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ABSTRACT

This document investigates the physical and psychological effects of sport-intensive training for children. The following questions are addressed as a preamble to tentative conclusions: (1) Is such training a hazard to the developing bones of the preadolescent? (2) Are there any special nutritional or thermoregulatory considerations for children in training? (3) Do growth and development benefit from training or are they impeded by such a regimen? (4) What are the psychological effects and ramifications of participation at a young age in any organized sport? and (5) What are children's norms, and how far can they drive themselves or be driven by others? The emphasis, organization, and long term benefits of much that constitutes organized children's sports today are questioned. The point is made that pressure to win in team sports is an adult creation and that the vast majority of children competing in sports are participating for the sake of having fun and not winning. (JD)

SPORTS AND THE YOUNG ATHLETE:

A FAMILY PRACTICE PERSPECTIVE

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I. INTRODUCTION

A survey of the area of pediatric athletic concerns reveals that much has been written and discussed concerning kids in sports. It has taken physicians almost twenty-five years to mature from the short-sighted, safe, smug position behind the 1956 American Academy of Pediatrics policy statement[1] opposing preadolescent competition in contact sports. As is true of much of the physicians interaction with sports, the above stance represented the classic over-reaction syndrome and conservative stance so characteristic of the medical profession. Lest the reader conclude that such thinking is a thing of the past, consider the following statement taken from an article by Sayre in 1975 ". . . a ban on competitive sports involving preadolescent children is an essential first step towards the cultural reorientation that would result in better physical and psychological adaptation of our adolescent children as well as maintaining a high level of physical activity in adulthood"[2].

Over-reaction can also be a two-edged sword, as is evidenced by this quote from a recent book entitled Growing With Sports, published in 1979, which states, "The stimuli for success in sports are parental encouragement and lots of opportunity for successful participation during childhood . . ."[3] The author asserts that neither of these statements is correct and that both have missed the important point behind children and sports. Only now are we beginning to think past the preadolescent epiphyseal plate and toward advocating sports programs for children based on opinions which have some basis in scientific fact. Hopefully, those of us interested in pediatric sportsmedicine

are past finding "fall guys", ergo the Little League, to blame for all the adult world feels is wrong with sports.

II. THE QUESTIONS

Consider if you will, some of the pertinent questions asked of today's doctors about preadolescent training regimens:

1. Is such training dangerous to the preadolescent epiphysis? In a large group of athletes suffering epiphyseal injuries, ninety-eight percent resulted in an uneventful recovery with no major medical intervention[4]. Such data then, realistically answer the above question in the negative.
2. Are there any special nutritional or thermoregulatory considerations for children in training? The nutritional requirements of the pediatric athlete vary little from those of the pediatric non-athlete with heavy growth demands dictating the rate of nutritional uptake[5]. Little in the way of special diet or special supplements are needed in any pediatric athlete as long as he eats a normal, well-balanced diet. It has been shown that the thermoregulatory mechanism of of the pediatric athlete is extremely efficient, even though the degree of sweating in a young individual is less than that in the adult[6]. The capacity to thermoregulatory remains higher in the child.
3. Do growth and development benefit from training or are they impeded by such a regimen? There is no way to accurately answer that question at the present time. Study results indicate that a normal amount of training is beneficial for growth and development, but

that excesses in exercise or lack of physical activity can have a harmful effect on growth and development[7].

4. What are the psychological effects and ramifications of participation at a young age in any organized sport? The subject of psychological effects of children in sports is too broad a subject for the scope of this paper, but definitely needs to be examined by the reader, as the question remains all too important.
5. What are children's norms, and how far can they drive themselves or be driven by others? This represents one of the least known and most potentially dangerous areas of pediatric athletics. It is a question at present that science cannot answer and that fact is most disturbing of all.
6. Can children achieve a training effect? The response to this question then, will be the central theme of this paper.

III. DIMENSIONS OF THE PROBLEM

Consider again some important facts about the exploding world pediatric sportsmedicine:

1. As seen in Table 1, there is a much wider choice of competitive sports available today to the young athlete. With the advent of new sports and new kinds of activity that are demanded by those sports, we are seeing unique kinds of injuries, different types of training, and much more participation from children in general. Table 2 shows such increased participation by children on a nationwide basis.

TABLE 1

Recognized High School Sports

	Male	Female
1971	26	14
1978	31	27

TABLE 2

High School Sports Participation
(in millions)

	Male	Female
1970	3.7	0.3
1978	4.4	2.1

2. There is much more regulation and organization by adults nowadays. This, of course, presents an opportunity for abuse by both well-meaning, and sometimes not-so-well-meaning parents and other adults.
3. In certain sports, there is an increased amount of media exposure. It is well recognized that the choice of a particular sport by a child is frequently dependent upon media emphasis. By the recent upsurge in such sports as gymnastics, soccer, ice skating, and following the 1980 Winter Olympics, speedskating and hockey is offered as evidence.
4. If one begins to look at the natural history of any sport from the moment of organization, it becomes evident that there is a step-wise progression of development. As the sport increases in popularity, the pressure to succeed in that sport increases along with it. This leads inevitably to increased intensity of training in an effort to "keep up" and excel at the sport. Of course, at some point, the "fun and games" cease and vigorous, demanding training begins. It is that change which most represents the all-important shift in a sport. The effect of that change is what we, the scientific and medical community, do not understand. We have not studied it in depth; thus, we cannot intelligently answer the question it poses.

IV. AN ANALYSIS OF THE DATA

What guidelines exist for the conditioning and training of the pediatric athlete? Extremes are very easy to point out. None of the following

examples is far-fetched, and indeed, may be commonplace. Consider the five year old who is already a veteran of several marathons, having run the twenty-six plus mile course in just under five hours. Training by this young athlete represents a commitment of sixty to seventy miles of training per week. Such devotion of time, energy, and motivation cannot be intrinsic to the psychological makeup of a five year old. More likely, there are extrinsic factors involved. At the other extreme, consider the seven year old, small for his age, slow in physical maturity, below average in motor skills development, and low in self-esteem. Research now suggest that there probably exits a minimum of exercise necessary for normal growth and development[7].

There appears to be a level of exercise stress beyond which growth can become retarded. Somewhere in between, lies a level of exercise which promotes maximal development. However, specific answers have yet to be delineated. From a preventive standpoint, it is obvious that exercise, and the habit of ongoing exercise, are beneficial to the future adult. The integration of good exercise habits should become a goal learned in childhood. We know percent body fat is lower in young adults who exercised as children. We also know that an active childhood has been shown to lead to a stronger, more supple, and sturdier adult physique. There is evidence pointing to decreased morbidity and mortality in adults who were active in childhood and continue to exercise in adulthood[7].

In this paper, the pediatric population is defined as inclusive of all children from neonates to late adolescents. Any discussion of

pediatric conditioning must be applied to a constantly changing group of individuals. Wilmore contends that the following are the basic components of conditioning: strength, power, agility, speed, and reaction time, flexibility, neuromuscular skill, and cardiorespiratory endurance[9]. The degree to which any athlete concentrates on any of these areas, depends to a great extent on the sport for which he/she is training. It is obvious that some sports will demand more of a particular component of conditioning than will other sports. It is interesting to note that a careful comparison of higher primates with Homo sapiens reveals that the very young of each species must master certain stages of fundamental motor skills - man taking considerable longer, but eventually achieving more than other high primates. On the average, it takes 4½ to 5 years of life and practicing to "break through" a proficiency barrier[10], and attain enough neuromuscular skill to begin to participate and compete in most sports. Running, perhaps because of man's tenuous origin as a relatively slow, defenseless, two-legged creature, appears to be one exception to the above statement. With this one exception, most children do not possess the neuromuscular skills to train at any sport until about five years of age. Examination of strength and power show that these two factors are intimately related to body size, physique, and muscle mass, and therefore increase with normal growth and development. They can be augmented with weight training. The factors of agility, speed, and flexibility are functions of coordination and genetics[9], but it is the component of cardiorespiratory endurance in the pediatric athlete that presents some interesting data.

Much of the work done in this area remains tentative because of the lack of studies reported with large numbers of subjects, and the paucity of longitudinal studies. Equally important obstacles have proven to be decreased accuracy of measuring the smaller physiologic parameters of a child, the use of relatively ill-fitting equipment secondary to subject size, the question of motivation in young children while testing, and finally, the constant learning component as children repeat a test over and over again. The recognized physiologic measuring stick used to estimate cardiorespiratory endurance is maximum oxgen uptake (V_{O_2} max). When measured during a treadmill or bicycle ergometer test, and then corrected per unit of body weight, height, or surface area, results have proven fascinating, if not conclusive. Older studies have shown a training effect with increases in V_{O_2} max and stroke volume, along with the decrease in resting heart rate in children [11-14]. More recent studies, however, indicate that pre-pubescent individuals exhibit little or no significant training effects [15-19]. The conclusions of the above cited recent studies are portrayed in Figure 1 by means of a schematic diagram.

It would appear that the pre-pubescent individual is already at maximum efficiency as far as his/her body is concerned, whether actively training or not. With the onset of pubescence and subsequent physiologic changes taking place, it appears that unless actively maintained, individual physical fitness, reflected by V_{O_2} max levels, begins to decline [16-18]. If this is the case, that surely would have far reaching implications in the area of pediatric sports medicine. One should then

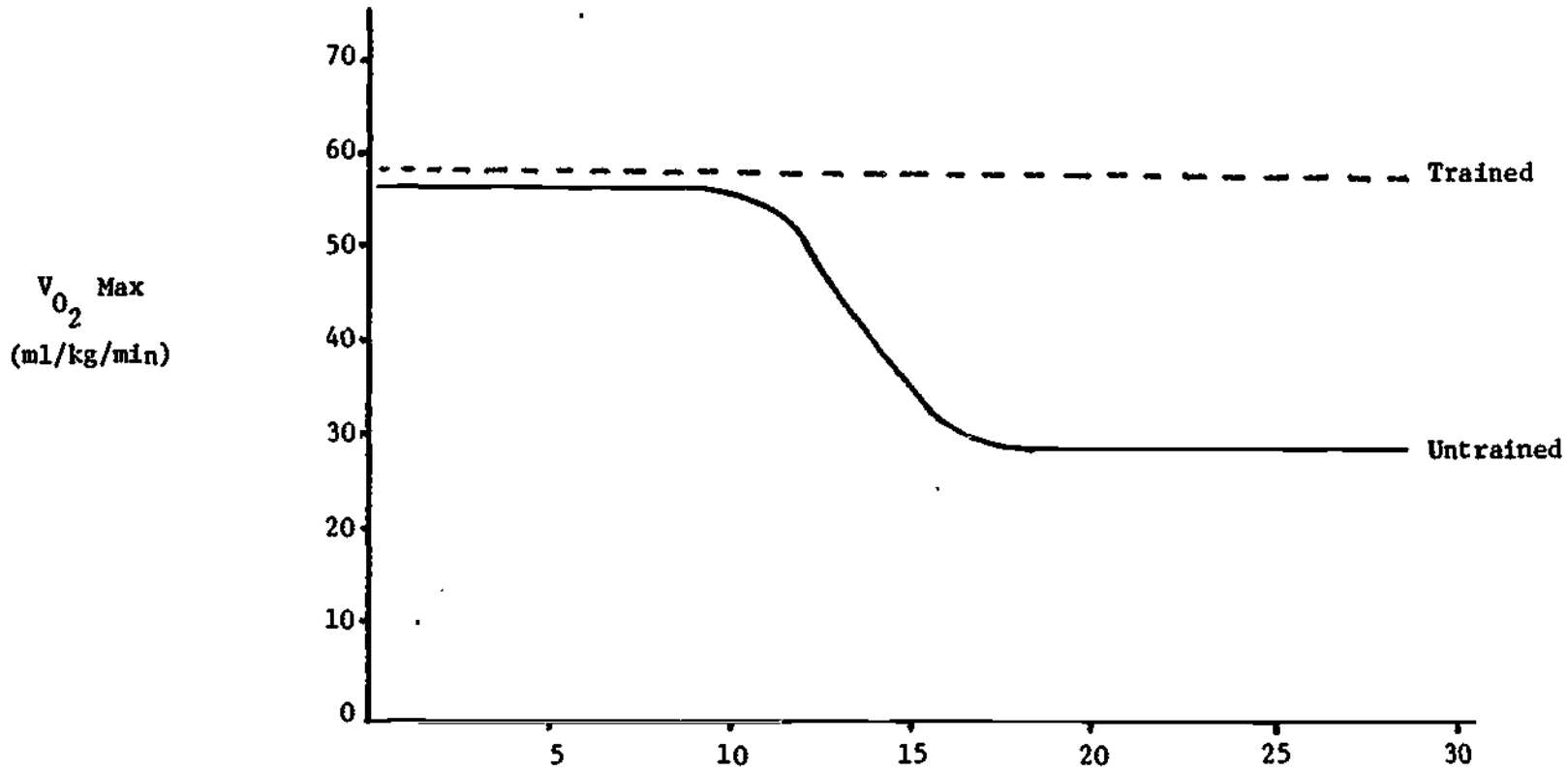

Figure 1. Schematic diagram depicting cardiorespiratory performance during childhood and adolescent years.

be able to delineate a certain age at which training could begin whose purpose would be to maintain physical fitness. The implications for pediatric sports medicine are far reaching. Application of this data would suggest that a skill proficiency, resulting from repetition, remains the only benefit derived from the long hours of practice invested by the pre-pubertal individual. However, one is unable to accurately use chronologic age as a accurate determinant of the onset of pubescense. Normal physical maturation represents a succession of events which happen in the same sequence in all individuals, but vary as to the starting point and speed with which that order of events proceeds. If one were to line up a group of thirteen year old boys from any school in the country, the vast differences in their physical maturation would be obvious. Some males may already shave and possess a small moustache; some probably have absence of body hair altogether. The phenomenon of physical maturation and its onset is not that difficult to gauge. The tool used for measurement is simple. It is the clinical evaluation of the secondary sexual characteristics of an individual. Tanner staging or physical maturity staging represents the most accurate reflection of internal bone and muscle growth[20]. The staging can be done in both male and female.

Criteria to follow when assessing Tanner staging can be found in the definitive work[20]. If a clinician becomes proficient in the use of Tanner staging, this tool becomes invaluable in the clinical application of pediatric exercise programs. The best way to examine the process of pubescent de-conditioning would be to change the

abscissa measurement on Figure 1 and refer to Tanner stages instead of chronologic years(Figure 2). Adapting training regimens to coincide with the onset of pubescense as gauged by Tanner staging would represent the most intelligent and safest means to regulate pediatric conditioning.

IV. POINTS OF CONSIDERATION

If training is sports specific, and as competition inevitably increases with increased participation,the most important question becomes, "Exactly what price are we asking our adolescents and pre-adolescents to pay for success?" The answer is unsettling; the currency with which these children pay is time - time to swim fifty to sixty thousand yards or run fifty to sixty miles per week; time to practice the motor developmental skills necessary to achieve high levels of competence in any sport. Hours of daily practice in one sport may end up limiting the child's opportunity to develop in other areas requiring other types of skills. Specialization can and often does take its toll in the development of the whole individual. While swimming thrity miles a week may not be necessary for pre-pubescent, it does indeed become essential for many post-pubertal teenagers, if a high level of excellence in competition is to be maintained.

Those of us in sportsmedicine have yet to answer our own question, "What price must be paid by our children?" Like the cost of a gallon of gasoline, this price continues to spiral upward with no end in sight. How will we as physicians respond when four hours of practice a day are not enough? At what point does the psyche of children and adolescents become traumatized? We basically have no answers for these questions

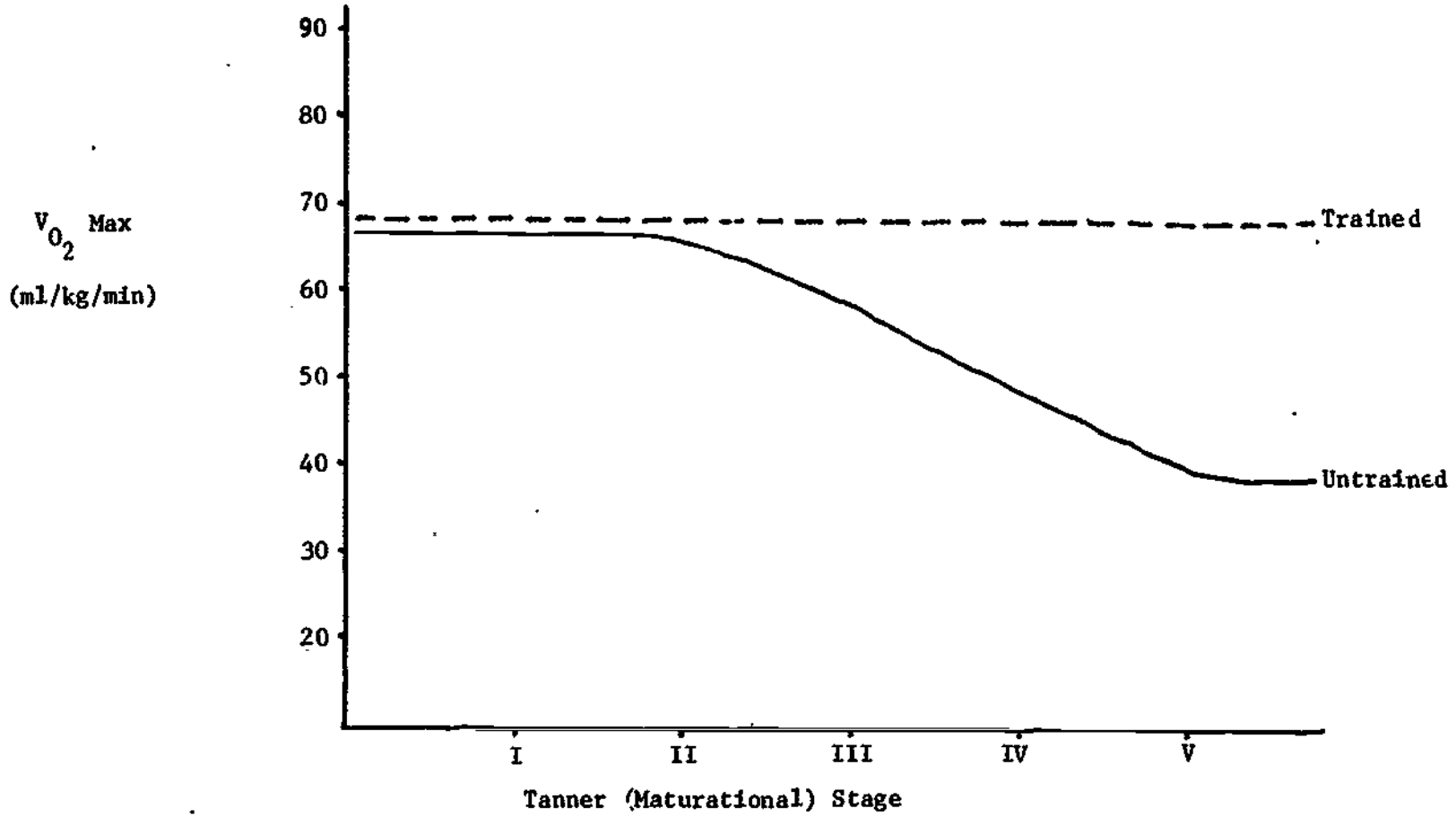

Figure 2. Schematic diagram depicting cardiorespiratory performance related to maturational stage.

and use anecdotal and outdated information in our responses.

Current athletic training regimens pose additional problems. Sports medicine has fully recovered from the thinking that gross epiphyseal injuries constitute a serious and common risk with disasterous outcomes to the pediatric athlete. We know from studies cited earlier[4] that this is not so. However, what about possible cumulative microtrauma being inflicted on these same growth plates in the adolescent gymnast, runner, or soccer player? What do we tell the young high school female runner whose present body fat is around seven percent and has primary amenorrhea, but otherwise has progressed normally through pubescence, achieving a Tanner stage of four or five?

This author questions the emphasis, organization, and long term benefits of much that constitutes organized childrens sports today. A 1977 study of over five hundred pediatric athletes clearly reveals that the pressure to win is an adult creation; that the vast majority of children competing in sports are doing it for the sake of having fun and not winning, and that most of these children would prefer to play on a losing team than to sit on the bench of a winning team[21]. The previous questions are disconcerting, not only because of the lack of any scientific data to answer them, but also because the situations they represent are becoming more commonplace in our society. We as physicians, are obviously in uncharted waters in this area of sports medicine and that is not a very reassuring feeling.

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