of primary school children in Kinshasha. In J. Ilmarinen, I. Valimaki (Eds.), Children and sport (pp. 18 - 30). New York: Springer-Verlag.

Ghosh, B. N. (1998). Malaysia: The transformation within. Petaling Jaya: Addison Wesley Longman Malaysia.

Gopalan, C. (1992). Undernutrition: Measurement and implication. Oxford: Clarendon Press.

Gordon, C. C., Chumlea, W. C., & Roche, A. F. (1988). Stature, recumbent length, and weight. In T. G. Lohman, A. F. Roche & R. Martorell (Eds.), Anthropometric standardization reference manual (pp. 3 - 8). Champaign,IL: Human Kinetics.

Fung, K. P., Lan, S. P., Chow, O. K. W., Baber, F., Chu, S. Y., Tsoi, N. S., Lun, K. W., Chan, S. C., & Lam, T. K. (1985). A survey of growth of Hong Kong children. Hong Kong Journal of Paediatrics, 2, 105 - 116.

Grantham-McGregor, S. M., Desai, P., & Back, E. H. (1972). A longitudinal study of infant growth in Kingston, Jamaica. Human Biology, 44, 549 - 561.

Guy, J. A. & Micheli, L. J. (2001). Strength training for children and adolescents. Journal of the American Academy of Orthopaedic Surgeons, 9, 29 - 36.

Hafez, A. S., Salem, S. I., Cole, T. J., Galal, O. M., & Massoud, A. (1981). Sexual maturation and growth pattern in Egyptian boys. Annals of Human Biology, 8, 461 - 467.

Hagg, U. &, Taranger, J. (1992). Pubertal growth and maturity pattern in early and late maturers. A prospective longitudinal study of Swedish urban children. Swedish Dental Journal, 16, 199 - 209.

Hagg, U. &, Taranger, J. (1991). Height and height velocity in early, average and late maturers followed to the age of 25: A prospective longitudinal study of Swedish urban children from birth to adulthood. Annals of Human Biology, 18, 47-56.

Hale, C. J. (1956). Physiological maturity of Little League baseball players. Research Quarterly, 27, 276 - 284.

Hamill, P. V. V., Drizd, T. A., Johnson, C. L., Reed, R. B., Roche, A. F., & Moore, W. M. (1979). Physical growth: National Center for Health Statistics percentiles. American Journal of Clinical Nutrition, 32, 607 - 629.

Hanushek, E. (1999). Some findings from an independent investigation of the Tennessee STAR experiment and from other investigations of class size effects. Educational Evaluation and Policy Analysis, 21, 143 - 163.

Harrison, G. C., Buskirk, W. R., Carter, J. E. L., Johnston, F. E., Lohman, T. G., Pollock, M. L., Roche, A. F., & Wilmore, J. (1988). Skinfold thicknesses and measurement technique. In T. G. Lohman, A. F. Roche & R. Martorell (Eds.), Anthropometric standardization reference manual (pp. 55 - 70). Champaign, IL: Human Kinetics.

Haubenstricker, J., & Seefeldt, V. (1986). Acquisition of motor skills during childhood. In V. Seefeldt (Ed.), Physical activity and well being (pp. 41 - 104). Reston, VA: American Alliance for Health, Physical Education, Recreation and Dance.

Haywood, K. M. (1986). Life span motor development. Champaign, IL: Human Kinetics.

Hill, G. M. (1991). Sports specialization in the secondary school: is it a good idea? National Association of Secondary School Principals Bulletin, 75 (532), 119 - 121.

Hunt, E. E., Cocke, G., & Gallagher, J. R. (1957). Somatotype and sexual maturation in boys: a method of developmental analysis. Human Biology, 30, 73 - 91.

Hollings, S. C., & Robson, G. J. (1991). Body build and performance characteristics of male adolescent track and field athletes. Journal of Sports Medicine and Physical Fitness, 31, 178 - 182.

Iliev, I. B. (1978). Maximal aerobic power in girls and boys aged 9-15 years who participate regularly in sport. In R. J. Shephard, & H. Lavallee (Eds.), Physical fitness assessment: Principle, practice, and application (pp. 172 - 176). Springfield, IL: Charles C. Thomas.

Johnson, R. D. (1962). Measurement of achievement in fundamental skills of elementary children. Research Quarterly, 33, 94 - 103.

Johnson, B. L., & Nelson, J. K. (1979). Practical measurements for evaluation in physical education (3rd ed.). Minneapolis, MN: Burgess Publishing Company.

Johnson, K. A. (2000). Do small classes influence academic achievement? What the national assessment of the national progress shows. A report of the Heritage Center for Data Analysis, 7. Washington: Heritage Center for Data Analysis.

Johnston, F. E., Hamill, P. V. V., & Lemeshow, S. (1972). Skinfold thickness of children 6-11 years, United States. Vital Health Statistics, Series 11, No. 120. Washington, D. C.: U.S. Department of Health Education.

Jones, M. A., Hitchen, P. J., & Stratton, G. (2000). The importance of considering biological maturity when assessing physical fitness measures in girls and boys aged 10-16 years. Annals of Human Biology, 27, 57 - 65.

Kane, R. J., & Meredith, H. (1952). Ability in the standing broad jump of elementary school children 7, 9, and 11 years of age. Research Quarterly, 23, 198 - 208.

Kassim, M. S. (1989). Health status of children attending clinics in Sentul and Selayang. Paper presented at the Symposium on Role of Voluntary Organizations in Improving the Health Status in Developing Countries, 11th - 13th August, Faculty of Medicine, National University of Malaysia, Kuala Lumpur.

Katzmarzyk, P. T., Malina, R. M., Song, T. M. K., & Bouchard, C. (1998). Physical activity and health-related fitness in youth: a multivariate approach. Medicine and Science in Sports and Exercise, 30, 709 - 714.

Katzmarzyk, P. T., Malina, R. M., & Beunen, G. P. (1997). The contribution of biological maturation to the strength and motor fitness of children. Annals of Human Biology, 24, 493 - 505.

Krahenbuhl, G. S., Skinner, J. S., & Kohrt, W. M. (1985). Development aspects of maximal aerobic power in children. Exercise and Sport Sciences Reviews, 13, 503 - 538.

Kemper, H. C. G., Verschuur, R., Ras, K. G. A., Snel, J., Splinter, P. G., & Tavecchio, L. W. C. (1978). Investigation into the effects of two extra physical education lessons per week during one school year upon the physical development of 12- and 13-year-old-boys. In J. Borms, & M. Hebbelinck (Eds.), Paediatric work physiology (pp. 159 - 166). Basel: Karger AG

Keogh, J. (1965). Motor performance of elementary school children. Los Angeles: Department of Physical Education, University of California.

Krogman, W. M. (1959). Maturation age of 55 boys in the Little League World Series, 1957, Research Quarterly, 30, 54 - 56.

Letchumanan, S. (1995). Factors influencing the academic achievement of pupils in the National Type Primary (Tamil) School, Sungai Renggam, Malaysia. Master's Thesis. University of Malaya, Kuala Lumpur.

Lindgren, G. (1976). Height, weight and menarche in Swedish urban school children in relation to socioeconomic and regional factors. Annals of Human Biology, 3, 501 - 528.

Lin, K. G., & Siong, T. E. (1997). Nutritional assessment of rural villages and estates in Peninsular Malaysia: nutritional status of children aged 18 and below. Malaysian Journal of Nutrition, 3, 21 - 47.

Lohman, T. G., Roche, A. F., & Martorell, R. (Eds.). Anthropometric standardization reference manual. Champaign,IL: Human Kinetics.

McKay, D. A. (1971). Nutritional assessment by comparative growth achievement in Malay children below school age. Bulletin WHO, 45, 233-242.

Malaysia (1989). Midterm review of Fifth Malaysian Plan. Kuala Lumpur: National Printing Department.

Malaysia (1991). Sixth Malaysia Plan, 1991-1995. Kuala Lumpur: National Printing Department.

Malaysia (1996). Seventh Malaysia Plan, 1996-2000. Kuala Lumpur: Economic Planning Unit, Prime Minister's Department.

Malina, R. M. (1969). Growth and physical performance of American Negro and White children: A comparative survey of differences in body size, proportions and composition, skeletal maturation, and various motor performance. Clinical Pediatrics, 8, 476 - 482.

Malina, R. M. (1974). Adolescent changes in size, build, composition, and performance. Human Biology, 46, 117 - 131.

Malina, R. M. (1975). Anthropometric correlates of strength and motor performance. Exercise and Sports Science Review, 3, 249 - 274.

Malina, R. M. (1982). Physical growth and maturity characteristics of young athletes. In R. A. Magill, M.J . Ash & F. L. Smoll (Eds.), Children in sports (2nd ed., pp. 73 - 96). Champaign, IL: Human Kinetics.

Malina, R. M. (1986). Growth of muscle tissue and muscle mass. In F. Falkner & J. M. Tanner (Eds.), Human growth: a comprehensive treatise (2nd ed., pp. 77 - 95). New York: Plenum Press.

Malina, R. M. (1988a). Competitive youth sports and biological maturation. In E. W. Brown & C. F. Branta (Eds.), Competitive sports for children and youth (pp. 227 - 244). Champaign, IL: Human Kinetics Publisher.

Malina, R. M. (1988b). Biological maturity status of young athletes. In R. M. Malina (Ed.), Young athletes: Biological, psychological and educational perspective (pp. 121 - 140). Champaign, IL: Human Kinetics Books.

Malina, R. M. (1988c). Racial/ethnic variation in the motor development and performance of American children. Canadian Journal of Sport Sciences, 13, 136 - 143.

Malina, R. M. (1989). Growth and maturation: normal variation and effect of training. In C. V. Gisolfi & D. R. Lamb (Eds.), Perspectives in exercise science and sports medicine. Volume 2: Youth exercise and sport (pp. 223 - 265). Carmel, IN: Benchmark Press Inc.

Malina, R. M. (1994). Anthropometry, strength and motor fitness. In S. J. Ulijaszek & C. G. N Mascie-Taylor (Eds.), Anthropometry: the individual and the population (pp. 160 - 177). Cambridge: Cambridge University Press.

Malina, R. M. (1989). Growth and maturation: normal variation and effect of training. In C. V. Gisolfi & D. R. Lamb (Eds.), Perspective in exercise science and sports medicine: youth, exercise and sport (pp. 223 - 265). Carmel, IN: Benchmark Press.

Malina, R. M. (1994a). Physical growth and biological maturation of young athletes. Exercise and Sport Sciences Review, 22, 389 - 433.

Malina, R. M. (1996). The young athlete: biological growth and maturation in a biocultural context. In F.L. Smoll & R. E. Smith (Eds.), Children and youth in sport: A biopsychosocial perspective (pp. 161 - 186). Madison: Brown and Benchmark.

Malina, R. M. (1998). Growth and maturation of young athletes - is training for sport a factor?. In K. M. Chan & E. J. Micheli (Eds.), Sports and children (pp. 133 - 161). Hong Kong: Williams and Wilkin.

Malina, R. M., & Bielicki, T. (1996). Retrospective longitudinal growth study of boys and girls active in sport. Acta Paediatrica, 85 (5), 570 - 576.

Malina, R. M., & Buschang, P. H. (1985). Growth, strength and motor performance of Zapotec children, Oaxaca, Mexico. Human Biology, 57, 163 - 181.

Malina, R. M. & Bouchard, C. (1988). Subcutaneous fat distribution during growth. In C. Bouchard & F. E. Johnston (Eds.), Fat distribution during growth and later health outcomes: a symposium held at Manoir St-Castin, Lac Beauport, Quebec, June 9-11, 1987 (pp. 63 - 84). New York: Alan R. Riss, Inc.

Malina, R. M., & Bouchard, C. (1991). Growth maturation and physical activity. Champaign, IL: Human Kinetic.

Malina, R. M., Hamill, P. V. V., & Lemeshow, S. (1973). Selected body measurements of children 6-11 years. Vital Health Statistics, Series 11, No. 123. Washington, D. C.: U.S. Department of Health Education.

Malina, R. M., Little, B. B., Shoup, R. F., & Buschang, P. H. (1987). Adaptive significance of small body size, strength, and motor performance of school children in Mexico and Papua New Guinea. American Journal of Physical Anthropology, 73, 489 - 499.

Malina, R. M., Little, B. B., Buschang, P. H., De Moss, J, & Selby, H. A. (1985). Socioeconomic variation in the growth status of children in subsistence agricultural community. American Journal of Physical Anthropology, 68, 385 - 391.

Malina, R. M., & Johnston, F. E. (1967). Relations between bone, muscle and fat widths of the upper arms and calves of boys and girls studied cross-sectionally at ages 6 to 16 years. Human Biology, 39, 211 - 223.

Malina, R. M., Meleski, B. W., & Shoup, R. F. (1982). Anthropometric, body composition, and maturity characteristics of selected school-age athletes. Pediatric Clinics of North America, 29, 1305 - 1323.

Marshall, W. A., & Tanner, J.M. (1986). Puberty. In F. Falkner & J. M. Tanner (Eds.), Human growth: A comprehensive treatise (2nd ed., pp. 77 - 95). New York: Plenum Press.

Martin, A. D., Carter, J. E. L., Hendy, K. C., & Malina, R. M. (1988). Segment lengths. In T. G. Lohman, A. F. Roche & R. Martorell (Eds.), Anthropometric standardization reference manual (pp. 9 - 38). Champaign,IL: Human Kinetics.

Martin, J. C., & Malina, R. M. (1998). Developmental variations in anaerobic performance associated with age and sex. In E. Van Praagh (Ed.), Pediatric anaerobic performance (pp. 45 - 64). Champaign, IL: Human Kinetics.

Martorell, R. (1982). Nutrition and health indicators: suggestion for surveys of the standard of living in developing countries. Washington D. C: World Bank Research Center.

Meszaros, J., Mohacsi, J., Frekl, R., Szabo, T., & Szmodis, I. (1985). Age dependency in the development of motor test performance. In J. Rutenfranz, M. Rolf & K. Ferdinand (Eds.), Children and Exercise XII (pp. 347 - 353). Champaign, IL: Human Kinetics.

Micheli, L. J. (1988). Strength training in young athlete. In E.W. Brown & C. F. Branta (Eds.), Competitive sports for children and youth (pp. 99 - 105). Champaign, IL: Human Kinetics.

Miller, D. C. (1983). Handbook of research design and social measurement (4th ed.). New York: Longman.

Ministry of Education, Malaysia (1989). The Integrated Curriculum for Secondary Schools (ICCS). Kuala Lumpur: Curriculum Development Center.

Ministry of Education, Malaysia (1997). A reevaluation of the National Sports School policy. Kuala Lumpur: Sports Division.

Ministry of Youth and Sport, Malaysia (1988). National Sport Policy. Kuala Lumpur

Mosteller, F. (1995). The Tennessee study of class size in the early school grade. The Future of Children, 5, 113 - 127.

Motor Performance Study (1975). Motor PerformanceTesting: Directions for administration of tests. Unpublished manuscript, Department of Kinesiology, Michigan State University.

Must, A., Dallal, G .E., & Dietz, W. H. (1991a). Reference data for obesity: 85th and 95th percentiles of body mass index (wt/ht2) and triceps skinfold thickness. American Journal of Clinical Nutrition, 53, 839 - 846.

Must, A., Dallal, G. E., & Dietz, W. H. (1991b). Reference data for obesity: 85th and 95th percentiles of body mass index (wt/ht2)- a correction. American Journal of Clinical Nutrition, 54, 773.

Naidoo, R. B. (1999). The effects of socioeconomic status, ethnicity, and nutritional status on the growth and physical fitness of 10 year old South African boys. Doctoral Dissertation. Michigan State University.

Naughton, G., Farport-Lambert, N. J., Carlson, J., Bradney, M., & Van Praagh, E. (2000). Physiological issues surrounding the performance of adolescent athletes. Sports Medicine, 30, 309 - 325.

National Sports Council, Malaysia (1998). Talent identification and fitness testing handbook. Kuala Lumpur.

National Sports Council, Malaysia (1999). Guidelines for selection of athletes under the Talent Identification Program. Kuala Lumpur.

Neinstein, L. S. (1982). Adolescent self-assessment of sexual maturation: reassessment and evaluation in a mixed ethnic urban population. Clinical Pediatrics, 21, 482 - 484.

Nikolic, Z., & Ilic, N. (1992). Maximal oxygen uptake in trained and untrained 15-year old boys. British Journal of Sports Medicine, 26, 36 - 38.

Ohsawa, S., Kokudo, S., Kasai, N., & Okoun, K. (Eds.). (1995). Comparative study on the growth of Thai and Japanese children. Tokyo: International Medical Foundation of Japan.

Oldenhove, H. (1996). Australia. In P. De Knop, B. Skirstad, L. M. Engstrom, & M. R. Weiss (Eds.), Worldwide trend in sport (pp. 245 - 259). Champaign IL: Human Kinetics.

Osterback, L. L, & Viitasalo, J. (1985). Growth selection of young boys participating in different sports. In J. Rutenfranz, M. Rolf & K. Ferdinand (Eds.), Children and exercise XII (pp. 373 - 380). Human Kinetic Pub.

Ostyn, M., Simons, J., Beunen, G., Renson, R., & Van-Gerven, D. (1980). Somatic and motor development of Belgian secondary schoolboys. Leuven: Leuven University Press.

Pfeiffer, R. D., & Francis, R. S. (1986). Effects of strength training on muscle development in prepubescent, pubescent, and postpubescent boys. Physician and Sportsmedicine, 14, 134 - 143.

Public Health Institute (1988). National health morbidity survey: Volume II. Kuala Lumpur: Ministry of Health.

Qamra, S.R., Mehta, S., & Deodhar, S.D (1990). Physical growth in school girls: relationship to socioeconomic status and dietary intake. Indian Pediatric, 27, 1051 - 1065.

Qamra, S.R., Mehta, S., & Deodhar, S.D. (1991). A mixed longitudinal study on the pattern of pubertal growth: Relationship to socioeconomic status and caloric intake. Indian Pediatric, 28, 147 - 156.

Rampal, L. (1977). Nutritional status of primary school children: a comparative rural & urban study 1976. Medical Journal Malaysia, 32, 6 - 16.

Rarick, G.L., & Smoll, F.L (1967). Stability of growth in strength and motor performance from childhood to adolescence. Research Quarterly, 39, 295-306.

Razikin, M. (1986). Selected Malaysian secondary schools in social context: a secondary analysis of school type, student background and teacher characteristics and their influence on academic achievement. Doctoral Dissertation. Florida State University.

Ren, H. (1996). China. In P. De Knop, B. Skirstad, L. M. Engstrom, & M. R. Weiss (Eds.), Worldwide trend in sport (pp. 76 - 86). Champaign IL: Human Kinetics.

Rencher, A. C. (1995). Methods of multivariate analysis. New York: Wiley-Interscience Publication.

Roche, A. F. (1986). Bone growth and maturation. In F. Falkner & J. M. Tanner (Eds.), Human growth: a comprehensive treatise (2nd ed., pp. 25 - 54). New York: Plenum Press.

Roche, A. F., Chumlea, W.C., & Thissen, D. (1988). Assessing the skeletal maturity of the hand-wrist: Fels Method. Springfield, IL: Charles C Thomas.

Roede, M. J., & van Wieringen, J. C. (1985). Growth diagrams, 1980. Tijdshrift voor Sociale Gezondheidszorg, 63 (suppl. 1985), 1 - 34.

Sady, S, P., Thomson, W, H., Berg, K., & Savage, M. (1984). Physiological characteristics of high-ability prepubescent wrestlers. Medicine and Science in Sports and Exercise, 16, (1), 72 - 76.

Salman, N. W. (1997). Sports in Malaysia: Opportunities and barriers for women. Master's Thesis. Leeds Metropolitan University.

Sanborn, C. F. & Jankowski, C. M. (1994). Physiologic consideration for women in sport. Clinics in Sports Medicine, 13, 315 - 327.

Sarjit, J. (1989). Socio-economic environment, academic achievement and occupational opportunities in Malaysia. Educational Planning and Research Division, Ministry of Education, Malaysia.

Seils, L. G. (1951). The relationships between measures of physical growth and gross motor performance of primary grade school children. Research Quarterly, 22, 244 - 260.

Shephard, R.J. (1978). Aerobic versus anaerobic training for success in various athletic events. Canadian Journal of Applied Sport Sciences, 3, 9 - 15.

Shephard, R.J. (1982). Physical activity and growth. Chicago: Year Book Medical Publishers, Inc.

Shephard, R. J., & Lavallee, H. (1994). Changes of physical performance as indicators of the response to enhanced physical education. Journal of Sports medicine and Physical Fitness, 34, 323-325.

Simri, U., Tenenbaum, G., & Bar-Eli, M. (1996). Israel. In P. De Knop, B. Skirstad, L. M. Engstrom, & M. R. Weiss (Eds.), Worldwide trend in sport (pp. 59 - 66). Champaign IL: Human Kinetics.

Simons, J., Beunen, G., Renson, R., Claessens, A., Vanreusel, B., & Lefevre, J. (1990). Growth and fitness of Flemish girls. HKP Sport Science Monograph Series. Champaign, IL: Human Kinetics.

Slaughter, M. H., Lohman, T. G., & Boileau, R. A. (1982). Relationship of anthropometric dimensions to physical performance in children. Journal of Sport Medicine, 22, 377 - 385.

Smith, D. S., & Brown, M. L. (1970). Anthropometry in preschool children in Hawaii. American Journal of Clinical Nutrition, 23, 932 - 939.

So, L. L. (1995). Correlation of sexual maturation with stature and body weight & dental maturation in southern Chinese girls. Australian Orthodontic Journal, 14, 18 - 20.

Sobolova, V., Seliger, V., Grussova, D., Machovcova, J., & Zelenka, V. (1971). The influence of age and sports training in swimming and physical fitness. Acta Paediatrica Scandinavica, 217(suppl.), 63 - 67.

Sprynarova, S., Parizkova, J., & Jurinova, I. (1978). Development of the functional capacity and body composition of boy and girl swimmers aged 12-15 years. In J. Borms & M. Hebbelinck (Eds.), Paediatric work physiology (pp. 32 - 38). Basel: Karger AG.

Spurr, G. B., Reina, J. C., Dahnners, H. W., & Barac-Nieto, M. (1983). Marginal malnutrition in school-aged Columbian boys: functional consequences in maximal exercise. American Journal of Clinical Nutrition, 37, 834 - 847.

Stephenson, L. S., Latham, M. C., Adams, E. J., Kinoti S. N., & Perte, A. (1993). Physical fitness, growth and appetite of Kenyan schoolboys with hookworm, Trichuris trichuria and Ascaris lumbricoides infections are improved after single dose of albendazole. Journal of Nutrition, 123, 1036 - 1046.

Stevens, J. P. (1980). Power of the multivariate analysis of the variance tests. Psychological Bulletin, 88, 728 - 737.

Stevens, J. P. (1986). Applied multivariate statistics for the social sciences. Hillsdale, NJ: Lawrence Erlbaum.

Sulisz, S. J. (1996). Poland. In P. De Knop, B. Skirstad, L. M. Engstrom, & M. R. Weiss (Eds.), Worldwide trend in sport (pp. 184 - 192). Champaign IL: Human Kinetics.

Tanner, J. M. (1962). Growth at adolescence, with a general consideration of the effects of hereditary and environmental factors upon growth and maturation from birth to maturity (2nd ed.). Oxford: Blackwell Scientific.

Tanner, J. M. (1981). Growth and maturation during adolescence. Nutritional Reviews, 39, 43 - 55.

Tanner, J. M., Hughes, P. C., & Whitehouse, R. H. (1981). Radiographically determined widths of bone muscle and fat in the upper arm and calf from age 3-18 years. Annals of Human Biology, 8, 495 - 517.

Tharp, G. D., Johnson, G. O., & Thorland, W. G. (1984). Measurement of anaerobic power and capacity in elite young track athletes using the Wingate test. Journal of Sports Medicine, 24, 100 - 106.

Thorland, W. G., Johnson, G. O., Tharp, G. D., & Housh, T. J. (1988). Comparative characteristics of elite junior and senior level athletes. In E. W. Brown & C. F. Branta (Eds.), Competitive youth sports for children and youth (pp. 129 - 142). Champaign IL: Human Kinetics.

Thomas, J. R., & Nelson, J. K. (1996). Research methods in physical activity (3rd ed.). Champaign, IL: Human Kinetics.

Thomas, J. R., Lochbaum, M. R., Landers, D. M., & He, C. (1997). Planning significant and meaningful research in exercise science: estimating sample size. Research Quarterly for Exercise and Sport, 68, 33 - 44.

Tyler, C. (1981). Intramural director's guide to program evaluation. New York: Leisure Press.

Vadocz, E. A. (1999). The psychobiological profile of competitive female figure skaters. Doctoral Dissertation. Michigan State University.

Walker, A. R., Walker, B. F., Jones, J., & Kadwa, M. (1989). Growth of South African Indian schoolchildren in different social classes. Journal of the Royal Society of Health, 109, 54 - 56.

Wan Arifin (1994). Child health in Malaysia. Archives of Diseases in Childhood, 71, 452 - 456.

Weiss, C. H. (1998). Evaluation: methods for studying programs and policies. Upper Saddle River, NJ: Prentice Hall.

William, R. L., Cheyne, K. L., Houfkooper, L. K., & & Lohman, T. G. (1988). Adolescent self-assessment of sexual maturation. Effects of fatness classification and actual sexual maturation stage. Journal of Adolescent and Health Care, 9 (6), 480 - 482.

Webb, D. R. (1990). Strength training in children and adolescents. Pediatric Clinics of North America,. 37, 1187 - 1210.

Wilmore, J. H., & Costill, D. L. (1994). Physiology of sport and exercise. Champaign, IL: Human Kinetics.

World Health Organization (1992). Our planet our health, report on the WHO Commission on Health and Environment. Geneva: World health Organization.

World Health Organization (1995). Physical status: the use of and interpretation of anthropometry. WHO Technical Report Series, 854, Geneva: World Health Organization.

World Health Organization (1999). The world health report: Making a difference. Geneva: World Health Organization.

Zainal, T. A. A. (1989). A study of the academic achievement of primary school students in rural peninsular Malaysia. Doctoral Dissertation. University of California, Los Angeles.

Zauner, C.W., Maksud, M.G., & Melichna, J. (1989). Physiological consideration in training young athletes. Sports Medicine, 8, 15-31.

________ List of rural and urban areas in Malaysia. Kuala Lumpur: Department of Statistics.