THE VERTICAL JUMP AS A FACTOR IN ASSESSING FREESTYLE SPRINT ABILITY IN ELEVEN AND TWELVE YEAR OLD MALE SWIMMERS

A Thesis

Submitted to the Graduate Faculty of Appalachian State University in Partial Fulfillment of the Requirements for the Degree Master of Arts in The Department of Health, Physical Education and Recreation

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ABSTRACT

Title of Thesis: The Vertical Jump as a Factor in Assessing Freestyle Sprint Ability in Eleven and Twelve Year Old Male Swimmers

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The purpose of this study was to (1) analyze the vertical jump as a factor in assessing freestyle sprint ability in eleven and twelve-year old male swimmers; and to (2) analyze a power weight training program's effect upon the vertical jump and freestyle sprint ability of eleven and twelve-year old male swimmers.

The subjects consisted of thirty-two eleven and twelve-year old male swimmers from the Greensboro North Carolina Community Swim Association (CSA). The experimental group's treatment consisted of a power weight training program. The test procedures included a pre and post-season test of vertical jump and freestyle sprint ability. Data was collected between May 30 and July 12, 1978.

Statistical analysis consisted of correlations employing the Pearson Product-Moment Method. The three groups analyzed for vertical jump vs. freestyle sprint were: all subjects (pre-test), control group (post-test) and experimental group (post-test). A t-test for correlated means was employed for the pre vs. post-test data of vertical jump and freestyle sprint. Both experimental and control group's data received this analysis.

For all subjects a correlation of -.29 was found for pre-test results. For the experimental group a correlation of -.38 was found for post-test results. For the control group a correlation of -.28 was found for the experimental group's pre vs. post-test vertical jump scores. A t - test value of 9.0 was found for the experimental group's pre vs. post-test freestyle sprint times. A value of 8.9 was found for the control group's pre vs. post-test freestyle sprint times. Mean differences for pre and post-test scores were found for all groups (see Table 4, page 29).

It was concluded from the investigation that:

1. No significant correlation was evidenced between the vertical jump and freestyle sprint ability.

2. No significant correlation was evidenced between post-test vertical jump and freestyle sprint ability.

3. Significant improvements in vertical jump and freestyle sprint times were not directly related to the weight training program.

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The cooperation of the other coaches in the Greensboro, North Carolina Community Swim Association is also greatly appreciated. Gratitude is also extended to the typist, Peggy Eller. The researcher would like to thank Sarah Ratliff for her patience. Finally, the researcher would like to thank those young swimmers and parents who gave of their time and energy to the completion of the study.

DEDICATION

This study is dedicated to Rhoda and John Edmonds, my parents. For their unfailing support and faith, the researcher would like to say thank you.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

In the area of athletic competition; decisions must be made as to who will play a certain position or participate in a certain event. Usually, an athlete decides what sport, position or event to participate in. In the same manner, a coach lets the athlete stay in that choosen position, unless a body is needed elsewhere. Some type of procedure is needed to help both the athlete and the coach. An appropriate testing procedure, along with statistical analysis, for each sport, could indicate the event an athlete should be competing in. Research related to defining factors that aid in the selection of athletes by position or event is greatly lacking.

One of the sports that appeared to need additional testing for event selection was swimming. Dr. James Counsilman, Indiana University swim coach, has an extensive ongoing investigation in the area of employing the vertical jump as a measurement of power. In the near future, Dr. Counsilman will establish norms for tests of power for various swimming age groups and both sexes. This testing of the vertical jump as a means of assessing power in swimmers has extended over the last twenty-five years.

> Results show that swimmers who have a high vertical jump score for their age and sex, make better sprinters, while those who have a low vertical jump score make better distance swimmers. Those near the norm make good middle-distance swimmers (10:123).

The researcher's interests lay in younger athletes because of the need for guidance and, directing relating to this investigation, the availability of subjects. The researcher could find no specific published data that has attempted to find a correlation between vertical jump and twenty-five yard freestyle sprint time for age group swimmers, i.e., eleven and twelve-year old male swimmers.

Subjects between ages eleven and twelve were selected for several reasons; recommendations of advisor, eleven and twelve is a recognized age group for competitive swimming and maturational development. In support of the last statement, Tihany stated:

> It is generally accepted that boys in the age range of eleven to twelve years are just entering into the puberal period. Therefore it is possible that the subjects within this age range may be more sensitive to structural changes, resulting from puberal growth and athletic training, than other age groups may be. If it is true then the individuality of the process of growth, development and maturation may well differentiate the subjects in terms of performance capacity (26:54).

For eleven and twelve-year olds, the ability to increase the vertical jump or decrease freestyle sprint times was accomplished if the swimmer's power was increased. To increase a swimmer's power an understanding of the relationship of muscle to power was needed. A muscle contains certain properties that through training allow an increase in power to take place. An important factor in the ability of a muscle to increase power was the amount of red (slow-twitch) or white (fast-twitch) muscle fiber. Physiologists have made the distinction between red (slow-twitch) and white (fast-twitch) fibers for more than one hundred years. Power is more concerned with white or fast-twitch muscle fiber. There are two types of fast-twitch fibers, namely:

> 2a (red fast-twitch fibers) and 2b (white fast-twitch fibers). Red 2a fibers contain more myoglobin than 2b and can sustain activity longer than 2b white fibers, but probably do not contract as fast as 2b fibers. White 2b fibers are historically different from 2a red fast-twitch fibers and probably contract faster, but fatigue more easily than 2a fibers (10:96).

Most physiologists support the theory that slow-twitch fibers cannot be converted to fast-twitch fibers or vice versa. The ability to increase the efficiency of both red and white fast-twitch fibers seems to depend upon the type of training undergone. It is recognized that each individual's proportion of fast to slow-twitch fibers is different and may be transferred heriditarily (1096). In this investigation that proportion of fast to slow-twitch muscle fiber will be unknown, but it was hoped that whatever percentage of fast-twitch fiber was present, the ability to produce power was improved through a power weight training program. Hopefully, through this investigation and others similar to it, a more scientific means of selecting athletes for competition was found.

Statement of the Problem

The purpose of this investigation was to (1) analyze the vertical jump as a means of assessing freestyle sprint ability in eleven and twelve year-old male swimmers, and to (2) analyze a power weight training program's ability to increase the vertical jump and decrease freestyle sprint times in eleven and twelve-year old male swimmers.

Sub-Problems

The sub-problems of this investigation included:

1. The selection of subjects and the obtaining of parental permission to test the vertical jump, freestyle sprint ability and the use of weights.

2. The selection, explanation, administration and supervision of subject's treatments and testing.

3. Coaches' instructions, plus the selection and administration of weight training locations, tests of power and dates of testing.

4. The collection of data.

5. The analysis of data.

Hypotheses

The following hypotheses were investigated;

HO_1: There was no significant correlation between the pre-season vertical jump and twenty-five yard freestyle sprint times for all subjects.

HO_2: There was no significant correlation between the post-season vertical jump and twenty-five yard freestyle sprint times for the experimental group.

HO_3: There was no significant correlation between the post-season vertical jump and twenty-five yard freestyle (sprint times) for the control group.

HO_4: There was no significant improvement in the vertical jump or the twenty-five yard sprint times for the experimental group in pre vs. post-testing.

HO_5: There was no significant improvement in the vertical jump or the twenty-five yard sprint times for the control group in pre vs. post-testing.

Definition of Terms

Aerobic: Aerobic work takes place in the presence of oxygen (2:11).

Age group swimming: Age group swimming involves categorizing swimmers by age and sex for the purposes of uniform competition and record keeping.

Anaerobic. Anaerobic work takes place in the absence of oxygen (2:11).

Circuit training: Circuit training is a method of weight lifting that requires the subject to move from station to station while performing different power exercises. These exercises are arranged so as to allow opposing muscles rest and work, while using a minimum of time.

Dorsi-flexion. To dorsi-flex the feet means to move the body.

Endurance training. Endurance training consists of continuous swimming of long distances, i.e., 400, 600, 800, 1,000. . . etc., or more yards.

Flexibility. Flexibility refers to the degree or range of movement around a joint.

Hypoxic training. Hypoxic training is a method of breathing through which certain patterns of breathing are employed (bilateral or a certain number per lap) that aid in the extraction of oxygen per unit volume ventilated.

Interval training. Interval training is a "system of repeated efforts in which a specific distance is run on the track at a timed pace, alternating with measured recovery periods of low activity" (10:103).

Maturation. The term maturation refers to the time-linked aspect, the process of development represented by progressive, qualitative and functional changes in tissues and systems toward adult status (25:4).

Maximum lift. A maximum lift will be that amount of weight with which a subject can only execute one repetition.

Motoneurons. Motoneurons are nerve fibers that carry impulses from the central nervous system to muscles and glands.

Myoglobin. Myoglobin is an iron-porphyrin protein in red muscle fibers that stores oxygen in combination with hymoglobin in the blood.

Overload principle. The overload principle involves the muscles being loaded beyond previous requirements. Progressive resistance is applied, meaning that the muscles must work against a greater resistance.

Plantar flexion. To plantar flex the feet means to move the toes away from the body.

Power. Power may be identified as the ability to release maximum force in the fastest time (17:80).

Rate. The rate is a final amount of a certain measurement, i.e., distance or time.

Repeat training. Repeat training involves for repetitions, longer rest periods and high quality swims, i.e., 20 rep x 50 yds. - 30 sec. rest at 90% effort (10:86).

Repetitions. One repetition involves a full completion of the particular weight lifting motion.

Resistance. Resistance is active opposition to motion, trying to overcome a force - in this case an amount of weight offers the resistance.

Sets. Sets equal the number of separate groups of repetitions.

Sprint training. Sprint training involves an all-out effort for short periods of time (10:85).

Sub-maximal lift. A sub-maximal lift for this study is a lift of between fifty and seventy percent of the maximum lift.

Vertical jump. The vertical jump is a means of measuring the power of the legs. For this investigation the jump and react method was employed, i.e., from a crouch position, jump without stepping and reach as high as possible.

Viscosity. Viscosity is a property of fluids that causes them to resist flowing. It is caused by internal friction from the fluids molecules moving against each other (28:332).

Weight training. Weight training is a series of physical activities deliberately planned and carried out and a mental attitude deliberately cultivated for the purpose of increasing efficiency in a given activity (24:41).

Basic Assumptions

The researcher assumed the following to be true:

1. The vertical jump was a reliable, valid and objective measure of overall power.

2. For Elks Club team members, any improvement in vertical jump was due to treatment.

3. For Elks Club team members, any decrease in sprint times was due to treatment.

4. Each subject gave a maximal effort during both pre and post-training.

Delimitations

The study was delimited to:

1. Eleven and twelve-year old male swimmers from the Greensboro North Carolina Community Swim Association.

2. Two pre and post-season tests of vertical jump and twenty-five yard freestyle ability. The experimental (Elks Club) underwent a power weight training program.

3. The swim season, May 30 through July 15, 1978.

4. Specific training programs for Elks Club members.

5. The Elks Club pool and facilities for testing purposes.

All testing took place in Greensboro, North Carolina.

Limitations

The investigation was limited to:

1. The lack of control over repairs to the pools, which delayed in-water practice by two weeks.

2. The delay in use of club weights in the morning because school was not yet dismissed.

3. The lack of control over subject's presence at practice and treatment sessions.

4. The length of the weight training program was shortened to only five weeks.

5. The lack of cooperation on the part of some league coaches, because the subject's school was still in session.

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter presents a review of research relevant to the investigation. The chapter has been divided into four sections. The first section briefly discusses the history of power measurement in the United States. Section two involves literature concerning the different types of muscle fibers, i.e., red and white, section three discusses the vertical jump and other measures of power, and the effects of different training programs employed to increase power and, the final section summarizes the entire chapter.

A Brief History of Measurement in Physical Education

From the beginning of time, man has needed power to survive. The combination of strength and speed enabled man to either allude or kill enemies and catch food to eat. The law of the land was kill or be killed and, thus, throughout the development of civilization, the smartest, swiftest, and strongest survived. Early measurements of power were determined by the size of one's army. Individual measurements of power took place in games or physical feats, the most famous being the ancient Olympic Games.

In the United States, much of the early colonial energies were directed toward survival. Early physical education in this country was patterned after European systems, especially the German and Swedish (8:1). They placed a great deal of emphasis on the total body, as did the Greeks.

> Physical education in the United States has a long history in the measurement of physical and motor traits, extending well over a century in time. Between the Civil War and World War I, pioneered by physicians who believed in exercise as preventive medicine, tests intended to measure aspects of physical fitness were dominant, as physical fitness was the primary objective during this period. The earliest form of testing was anthropometry, based upon the theory that emphasis should be placed on bodily symmetry and proportion, the ancient Greek ideal. With the invention of dynamometers in France and England during the nineteenth century, testing the strength of muscles rather than their size was introduced (8:1).
>
> Until the 1900's, people thought strength test practices would make you muscle bound. So tests of general ability, which emphasized running, jumping and throwing were devised. Here again, Sargent did pioneer work and in 1901 devised a test in the nature of six simple exercises which were continued for a period of thirty minutes without rest and in which the survivors were considered to be efficient physically (5:35).

After World War I, people became more interested in games and sports, and with this came the development of measures of motor ability. Some of these tests are the Brace Motor Ability Test (1929), a revised version of the former by McCloy called the Iowa Brace Test (1931), and the Johnson Motor Educability Test (1932).
Physical educators became concerned with the skills involved in the activity and how to improve these skills. Other areas of interest were: agility, balance, flexibility, power, endurance (muscular and cardiovascular) and strength. More sophisticated research in physical education was continuing, with increased emphasis upon specificity of skills taking precedence.

Power is one area that a great many coaches have an interest and specifically in sprint swimming more research is needed. An investigation of the sources of power was the next area of interest to the reader.

Influences of Red and White Muscle Fibers

A muscle must contain certain properties that enable the performance of varying tasks. The properties of the muscle that facilitate an increase in power, needed to be isolated and investigated more closely.

Early scientific investigations were the first steps to understanding the muscle.

> Renee Descartes (1596-1650) who contributed a mechanical explanation of the nervous system in terms of animal spirits conveyed through nerves to muscles. Gian Alfonso Borelli (1608-1679) was among the first to explain scientifically the causes of muscle action, a process which ascribed to fermentation. He did not explain the physiochemical reactions, but he did assume the involvement of complicated chemical reactions. Luigi Galvini (1737-1798) discovered that an electric current could elicit muscle contraction added important knowledge to the physiology of contraction (21:11).

These scientists led the groundwork for the investigation of muscular contraction.

This investigation was concerned with muscles of locomotion or striated muscle tissue. A striated muscle is made up of elongated mutinuclear fibers enclosed in a delicate sarcolema and marked by transverse dark and light bands that persumably indicate differing physical or clinical states (15:2261). Under the microscope it is noted that the individual cells of striated muscle tissue are relatively long and thin, and for this reason are generally designed as fibers (7:66). Striated muscle is frequently made up of different quality, its "pale" constituents reacting more rapidly than its

Gutmann and Syrevy (1967) and Guth (1968) found that the small motoneurons innervate few, slow muscle, and the large motoneurons contact many fast fibers. There have been studies that indicate there may be more than just two classifications of muscles. Bernard, Edgerton and Peter (1970) found these categories: fast-twitch red, fast-twitch white, slow-twitch intermediate and slow-twitch red. It has been stated that, even grossly red fibers may be fast-twitch (20:126).

Dr. John P. Kalas, Pathology Chief at West Volusia County Hospital, Florida feels that one should not generalize muscle fibers by color. One cannot infer that just because a fiber is white it is a fast-twitch fiber, or that a red fiber is a slow-twitch fiber is a slow-twitch fiber (18:3). According to Kalas, the two main fibers (red and white) are combined in many different ways, so one cannot classify muscle as either red or white fibers.

> Remember, literally nothing is known about white and red muscle distributions in humans. I would like to reemphasize that there is no clear distinction between fast-twitch (white) and slow-twitch (red) muscle fibers in men. For some coaches and physical educators to say there is a difference, and in turn train athletes according to these differences, only means that they have over-interpreted the histochemical studies that have been used to clarify white and red fibers (18:5).

Dr. A. J. Buller suggests that it is the nerve fiber innervating the muscle fibers that determines whether the motor unit is fast or slow-twitch (6:437).

Motorneurons act upon the muscle fiber and cause a contraction of that muscle. One explanation of the influence of motoneurons on muscle speed would be that it is due to the frequency of impulse discharge: the contraction time of a slow muscle is accelerated when subjected to the high frequency discharges from fast (phasic) motoneurons, while a slowing of contraction time ensues when a fast muscle is subjected to the relatively slow frequenciea of discharge from tonic (slow) motoneurons (6:431). Beck employed surgical attachment of a red muscle to a white tendon which resulted in a reduction of myoglobin content and decrement in endurance. It appears in this example that the function of a muscle determines its chemical structure (21:17). In an experiment by Buller, a cross-union of nerves was completed on kittens. Some of the findings in that study included: when a nerve from fast or phasic motoneurons has been made to innervate a slow muscle, the muscle is transformed to a fast muscle, even in the adult; likewise, slow or tonic motoneurons convert fast muscles to slow (6:437). It is thought that some substance passes through the slow motoneurons, crosses neuromuscular junctions and converts the muscles to slow units; the same process is probable in the fast motoneurons.

The part of the nerve endings play in muscle contraction is a little more clear. The use of fast and slow-twitch muscles needs further investigation. Most highly specialized muscle fibers are pale, non-granular and clearly striated; such fibers are assumed to be differentiated for rapidity of contraction (22:7). Earlier, the oxygen attracting myoglobin was referred to endurance; here Ricci states:

> Because of high oxygen affinity, red muscles are capable of much great endurance than are the white muscles. Generally, flexor muscles possess a preponderance of white fibers. Muscles of this type are characterized by speed of contraction rather than by magnitude of exerted tension. In the 1930's Kruger found a difference in muscle fibers length of responses and the motor nerve terminals also differed (21:17).

The consensus of literature was that there is a difference between red and white muscle fiber. What causes the different contractile speeds is still in question. The need to relate different measures of power and increase the body's efficiency in power movements is the main interest of this study.

The Measurement of Power

The term "muscular power" has had common usage to indicate the ability to release maximum muscular force in the shortest possible time. The tests widely used involving the leg musculature are the vertical and standing broad jumps (8:10). These two are not pure power tests; this is a test which eliminates use of the arms and a set takeoff position.

This study employed jump and reach tests to measure the vertical jump. Using a factor analysis, Wendler (1938), and Phillips (1949) found the standing broad and vertical jumps significantly related to strength and velocity. Scoring the vertical jump simply as distance is considered a relative power test (8:19). Considering coordination of movement in eleven and twelve-year old boys, the vertical jump appeared to be the appropriate measure of power.

The only study found relating vertical jump to swimming was by Counsilman. In his findings he stated, "I have measured the vertical jump of hundreds of swimmers and have found there is a positive correlation between the height a swimmer can jump and his sprinting ability" (10:94). Other measures of power are the power level (14:202), the standing broad jump, and the vertical power jump (16:44). From studies regarding weight training and its effect on altering vertical jump performance, it was shown by Brown, Capen and Ness that programs of progressive resistance exercise increased jump performances by 6.2 to 8.2 cm. (3:432). Karpovich stated that as recently as 1951, no research had been conducted specifically related to the problem of overload training and its effect on speed of movement (13:6). In a study by Berger (1963), it was found that groups that trained dynamically improved significantly more in vertical jump from the group that trained statistically or trained by jumping vertically. A significant increase in static strength does not guarantee an improvement in vertical jumps ability (4:423).

Several studies concluded that static and dynamic training were not significantly different in capacity to increase strength (Asmussen, Darcus and Salter).

For the jump and reach and chalkboard jumps, Considine found the standard deviation and reliability to be very similar. He also found a correlation coefficient of .89 between these same two jumps (9:411). L. W. Sargent (1924) and C. H. McCloy (1932), postulated that the vertical jump was a measure of the ability of the body to develop power (1:1). Clayton Williams conducted a similar study consisting of: Group A -- arm and shoulder exercises; Group B -- leg exercises; and Group C -- a combination of both A and B exercises. His weight training program lasted six weeks, three periods a week. It was concluded that both Group B and C exercises will produce an increase in vertical jump ability (29:iii). For the factor only Group B exercises should be used but for overall performance use Group C exercises (29:iv).

Other training methods that could be employed are isometrics, the nautilus program and one that Counsilman highly recommends, isokinetic exercises. He stated:

> The ideal form of exercise would be one in which the force that the muscle worked against would change as the muscle's capacity to create force changed. In this manner the muscle would always be working against maximum resistance through its full range of movement. This type of exercise has recently been developed and it is referred to as isokinetic exercises (10:115).

Summary

The review of literature has revealed that, although numerous studies have been completed on both tests of power and the effects of weight training on power, specific research relating directly to swimming is lacking. However, the conclusions contained in this literature indicate that the vertical jump is a good measure of power, and that weight training will increase power, i.e., sprint swimming and jumping ability.

CHAPTER III

PROCEDURES

Selection of Subjects

The selection of subjects and the gaining of parental permission to test the vertical jump, freestyle sprint ability and the use of weights was sub-problem number one. Eleven and twelve-year old male swimmers from the Greensboro, North Carolina Community Swim Association (CSA) were subjects. Subjects came from mainly middle to upper-middle class families. The range of ages for the subjects was from 12.9 to 11.1 years. The range of swimming experience for the subjects was from 7.0 to 11.0 years. For more specific information see Table 4 and Table 5, pages 29 and 30.

Contact with subject's coaches was initiated at a pre-season CSA meeting, where the investigators procedures were explained and coaches cooperation solicited. Arrangements were completed to meet with each participating team, explain procedures and distribute permission sheets to subjects. The parents of each subject were given a permission form, which was to be signed and returned before any testing could begin (see Appendix B, Forms 1 and 2 pages 48 and 49).

Selection and Administration of Treatments and Tests

The selection, explanation, administration and supervision of subjects, treatments and testing was sub-problem number two. The jump and reach method of testing for the vertical jump was employed for both pre and post-tests. A twenty-five yard freestyle sprint was employed as the pre and post-swimming test. Both tests were selected because of adaptability in ease of execution and appropriate distance for eleven and twelve year old male swimmers.

<u>The Jump and Reach Test</u>

The jump and reach test was conducted in the following manner: The subject stood in a comfortable position with feet approximately shoulder width and had the dominant hand side facing the wall. With chalk dust placed on the middle finger of the dominant hand, the subject reached as high as possible. While keeping both feet flat on the ground, subjects made a mark on the chalkboard. The subject rechalked and then assumed a squating position. The subject then moved the arms in a swinging motion, jumped as high as possible and made another chalk mark on the board. All subjects were allowed two practice jumps, then three trials were taken and the best jump was recorded. A tape measure was attached to the chalkboard and subjects were told to touch the board as near to the tape as possible. The number of inches between marks on the board was measured to the nearest half inch. Equipment included: a chalkboard, a tape measure, chalk dust, a ladder and a ruler. Subjects dressed in shorts and no shoes. The test procedure was the same during post-testing.

The Weight Training Program

The experimental groups (Elks Club subjects) treatment (power weight lifting) was done in the following manner. The first week of the treatment consisted of basic conditioning exercises, flexibility movements and endurance swimming. From then until three days before post-testing, the experimental group lifted weights three times a week. Subjects had at least one day of rest between treatment workouts.

Through the treatment (power weight lifting), it was anticipated that a muscle's forceful contractile ability could be improved. The treatment consisted of submaximal lifts, low repetition, high speed contractions, and the overload principle. Circuit training was the specific method of dryland exercises that was employed in this study. The arrangement of the circuit stations was such that the intended factors (sub-maximal lifts, low repetitions), rest of opposing muscle groups and the overload principle that aid in the improvement of power were facilitated. This method of training was employed because (1) its procedures tend to facilitate an improvement in power (Capen, Chui, Darling, Garth) and; (2) the time, space, type of facility and convenience involved. The general concept of power weight lifting was to find a maximum weight for each exercise and perform the prescribed submaximal lifts.

To determine the correct amount of weight for the treatment, each subject found a maximum lift for each exercise. The exercises were performed in a controlled manner; as demonstrated by the researcher. The exercise of stations were: the bench press, jumping quarter squats, supine straight arm pullovers, bent knee sit-ups, elbow extensors, rowing, toe raises, leg raises, latissimus pulls and arm rotators. For a description of each individual exercise, see Appendix A, page 44. The following is a list of the main muscles employed in the propulsive phase of swimming movements:

1. Arm Depressor: (The latissimus dorsi, pectoralis major, teres major, and long head of the triceps). These muscles pull the arm through the water. They can be tested and strengthened by doing the supine pullover.

2. Arm Medial Rotators: (Pectoralis major, latissimus major, teres major and subscapularis). These are almost the same as the arm depressors, but they are used in a slightly different manner. They rotate the upper arm medially, and it is necessary for these muscles to be strong if the swimmer is to maintain the high-elbow position so desirable during the first part of the arm, pull of all four competitive strokes.

3. Elbow Extensor: (Triceps). This is the muscle that extends the elbow during the last half of the arm pull in the crawl, butterfly and backstroke. A strong triceps enables the swimmer to finish the last half of his arm stroke with a strong pushing action (10:117).

Each subject proceeded through the circuit program until three sets of each exercise were completed. The percentage of the maximum lift for each exercise followed this order: first set, 50 percent of max.; second set, 60 percent of max.; and third set 70 percent of max. Subjects attempted to do five repetitions per set. Each Friday subjects reviewed their results to see if the maximum has increased, and if so, adjust the weights accordingly. Sit-ups were progressively increased in numbers. Subjects were instructed in spotting techniques and safety factors concerning the weight room.

The Aquatic Training Program

The aquatic training completed by the experimental group (Elks Club) included the following areas: endurance, interval, repeat, sprint and hypoxic training (see definitions for more specific information concerning the terms). All of these techniques were employed during the swimming season. Training was interwoven, moving from quantity (endurance) to quality (speed) as the city championship meet drew near. For a sample of daily workouts, see Table 1 , page 24.

Location and Dates of Testing

The location and dates of subjects testing and the coaches instructions was sub-problem three. The Elk's Club was the site of the vertical jump and freestyle sprint testing. The Elk's Club was the site of the experimental group's weight training program. The pre-season vertical jump and twenty-five yard freestyle sprint tests were administered between May 30 and June 2 during the first week of the season. The post-season procedure for the same tests took place during the week before the city championship meet, July 10 - July 12. The experimental group began the weight training program one week after the first practice session, June 5. The weight training program ended two days prior to post-season testing, July 10. (All testing was completed in 1979.)

TABLE 1

ELKS CLUB SWIM TEAM TRAINING PROGRAM (SAMPLE MORNING AND EVENING WORKOUT)[a]

	A.M.	P.M. (4-5 workouts per week)
	Stretching*	Stretching
	400 yd. free warm-up	400 yd. warm-up
	200 yd. pull	4 x 50 kick
Monday Wednesday Friday	200 yd. kick	4 x 100 free on 1 min. 45 sec.
	4 x 200 free on 3 min.	4 x 100 I.M. on 2 min.
	2 x 200 I.M. on 4 min.	4 x 25 on 30 sec.
	Hypoxic training, bilateral breathing	4 x 25 on 1 min.
Tuesday Thursday Saturday	Stretching* Weight training program	

[a]The researcher considered the individuality of each swimmer as it applied to the workouts. The above are only samples of the possibilities for workouts; stroke, distance, frequency and amount will depend upon individual needs and nearness to city meets, Each subject participated as often as possible.

*Stretching was mandatory before all workouts.

Each coach instructed team members not to participate in any other athletic programs during swim season. Control group teams did not include lifting weights in the training program. All control group coaches kept a daily log consisting of training methods, number of hours and practices in which eleven and twelve-year old male swimmers participated.

The Collection of Data

The collection of data was sub-problem number four. A swimming data form was employed to record each subjects name, age, date of birth, past swimming experience and present team. The pre and post-measurements of the vertical jump and freestyle sprint were also recorded on this sheet. All subjects performed the pre-vertical jump and pre-freestyle sprint between May 30 and June 2. Two trials and three actual vertical jumps were allowed during testing periods. One twenty-five yard freestyle sprint time was recorded at both pre and post-testing periods. Only the experimental and control groups participated in the post-testing periods. All data was then compiled into separate forms to facilitate the analysis of data. For raw data see Appendix F, page 56.

The Analysis of Data

The analysis of data was sub-problem number five. The comparisons between vertical jump and freestyle sprint times were analyzed through the Pearson Product-Moment Method The pre vs. post values for vertical jump and freestyle sprint times were analyzed through $\underline{t}$ - tests. Means were found for vertical jump, freestyle sprint, subject ages and swimming experience. Both Pearson Product and $\underline{t}$ - tests were computed at the .01 level of significance.

CHAPTER IV

RESULTS AND DISCUSSION

Thirty-two male swimmers from eight teams in the Greensboro, North Carolina Community Swim Association served as subjects. The test items were the vertical jump and a twenty-five yard freestyle sprint. The experimental group's treatment consisted of a power weight training program, a flexibility program and specific swimming programs. The control group's training was similar to the experimental group, except for the exclusion of a weight training program. Data were analyzed through the Pearson Product-Moment Method, and t-tests.

Correlation Results for Vertical Jump and Freestyle Sprint Scores

For all subjects a correlation of -.29 was found for the vertical jump in comparison with freestyle sprint times. For the experimental group, a correlation of -.38 was found for the vertical jump in comparison with freestyle sprint times. For the control group a correlation of -.28 was found for the vertical jump and freestyle sprint times. This information can be found in Table 3, pag3 28.

TABLE 2

DESCRIPTIVE STATISTICS OF COEFFICIENT OF CORRELATION
FOR UNGROUPED SCORES USING THE
PEARSON PRODUCT-MOMENT METHOD
VERTICAL JUMP VS. FREESTYLE SPRINT

Group	Test	N	df	r	p
All subjects	Pre	32	30	-0.29	0.449
Experimental	Post	7	5	-0.38	0.874
Control	Post	18	16	-0.28	0.590
Year-round	Post	9	7	-0.50	0.798

*significant at .01 level

t - Test Results for Comparisons of Pre- and Post-Test Scores

A t - test value of 5.0 was found for the experimental group after a comparison of pre and post vertical jump scores. A t - test value of 11.4 was found for the control group after a comparison of pre and post vertical jump scores. A t - test value of 9.0 was found for the experimental group after a comparison of pre and post freestyle sprint times. A t - test value of 8.9 was found for the control group after a comparison of pre and post freestyle sprint times. This information can be found in Table 3, page 28.

TABLE 3

t - TEST VALUES FOR COMPARISONS OF PRE AND POST-TEST SCORES
VERTICAL JUMP VS. FREESTYLE SPRINT

Group	Test	N	df	t	p
Experimental	Vertical Jump	7	6	5.0*	3.71
Control	Vertical Jump	18	17	11.4*	2.90
Experimental	Freestyle Sprint	7	6	9.0*	2.71
Control	Freestyle Sprint	18	17	8.9*	2.90

*significant at .01 level

Mean Results for Pre and Post-Test Scores

Mean differences were found for all subjects, experimental, control and year-round swimming groups. Vertical jump differences were: 1.4, 2.1, 1.6 and 1.8 inches respectively. Freestyle sprint differences were: -1.8, -1.9, -1.7 and-1.5 seconds respectively. This information can be found in Table 4, page 29.

TABLE 4

MEAN DIFFERENCES FOR PRE AND POST-TEST SCORES
VERTICAL JUMP AND FREESTYLE SPRINT

Group	N	Vertical Jump (in.)			Freestyle Sprint (sec.)		
		Pre	Post	Diff.	Pre	Post	Diff.
All subjects	32	12.6	14.0	1.4	18.2	16.4	1.8
Experimental	7	12.1	14.2	2.1	17.2	15.3	1.9
Control	18	12.6	14.2	1.6	18.3	16.6	1.7
Year-round	9	12.2	14.0	1.8	16.6	15.1	

Age and Experience Results for All Groups

The range of the subjects age's was from 11.1 years to 12.9 years, with a mean age of 11.5 years. The range of the subject swimming experience was from 1.0 to 7.0 years, with a mean experience value of 3.1 years. This information can be found in Table 5, page 30.

TABLE 5

MEAN AND RANGE VARIATION OF SUBJECTS' AGE AND EXPERIENCE

Group	N	Range		Mean	
		Age	Experience	Age	Experience
All subjects	32	11.1-12.9	1.0-7.0	11.5	3.1
Experimental	7	11.2-12.2	1.0-5.0	11.6	3.0
Control	18	11.1-12.9	1.0-6.0	12.0	3.1
Year-round	9	11.1-12.9	1.0-7.0	11.7	3.7

Discussion of Results

The investigation indicated that the vertical jump was not a significant factor in assessing freestyle sprint ability in eleven and twelve-year old male swimmers. The low correlation of -.29 for a pre-test of vertical jump vs. freestyle sprint did not concur with Counsilman's opinion (see Appendix G, page 58).

This perhaps can be explained by the fact that there were only thirty-two subjects for the entire investigation. Counsilman's opinion that a positive correlation between vertical jump and sprinting ability was based upon thousands of cases, and that opinion did not indicate if the correlation was significant (see Appendix G, page 58).

Low correlations of -.38 and -.28 were found for the post-test vertical jump and freestyle sprint. Again, perhaps this can be explained by the small number of subjects. The higher correlation for the experimental group (-.38) might be attributed to a more regimented training program, and specifically to a power weight training program. The negative correlations were expected because of the inverse directions taken by improvements in the vertical jump and freestyle sprints.

The greatest factor influencing correlation results was the fact that 72 percent of the subjects only swam during the summer season (see Table 5, page 30).

This might explain the similar poor pre-test scores and equally similar good post-test scores. In year-round swimmers perhaps longer periods of training eliminated this factor. A correlation of .50 indicated some additional factors affecting the results.

For this investigation, all t-test values investigated were found to be significant at the .01 level. Both experimental and control group's were significant, which indicated that the weight training program was not the only factor affecting improvement in the vertical jump and freestyle sprint. A five week weight training program was not long enough to effect only the experimental group. A weight training program conducted over a period of eight weeks or longer might produce a significant difference in only the experimental group. Other possible factors were: number and length of practices; flexibility exercises; specific aquatic training (interval, hypoxic . . .); and motivation. Any or all of these factors might have had an effect upon test results.

Mean differences for pre and post-test scores ranged from 1.4 to 2.1 inches for the vertical jump and 1.5 to 1.9 seconds for the freestyle sprint. The experimental group improved the greatest amount in both sets of results. This perhaps could be explained by the use of a power weight lifting program.

Subjects ranged in age from 11.1 to 12.9 years and in swimming experience from 1.0 to 7.0 years. The mean age of 11.5 years for all subjects was more indicative of a similar group. Mean years of swimming experience were almost identical, which supports the earlier statement concerning the effect of factors upon performance. Even though year-round swimmers had at least one-half year more experience than all other groups, vertical jump results were quite similar. The experimental groups freestyle sprint times were much faster than either all subjects or the control group's, but quite close to the year-round times. This might be attributed to the fact that three experimental subjects were year-round swimmers, including the fastest of all the subjects, by a full second.

Variables that could have affected test results were beyond the researcher's control. A two week delay of in-water training was caused by the failure and repair of pool filter pumps. This delay caused a speeded-up training sequence that might have affected the experimental group. Waiting for school caused a delay in the beginning of the weight training program. The researcher could only secure the club's weight room from 10 to 11 a.m., and school did not conclude until 3:00 p.m. This delay lasted for about one and one-half weeks. A certain lack of cooperation from some coaches had the direct result of fewer subjects. A lack of control over the experimental group's practice attendance might have affected test results. Examples of missed practices were: vacation, sickness and leaving with car-pools. The latter was especially a problem on weight training days (Monday, Wednesday, Friday). Only the eleven and twelve-year olds were required to stay and parents had to make sacrifices to aid the investigation.

For this investigation the small number of subjects, training effects and additional variables all could have contributed to the improvements in test results. Counsilman agreed:

> With so many variables present among age-group swimmers, I believe it is necessary to have thousands of cases on record before we can draw any valid conclusions, but I am willing to go out on a limb somewhat as to my opinion as to the results. This is what I meant when I say that I believe there is a positive correlation between the height a swimmer can jump and his sprinting ability (see Appendix G, page 58).

In both tests for the experimental group, the Hawthorne effect cannot be passed over as a possible factor in the improvement. Possible elimination or reduction of this variable might take place by increasing the number of jumps and sprints to such a point, that the subjects almost become bored with the idea of a weight-training program improving jump and sprint ability, so this process will occur naturally.

The results of this investigation revealed that basic swimming programs, with or without a weight training program resulted in the improvement of vertical jump height and freestyle sprint times. One fact to remember was that most subjects did not swim year-round, thus any swimming should cause times to drop. A negative correlation was found between the vertical jump and freestyle ability in eleven and twelve-year old male swimmers. The negative correlation was expected by the investigator, because of the inverse relationship of vertical jump height and freestyle sprint improvements.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this investigation was to 1) analyze the vertical jump as a factor in assessing freestyle sprint ability in eleven year old male swimmers; 2) twelve year old male swimmers; and 3) to analyze a power weight training program's effect upon the vertical jump and freestyle sprint ability of eleven and twelve-year old male swimmers.

The subjects consisted of thirty-two eleven and twelve-year old male swimmers from the Greensboro, North Carolina Community Swim Association (CSA). The experimental group's treatment consisted of a power weight training program. The control group's training was similar to the experimental group, except for the exclusion of a weight training program. The test procedures included a pre and post-season test of vertical jump and freestyle sprint ability and data were collected between May 30 and July 12, 1978.

Statistical analysis consisted of correlations employing the Pearson-Product-Moment Method. The experimental group, control group, and all subjects were analyzed for the vertical jump in comparison with freestyle sprint times. A t-test was employed for all comparisons between pre and post-test data.

For all subjects a correlation of -.29 was found when pre-test data were analyzed. For the experimental group a correlation of -.38 was found when post-test data were analyzed. For the control group a correlation of -.28 was found when post-test data were analyzed.

A t-test value of 5.0 was found for the experimental group when pre and post-test vertical jump scores were compared. A t-test value of 11.4 was found for the control group when pre and post-test vertical jump scores were compared. A t-test value of 9.0 was found for the experimental group which pre and post-test freestyle sprint times were compared. A t-test value of 8.9 was found for the control group when pre and post-test freestyle sprint times were compared.

Mean differences for pre and post-test scores were found for all groups (see Table 4, page 29). The range for subject age and swimming experience was computed for all groups (see Table 5, page 30).

The variables beyond the researcher's control were: a two-week delay of in-water training because of filter pump breakdowns; the small number of subjects; and missed practices by the experimental group (vacation and car pool).

These variables (see Limitations, page 8) hampered the researcher's ability to assess the weight training program's effect upon the experimental group's post-test data. Therefore, the researcher felt that the vertical jump could not be used in assessing freestyle sprint ability.

Conclusions

The following conclusions were drawn for this investigation:

1. The vertical jump was not a significant factor in assessing freestyle sprint ability in eleven and twelve-year old male swimmers.
2. The weight training program alone did not produce a significant improvement in the vertical jump or freestyle sprint times.
3. The swimming program as a treatment was a significant factor in the improvement in the vertical jump and freestyle sprint times.
4. The use of a weight training program of at least eight weeks in length, and the use of year-round swimmers, would facilitate a significant improvement in only the experimental group.
5. Variables beyond the researcher's control had an adverse affect upon the results of the investigation.

Recommendations

The following recommendations were proposed:

1. To conduct a similar investigation with a greater number of subjects.
2. To conduct a similar investigation in a better controlled environment, i.e., a camp.
3. To conduct a similar investigation with subjects who participated in swimming year-round.

4. To conduct a similar investigation when the weight training exercises would continue over a longer period of time.
5. To conduct a similar investigation employing varied weight training programs, i.e., free-weights, Nautilus and isokinetic exercises.
6. To conduct a similar investigation employing varied training methods, i.e., distance, interval and hypoxic methods.
7. To conduct a similar investigation employing varied flexibility techniques.

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APPENDICES

APPENDIX A

A DESCRIPTION OF THE STUDY'S
POWER EXERCISES

1. Arm Rotator

A. Starting position: Lying on back with top of head almost touching bar. Grasp barbell with palms up and wide grip, so that the elbows are bent 90° and are on the ground at shoulder level.

B. Action: Raise bar to vertical position in an arc by rotating upper arm. Keep elbows on floor. Return to starting position.

C. Muscles developed: Medial arm rotators: pecturalis major; subscapulars, latissmus dorsi, teres major (10:116).

2. Bench Press

A. Starting position: Take weight off of supports (or from spotters) and hold it briefly on straight arms that point directly up from your shoulders.

B. Action: Take a deep breath and lower the weight to touch the lower chest muscles, near where the pectoral muscles meet the abdomen. Then immediately push the weight back up so that your arms are straight. Begin to exhale as the weight goes up and take a breath while your arms are straight.

C. Muscles developed: Shoulders, chest, and arms (19:27).

3. Bent Knee Sit-Ups

A. Starting position: Lying on back with knees bent, feet and heels flat on floor. Angle at knees less than 90°. Hands are behind head with fingers clasped and elbows flat on floor. Feet are held down by a partner.

B. Action: Subject tightens abdominal muscles and brings head and elbows forward to touch the knees.

This constitutes on sit-up. Return to starting position, elbows down flat.

C. Muscles developed: Trunk and hip flexors -- rectus abdominus, external obliques, psoas magnus.

4. Jumping Quarter Squats

A. Starting position: Stand erect with bar balanced on shoulders at back of neck. With one foot slightly in front of the other, grasp barbell firmly so that it does not bounce up and down on the shoulders. Subject looks straight ahead or up (11:293).

B. Action: Bend knees only slightly, raise heels slightly off floor. Jump up and down, emphasizing a vigorous drive of the legs and extensors of the ankles and reverse foot on each jump.

C. Muscles developed: This exercise develops speed and power in the hip and knee extensors and the plantar flexors of the ankles; gluteus maximus, quadriceps extensors, gastrocnemius, and soleu (10:116).

5. Leg Raises

A. Starting position: Lying flat on back with knees straight, hands behind head and fingers clasped. Heel of feet should be on the floor.

B. Action: Subject tightens abdominal and hip muscles and lifts legs off of floor (six to twelve inches). Legs are held stationary for a specific time period and then returned to starting position.

C. Muscles developed: Hip flexors.

6. Supine Straight Arm Pullover

A. Starting position: Lying on the floor on the back, barbell held in wide grip, palms up, arms extended overhead.

B. Action: Without bending the elbows, pull the barbell in an arc up to a vertical position. Return to starting position.

C. Muscles developed: Arm depressors, pectoralis major, latissimus dorsi, teres major (11:116).

7. Elbow Extensor

A. Starting position: Kneeling on cushion or pad (exercise can be done standing if ceiling is high enough). Barbell is held straight overhead with elbows extended, palms forward, gripping the bar 6 to 12 inches apart.

B. Action: The barbell is lowered to a horizontal position behind head by flexing the elbows, not lowering them. Return to starting position.

C. Muscles developed: Elbow extensors triceps (10:116).

8. Toe Raises

A. Starting position: Stand erect with bar balanced on shoulders at back of neck; feet are about shoulder width, turned slightly outward, and heels are resting on a block (1" to 3" in height). Hands are at a comfortable width; the subject looks straight ahead. Knees are slightly bent.

B. Action: Raise heels off block and straighten legs. Do not jump or bounce. Return to starting position.

C. Muscles developed: This exercise develops speed and power in the plantar flexors of the ankles, quadraceps, gastrocnemius, and soleus.

9. Rowing

A. Starting position: Let the weight hand straight down under your chest. An overhead grip is used and you lean forward from the hips so that torso is parallel with floor. Heads should be about should width apart and knees slightly bent.

B. Action: Roll barbell up and slightly toward your abdomen so that it touches below your chest, but well up on your abdomen. Try to feel your back muscles stretching as weight goes down. Lower weight to starting position.

C. Muscles developed: Latissimus dorsi and allied back muscles between latissimus dorsi muscles.

10. <u>Latissimus Pulls</u>

A. Starting Position: Kneeling on pad facing device, body is erect. Arms are extended, with palms down on bar. Have elbows flexed to 90^{o}. Partner will place hands on shoulds in case body rises when weight is returned to starting position.

B. Action: Pull bar down all the way through flexion to extension near waist. Do not lower body, stay erect and look straight ahead. Return to starting position.

C. Muscles developed: Arm depressors, medial rotators and elbow extensors (10:120).

APPENDIX B, FORM 1

STUDY PERMISSION SHEET

Dear Parents:

Hello, my name is John Edmonds. I am in the midst of a thesis entitled, "The Vertical Jump as a Factor in Assessing Freestyle Sprint Ability in Eleven and Twelve-Year Old Male Swimmers." This study would require your son to meet with me two times: once is for a pre-vertical jump test and once for a pre-twenty-five yard freestyle sprint time. No special exercises will be required, just an energetic body. Dates, testing locations and testing times will be announced to your son's coach.

PERSONAL INFORMATION

I am working on my Master of Arts degree at Appalachian State University, where I presently have a teaching assistantship. This is my first summer as manager of the Elks Pool, and my second summer as boy's coach at the Elks Club. I am looking forward to working with your son. If you have any questions, please call the Elks Club or my home (264-6820).

READ CAREFULLY: I, ____________________________, the parent of ____________________________, give permission for my son to be a subject in this study.

Signed ________________________

Thank you very much.

John Edmonds

APPENDIX B, FORM 2

STUDY PERMISSION SHEET

Dear Parents:

Hello, my name is John Edmonds. I am in the midst of a thesis entitled, "The Vertical Jump as a Factor in Assessing Free-style Sprint Ability in Eleven and Twelve-Year Old Male Swimmers." This study would require that your son participate in four testing periods: a pre and post vertical jump test, and a pres and post twenty-five yard freestyle sprint time. Also, in addition to the swimming program, a weight training program will be added. All directions, procedures, safety factors and lifting methods will be supervised by me. Dates, location of testing and times will be announced.

PERSONAL INFORMATION

I am working on my Master of Arts degree in Physical Education at Appalachian State University, where I presently have a teaching assistantship. This is my first summer as manager of the Elks Pool, and my second summer as boys' coach at the Elks Club. I am looking forward to the upcoming swim season and working with your sons. If you have any questions, please call the Elks Club or my home (274-6820).

READ CAREFULLY: I, the parent of ______________________________ give permission for my son to be a subject in this study,

Signed; ___________________________

Thank you very much.

John Edmonds

APPENDIX C

THE EDMONDS SWIMMING DATA FORM

Name ______________________________

Age ______________________________

Weight ______________________________

Date of Birth ______________________

Number of years of competitive swimming ______________________________

What teams have you swam for ______________________________

____

What team are you now on ______________________________

Have you ever had swimming lessons? ______________________________

What is your best stroke? ______________________________

Pre-Season Vertical Jump ______________________________

Date ________________ ______________________________

____

Post-Treatment Vertical Jump ______________________________

Date ________________ ______________________________

____

Pre-Season twenty-five
yard freestyle sprint ______________________________

Date ________________ ______________________________

Post-treatment twenty-five
yard freestyle sprint ______________________________

Date ________________ ______________________________

APPENDIX D

TIMER'S GUIDE

Hopefully, you will be assigned a seat for each event or at least a station from which to operate. This may be at the finish line, at the starting line or even at an intermediate point from which both lines are clearly visible.

At preliminary signals from the official starter, hold your stopwatch up in front of you and focus your attention on the signaling device to be used. This may be a pistol, a whistle or a flag banner. Do not make the mistake of watching the contestants. Take the play out of the stopwatch.

Where a pistol is used, start your watch at the flash of its discharge rather than the sound of its report. This sound can take as much as three-tenths of a second to travel little more than a hundred yards.

Where a whistle is used, watch the arm of the official starter; depress the crown of your stopwatch as his arm passes the horizontal plane on its descent. Pay no attention to the sound of the whistle.

Where a flag is used, follow the same procedure as you would in the case of a whistle. Start your stopwatch as the banner passes the horizontal plane of its descent.

Depending on your location, you may feel the need for field glasses to make your start even more accurate. Weigh this advantage against the need to hold your stopwatch in only one hand when field glasses are used.

Immediately after the start, check your timer to make sure it is running. Remember that it is your responsibility to call for an alternate Timer if your stopwatch fails; the same is true if you miss a start or are knowingly late. In most cases, alternate Timers will have been appointed for just such a contingency by presiding officials.

Your most demanding job as a Timer is determining the exact moment of finish. In some cases you will be assisted by a judge who should receive your undivided attention. By and large, however, you will be on your own. For that reason, you should keep in mind just what you are required to time. Depending on regulation, custom or official discretion, you may be responsible for a given place in the running -- first, second or third -- or for a specific lane participant regardless of where this entrant may finish in the competition.

In any case, concentrate on the finish line and not on the competitors. It is only natural that you will want to see how they "stack up" at the finish, but a Timer who is "panoramic" or sees more than one object at a time is not really doing his job as an official.

Another tendency you will have to overcome is an urge to anticipate the finish. Over the years, it has been shown that the majority of Timers give away as much as half a second by squeezing the crowns of their stopwatches when they think a contestant should have crossed the finish. Don't join this group; it is too large already!

All your efforts at both start and finish will be nullified if your interpretation of the data you have recorded with your stopwatch is not accurate. You can overcome many of the obstacles you will face in reading by going along with a few precautions adopted by others (23).

APPENDIX E

STRETCHING EXERCISES

Flexibility refers to the degree or range of movement of a joint. The two limiting factors that determine flexibility are (1) bone structure, and (2) the degree to which the muscles around the joint will permit it to move (the muscle's elasticity) (10:125).

1. Running in Place

An easy, relaxed motion, which should warm and loosen up the muscles. For up to two (2) minutes.

2. Three Part Shoulder Stretch

Slowly move arms in the following directions:

A. Horizontal, arms outstretched in front of body and palms facing each other -- then separate hands and move arms back as far past shoulders as possible.

B. Vertical, arms outstretched in front of body, palms down; move arms up towards head trying to break the perpendicular plane between shoulders and ceiling or sky.

C. Lateral, arms outstretched to side of body, palms down; bringing arms up over head and touch back of palms together.

Repeat each of these five times. Stretches shoulders and chest.

3. Toe Touches

Keeping knees straight in all three positions (right leg over left, left leg over right and both together), try to touch toes or flatten palms on floor. Go down as far as possible and hold for ten seconds; repeat each one twice.

4. Hurdlers Stretch

Sitting on floor, right leg should be bent and back in 90° angle, with the left leg outstretched straight in front of the body.

Keeping the left leg straight, try to bring the head to the left knee (slowly) and hold for ten seconds. For each leg repeat three times.

5. Isometric Shoulder Stretch

The subject sits with his back erect, legs extended forward and knees straight, arms raised to shoulder height with palms facing forward. The person who is going to stretch the subject grasps him by the wrists and pulls the arms backward in a horizontal plane until the arms are fully stretched and there is some tension but no pain. The subject then contracts his muscles as if to pull the arsm forward. The stretcher continues to hold the arms firmly so the subject cannot move them forward. The tension of the stretcher's resistance against the interaction of the muscles is the stress factor that causes the muscles to be stretched. Hold for 10 seconds and repeat three times (10;130).

6. Ankle Stretches (Plantar Flexor)

Subject A sits on deck with his legs held together and extended in front of him. Subject B assumes kneeling position at the feet of Subject A. He places his hands so the palms cover A's toes and the lower part of his insteps. He pushes downward and forcibly plantar flexes A's ankles. Knees are kept straight throughout; repeat five times each (11:306).

7. Ankle Stretches (Plantar Flexor)

Place a towel on floor or deck. Assume a kneeling position and plantar flex the feet so the insteps of the ankles are facing downward on the towel, then sit back on the bottoms of the feet. Place hands on the floor in back of feet. Rock backward, lifting the knees off the ground and placing the weight of the body over the feet so the ankles are forcibly stretched. Repeat 10 times (11:307).

8. Achilles Tendon Stretches (Dorsi Flexor)

Subject A sits on the floor or deck. Subject B kneels down and firmly grasps one of A's feet by placing his left palm in back of A's heel. He places the right hand with his palm over the ball of the foot and forcibly dorsiflexes the ankle. Repeat 10 times (11:307).

9. Windmilling

Standing erect, the arms are swung in a circular motion in the lateral (side) plane, much in the same manner as when doing the butterfly arm stroke. Repeat 20 times each, forward and backward (12:208).

APPENDIX F

RAW DATA

Subjects	Group	Vertical Jump		Twenty-five yard Sprint	
	Control or Experimental	Pre	Post	Pre	Post
1	Control	11	12	19.3	18.1
2	Control	13	15	25.2	21.4
3	Control	10	11.5	15.5	13.8
4	Control	11.5	13	17.5	16.2
5	Control	12.5	14	19.1	18.0
6	Control	13.5	14	17.0	16.1
7	Control	17	19	15.9	15.1
8	Control	13	14.5	15.5	14.0
9	Control	10	12	23.4	21.2
10	Control	13	14.5	15.8	14.7
11	Control	13	16	15.5	14.3
12	Control	15	16.5	18.0	16.4
13	Control	13.5	16	14.9	13.6
14	Control	12	13.5	18.3	17.0
15	Control	13	15	22.4	20.2
16	Control	11.5	13	18.5	16.9
17	-------	13	14.5	17.9	16.2
18	-------	11	12	22.0	19.7
19	-------	13	13	25.3	18.5
20	-------	16	17	16.9	14.7
21	-------	13	12.5	15.7	14.3
22	-------	12	12	21.9	19.0
23	-------	12.5	13.5	16.7	15.0
24	Experimental	13	14	19.5	17.4

Subjects	Group	Vertical Jump		Twenty-five yard Sprint	
	Control or Experimental	Pre	Post	Pre	Post
25	Experimental	11.5	14	15.2	13.8
26	Experimental	14	16	19.9	17.3
27	Experimental	9.5	12	17.0	15.1
28	Experimental	14	18	13.5	12.6
29	Experimental	14	15.5	16.2	14.7
30	Experimental	9	10	19.2	16.2
31	Control	11	12	21.9	18.7
32	Control	13	14	15.3	13.8

APPENDIX G

LETTER CONCERNING INFORMATION ABOUT
NORMS FOR VERTICAL JUMP AND THE
CORRELATION BETWEEN HEIGHT OF VERTICAL JUMP
AND SPRINTING ABILITY

May 15, 1978

Mr. John J. Edmonds, Jr.
Department of Health, Physical
Education and Recreation
Appalachian State University
Boone, NC 28608

Dear Mr. Edmonds:

This is in response to your letter concerning information about norms for vertical jump and the correlation between height of vertical jump and the sprinting ability.

We are still in the process of gathering this data and will probably hand it over to a grad student to provide the statistical treatment when we consider there is enough. Pat Barry, formerly coach at Mercersburg Academy and presently here at Indiana working on his Masters, had been gathering data for years from the children who came to his summer program at Mercersburg. I have asked other interested coaches to participate in the gathering process, making sure the test was administered properly (with no step allowed). With so many variables present among age-group swimmers I believe it is necessary to have thousands of cases on record before we can draw any valid conclusions, but I am willing to go out on a limb somewhat as to my opinion as to the results. This is what I meant when I say that I believe there is a positive correlation between the height a swimmer can jump and his sprinting ability.

I think you will be able to find more information on this subject when you search. The use of the vertical jump for this purpose is not new, I have been using it for twenty-seven years and I know that other physical educators and coaches have done so. The problem is that most of their subjects have been adults and we have therefore had little data on children.

Sincerely,

James E. Counsilman, Ph. D.