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What Physical Education Teachers and Sports Trainers Should Know About Growing and Developing Young People

Michael Chia and Quek Jin Jong

INTRODUCTION

Physical Education (PE) teachers and sports trainers play significant roles in shaping young people’s attitudes towards physical activity and exercise. As professionals they must recognise that young people are not merely miniature replicas of adults. PE teachers and trainers ought to handle young people under their charge with expertise to help them achieve their full physical potential. They are expected to be knowledgeable about not just the physiological and health characteristics of youth, but also the social and psychological issues involved in teaching and training them. This article will focus on some of the pertinent physiological and health issues that PE teachers or trainers ought to know and practise when working with young people. This is important because PE teachers and trainers must practise relevant theories so that young people can benefit from effective physical activity, exercise or training. With proper guidance, they can learn to be positive about the way they perceive exercise and physical activity, and live active and healthy lives.

ENERGY PATHWAYS

PE teachers and trainers must have a working knowledge of the characteristics of the energy pathways that young people are equipped with. This will enable them to formulate and carry out appropriate physical activities or exercise regimens for young people. More importantly, they should be able to capitalise on and work with the maturing body systems, helping young people to obtain optimal physical health.

Anaerobic energy pathway

Like adults, youth derive their energy for physical activity and exercise from the food that they consume. The energy sources within the body are mainly in the form of fatty acids (from stored fat) and muscle glycogen (from stored carbohydrate within the muscle). Young people’s ability to perform brief maximal effort exercise in tasks such as sprint
running, sprint swimming, sprint cycling, rowing, jumping or throwing over a distance, are predominantly met by energy supplied via the anaerobic energy pathway. Simply explained, the anaerobic energy pathway uses mainly carbohydrate stores within the muscle (i.e. muscle glycogen) to supply the necessary energy required for brief and intense exercise (usually less than 90 seconds). This energy pathway is described as “anaerobic” because it does not require or involve the use of oxygen. Energy derived from this pathway also results in the production of an end product called lactic acid. Young people fatigue very quickly when the end product of this acid accumulates within the muscle, because this anaerobic energy pathway is less developed in young people than in adults. Young people under the age of 16 years are therefore less physiologically suited than their older peers, to perform very intense exercise that lasts between 10 and 90 seconds.

It is prudent for trainers to limit each intense exercise bout to up to 10 seconds’ duration when dealing with young people below 16 years and if interval training-type protocols are to be used. This can be followed by at least two-minute rest intervals between any repeated efforts. The two-minute rest interval between the intense exercise bouts will allow time for the acid end-product to be cleared within the muscle. Young people’s ability to tolerate or endure lactic acid accumulation (i.e. anaerobic fitness) will improve as they mature and trainers can start to increase the duration of intense exercise efforts after 16 years of age.

**Aerobic energy pathway**

Young people’s natural habitual physical activity patterns have been described as sporadic bursts of high intensity exercise, interspersed with longer periods of low-to-moderate intensity activity periods. During low-to-moderate activity periods or recovery periods between intense exercise bouts, the energy is supplied predominantly via the aerobic energy pathway. This energy pathway, uses mainly fat in the form of fatty acids to provide the energy requirements for longer periods of physical activity or exercise (from a few minutes to many hours) that are of a low-to-moderate intensity. This energy pathway is described as “aerobic” because oxygen is required for the generation of energy. PE teachers and trainers should know that the rate of energy provision via the aerobic energy pathway is about 50% of that of the anaerobic pathway, but the capacity to provide energy via the former is about 200% of the latter. In other words, young people are better able to cope with sustained exercise efforts of a low-to-moderate intensity than with very intense exercise of a brief duration. Young people’s ability to maximally utilise oxygen to provide energy via the aerobic energy pathways (i.e. aerobic fitness) improves with age as adult values are developed after puberty. In active
young people, the trainability of the aerobic energy pathway is marginal and has been estimated at less than 10%. Trainers should therefore focus on other aspects of physical education or game performance than on improving aerobic fitness per se.

**Energy pathway determinants**

Neither the anaerobic nor the aerobic energy pathways are fully mature in developing youth. Full maturity of each of the energy pathways will be achieved sometime in adulthood. In young people as well as in adults, neither pathway is exclusively used at the expense of the other. Both energy pathways help to meet the energy demands of physical activity and exercise. For example, in most variable intensity game activities such as soccer, basketball and tennis, both aerobic and anaerobic energy pathways play integral roles in meeting the energy demands of the game. During periods of brief and intense effort, the anaerobic pathway predominates whilst during more sustained periods of low-to-moderate intensity exercise, the aerobic energy pathway is the major means of energy supply. As young people mature and develop, the proportion of energy supply from each of the pathways will change. Other factors that can influence the degree of energy pathway involvement in the provision of energy in young people include the anaerobic and anaerobic fitness of the group as well as the nutritional status of the group. More information on the energy pathways can be found by accessing the web-site: [http://www.spe.ntu.edu.sg:8080/yhmchia/ENERGY1 to 3](http://www.spe.ntu.edu.sg:8080/)

**Physiological vulnerabilities of young people**

Young people are well equipped to exercise aerobically during sustained exercise (e.g. long distance running) but compared to adults, their movements are less efficient. This means that for the same distance covered, young people will expend more energy in relative terms compared with adults. However, the efficiency of movement in young people will improve as they grow and mature.

Young people also have lower reserves of power and smaller stores of muscle glycogen (stored carbohydrate within the muscle) when compared with adults. They will therefore be able to accomplish a smaller number of repeated sprints. Trainers who coach both young and older athletes in the same training session must therefore have appropriate training regimens for the two different groups of athletes. Growing youths have immature skeletons so PE teachers and trainers must be mindful during training by not having the young athletes run on very hard surfaces.

PE teachers and trainers must know that the thermoregulatory
capabilities of young people are also comparatively inferior to those of adults. For example, they perspire less than adults. Moreover, young people begin to perspire at a higher core temperature than adults. During exercise, young people have to tolerate a greater thermal load than adults. One explanation for this is that the sweat glands in young people are less sensitive and they are not yet fully mature. This makes young people more vulnerable to heat disorders than adults while exercising in the heat because there is less evaporative cooling on the surface of the skin.

In comparison with adults, young people have a larger surface area-to-volume ratio, resulting in a greater loss of body heat while exercising in cold environments. Conversely, they gain more heat when exposed to hot environments. Trainers must therefore preserve the good health of young people by not exposing them to the extremes of temperature during training or competition.

**Physiological Strengths of Young People**

In game activities that require repeated efforts of high-to-moderate intensity exercise (e.g. a counter-attack in soccer) interspersed with brief periods of active rest intervals (e.g. walking), young people recover faster than adults, and are better able to replicate their previous exercise efforts. One reason for this is that young people do not generate as much lactate as adults do during very intense exercise. Trainers can take advantage of this faster recovery of young people by organising training routines that require short periods of intense activity followed by brief but active recovery periods.

**Responsibility and Ownership for Well-being**

Young people seem to have a natural thirst for knowledge and can be encouraged to take ownership of and responsibility for their own well being. PE teachers and trainers must educate them about the importance of taking sensible precautions before, during and after exercise. This will involve teaching them how to warm up and cool down appropriately before and after vigorous physical exercise. Young people must know if the clothes are appropriate to wear during physical activities. PE teachers and trainers must also emphasize to them the importance of drinking enough water throughout the activities. This is especially important in Singapore's hot and humid weather. A simple practice that can be adopted is to weigh athletes before and after the training session. That way, young people will know quantitatively how
much fluid they have lost during training and take the appropriate measures to replenish the lost fluids.

People should not train or engage in strenuous physical activity when they have a viral infection, or when they are not feeling well. When they return to train after a period of not exercising, PE teachers and trainers must ensure that these people pick up physical activities gradually.

**AVOIDANCE OF MAXIMAL RESISTANCE AND PLYOMETRIC TRAINING**

The growth zones of the skeletons of young people are relatively more susceptible to damage. Trainers must therefore be very cautious about using maximal resistance training. Young people must avoid using very heavy resistance (i.e. resistance that they can perform for less than six repetitions), and repetitive jumping from a height onto a hard surface (i.e. plyometrics). Such strenuous exercises are best delayed until their growth spurts are virtually over (i.e. after 18 years of age).

During the accelerated growth periods that usually occur between 10 and 14 years of age, muscle endurance-type exercises (e.g. performing lightweights for 15 repetitions or more) are particularly suitable. Younger children between seven and nine years old, on the other hand, should be encouraged to use sub-maximal resistance, or proportions of their own body weight to perform various types of body weight exercises (e.g. push ups and sit-ups) for 15 repetitions or more. Trainers and PE teachers can maximise learning during this growth period by teaching and emphasizing the proper form and technique of training appropriately and safely using either light weights or body weight. As youths become older, a balanced programme of more intense resistance training can be advantageous. During this period, the muscle building hormones (e.g. growth hormone and testosterone) are particularly active and a regimen of resistance training will have an anabolic or body building effect.

**Stretching right**

PE teachers and trainers must be mindful that poor flexibility can be a cause of injuries. An imbalance between muscle strength and flexibility can result in muscle or joint injuries. Young people can be taught the correct principles of stretching and the correct type of stretching exercises to do for all major muscle groups.

Static stretching must be emphasized in preference to bouncing-type stretches as there is less chance of damage to the soft tissue and less likelihood of causing muscle soreness. The use of more advanced
stretching techniques like assisted passive stretching and proprioceptive neuro-muscular facilitation (a stretch-contract-stretch technique), can also be taught but young people must remain in control of the assisted stretching of their bodies. Sports trainers and PE teachers should avoid using contraindicated flexibility exercises (e.g. hurdler's stretch, the plough, or the cobra) but instead teach the youths safer alternative exercises. For more information on getting the most out of sports and physical activities, and avoid sports injuries, visit the web-site: http://www.spe.ntu.edu.sg:8080/yhmchia/special presentation/sports injury

SCIENTIFIC APPROACH TO TRAINING

PE teachers and trainers must understand fully the principles of training: overload, progression, specificity, reversibility, adaptability, recovery, evaluation and periodization. More importantly, they must explain training regimens to young people in terms that they can understand. This can take the form of the FITT format (i.e. Frequency-how often; Intensity-how hard; Time-how long; and Type-what type of exercise). Appropriate training regimens for young people, for the various fitness parameters using the FITT format can be found in a number of exercise physiology textbooks written for young people, e.g. Young People and Physical Activity (Armstrong and Welsman, 1997); The Child and Adolescent Athlete (Oded Bar-Or, 1996) and Developmental Exercise Physiology (Rowland, 1996).

SOUND AND SENSIBLE NUTRITIONAL ADVICE

PE teachers and sports trainers must educate young people about appropriate diet for their training and physical activity. The ideal diet is of course balanced with the right servings of each food groups-rice and alternatives (5-7 serves), fruits and vegetables (4 serves or more); meat and alternatives (2-3 serves); and dairy products and their alternatives (2 serves). Examples of what constitutes a serving for each of the food groups are available in 'My Health Workbook' (National Health Education Department, 1998) and the following websites: http://www.spe.ntu.edu.sg:8080/yhmchia/Health%20education/Basic%20nutrition/or http://www.gov.sg/moh/).

Rice and such alternatives as energy giving foods, should form the bulk of young people's diet. Eating enough fruits and vegetables will also provide the necessary vitamins, minerals and fibre for a healthy diet. Meat and alternatives are essential for muscle growth and repair as young people recover from each training session. Dairy products or their alternatives will provide the necessary calcium to help build strong
skeletal systems and will also serve as essential safeguard against the
diseases of brittle bones and osteoporosis in old age.

Trainers must advise young people to eat as soon as the training
is completed because the enzymes that synthesise the depleted muscle
glycogen are most active immediately after strenuous physical activity.
Trainers must also equip young people with the necessary knowledge
and wisdom to resist fad diets or anabolic supplements that may
endanger their health and well being.

VIGILANCE ABOUT EATING OR BODY IMAGE DISORDERS

Young people are sensitive about their own body image. Eating or body
image disorders among young people in Singapore are on the rise and
the people most at risk are females between the ages of 14 years and
25 years (The Straits Times, 1999). 90% of those affected by body image
or eating disorders are female. Many of these disorders are triggered
by familial stress and insensitive remarks about their body shape and
appearance.

PE teachers and trainers must therefore NOT make undesirable
remarks about young people’s body shape or appearance. Instead, PE
teachers must be proactive in helping young people develop a healthy
perception of their own body image. PE teachers and trainers must show
concern especially when young people lose weight drastically, even
when that helps them win sports medals. Trainers must be vigilant about
eating disorders (e.g. anorexia nervosa and bulimia) amongst young
people especially when they are involved in sports like gymnastics,
dancing and long-distance running. For more information about eating
or body image disorders, call the Singapore Association For Mental
Health at the hotline number of 1800-283 7019 or 283 1576. For more facts
on eating disorders, visit the web-site: http://www.spe.ntu.edu.sg:8080/
yhmchia/Health%20education/Eating%20disorders/

SUPPORT SYSTEMS AVAILABLE FOR PE TEACHERS AND SPORTS TRAINERS

PE teachers and sports trainers must be aware of the teaching and
coaching support programmes offered by the Physical Education And
Sports Science (PESS) Academic Group at the National Institute of
Education (NIE) and the Singapore Sports Council (SSC) to keep abreast
with the latest teaching or training information. With prior arrangement
or with research funding, the PE teacher or trainer can get young people
tested in a sports science laboratory (e.g. at PESS or SSC). The purpose
of testing young people is to identify their individual strengths and
weaknesses in physiological performance terms (e.g. strength, endurance, flexibility, power and balance). Based on such laboratory results, optimal training regimens can be designed to ameliorate those physiological weaknesses. Such laboratory evaluations will also be helpful in appraising the efficacy of the training regimens. This will help young people realise their full potential as athletes.

It is often difficult to simulate actual sporting situations in the laboratory and trainers must realise that the value of non-sport-specific laboratory tests decreases when the measured task has little resemblance to the actual sporting performance. Test apparatus that is often designed for adult use must be customised for youngsters so that the test will be appropriate. For more information about the courses offered by PESS, visit the web-site: http://www.spe.ntu.edu.sg:8080/

**Conclusion**

In conclusion, PE teachers and sports trainers must realize that young people are not miniature replicas of adults and be expected to perform like adults. Young people are less equipped than adults to handle intense exercises of short duration but they are better equipped than adults in handling intermittent-type activities. This is because young people recover faster than adults from a previous exercise session. In developing young people to be responsive to muscular endurance training, regimens involving heavy weights should be avoided until they are in late adolescence.

PE teachers and sports trainers must realise that childhood success in sport is often linked to the rate of maturation. Early maturing boys have a distinct advantage in most sports but with girls, often those who mature later are more successful (e.g. gymnasts). Trainers and PE teachers must help young people to be intrinsically motivated to exercise (by making physical activity fun and rewarding) so that without the assistance of the physical education teacher or trainer, they will persist on with exercise and stay physically active throughout adulthood. When young people are taught to comprehend the principles underlying fitness and health and are taught how to develop and be responsible for their own training regimens, they will really benefit from the teachings of their PE teachers or sports trainers.

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Both authors are currently involved in a research study that examines the impact of information technology on the physical activity patterns and physical fitness of young people in primary and secondary schools in Singapore.

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