VALIDITY OF THE SQUAT-THRUST TEST COMPONENT OF THE NEW YORK STATE PHYSICAL FITNESS TEST AS A MEASURE OF CARDIOVASCULAR ENDURANCE

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Mary Bates Dorman

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Author: Mary Bates Dorman

Read and Approved by: Nat Goodhartz

Constance K. McIntyre

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Constance K. McIntyre
Chairperson of Department of Sport and Physical Education

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Mary Bates Dorman

Mary Bates Dorman

COMPLETED RESEARCH IN HEALTH, PHYSICAL EDUCATION, AND RECREATION
State University College at Brockport
Brockport, New York

(Dr. Nat Goodhartz)

Institutional Representative

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Many schools require the New York State Physical Fitness Test to be administered to grades four through twelve, at the beginning and end of the school year. The squat-thrusts are used to measure endurance. The purpose of this study was to determine if the squat-thrust test component of the New York State Physical Fitness Test was a valid test of aerobic endurance. Cooper's Twelve-Minute Run/Walk Test was used as the criterion measure of aerobic capacity. Eight hundred and thirty-six students were tested on the twelve-minute run/walk test and the squat-thrust test. Twenty students stopped while taking the twelve-minute run/walk test, and their results were not used. Students tested were in the fourth grade, eighth grade, eleventh grade and twelfth grade. Data were statistically analyzed by the Pearson r. The correlation coefficient was +0.30. This correlation coefficient did not indicate a significant relationship between the twelve-minute run/walk test and the squat-thrust test. It is recommended, based on these results, that Cooper's twelve-minute run/walk test be substituted for the squat-thrust test to measure aerobic

capacity. The researcher also suggests that the squat-thrust test be assessed for suitability as a measure of anaerobic capability.

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Chapter I

Introduction

Several factors contributed to a special national interest in youth fitness. The rejection rate of youth for military service in times of national crisis, an increase in the percentage of the population made up of youth and children, and comparative studies of fitness in American and European children led ultimately to the formation of a President's Council on Physical Fitness and Sport. During the 1950's laboratory and field studies were aimed at assessing the physical fitness of youth.

In 1984 the United States Public Health Service reported the results of a national fitness survey, indicating that "American young people have become fatter since the 1960's" (National Children and Youth Fitness Study) (Gabbard & LeBlanc, 1986). The purpose of the study was to describe the current fitness status of children and youth in the United States and the patterns of participation in physical activity, and to evaluate the relationship among physical activity patterns and measured fitness. This test was administered to 8,800 boys and girls ages ten through seventeen across the country. The sum of skinfold data demonstrated a tendency for all age groups to be fatter than comparable groups in the 1960's. The National Children and Youth Fitness Study test battery consisted of the sum of triceps and subscapular skinfolds, sit-and-reach test, bent knee sit-ups (number completed in sixty seconds), chin-ups (number completed), and a one mile run/walk test.

Because research indicates that American youth have become fatter since the 1960's, the development of fitness among young children should not be left to chance. Sharkey (1984) mentions that several recent surveys have identified the presence of cardiac disease risk factors in children of all ages in urban, suburban, and rural settings. Kannel and Dawber recently stated that atherosclerosis is not only a disease of the aged but is primarily a pediatric problem, since the pathologic changes which lead to atherosclerosis begin in infancy and progress during childhood (Boyer and Wilmore, 1977). Cooper (1970) stated that at least one million Americans die each year from heart and blood vessel disorders, which adds up to one death every 50 seconds, from coronary disease alone. Some students only participate in physical activity that is received in school instruction. Most young people do not even get enough exercise on their own. Statistics show that children spend a large poportion of their time engaged in sedentary activities such as television, bus riding, studying, and idle socializing. With this information, research is abundantly available to support the need for directing the fitness development of children.

Dr. Kenneth H. Cooper, in Aerobics, outlines the exercises he believes make the greatest contribution to aerobic fitness. Cooper (1968) states that active exercises such as running, swimming, and walking are extremely productive, while calisthenics are the least valuable type of activity.

Active exercises not only make a great contribution to aerobic fitness but may also aid in the improvement in the efficiency of the heart. Benefits of the trained heart include reduced systolic blood pressure, greater stroke volume and cardiac output, decreased heart rate per work load, and more efficient distribution of blood to the active muscles (Edington and Edgerton, 1979; Corbin and Lindsey, 1985).

Fitness Testing in Physical Education

Physical education in the schools plays an important role in the physical fitness of students. During this decade an exciting trend which has significantly changed the curriculum for young children's physical education programs is the implementation of the health-related fitness philosophy. Health-related fitness is relevant to all students, and meaningful goals can be established for the improvement of each fitness component in this area. Health-related fitness has an impact on a person's physical well being and performance, and invoves such factors as muscular strength and endurance, cardiovascular endurance, body composition and flexibility.

Current employment of fitness tests can help ensure that each student leaves the secondary school with an appreciation of lifetime fitness and an understanding of the means by which it can be maintained. There are a great variety of tests that purport to measure fitness. Some measure only two or three components of fitness and others claim total measurement.

Relatively few tests have been constructed to measure youth fitness exclusively. However, many tests have application to childhood and adulthood as well.

One fitness component necessary to test is aerobic fitness. It is useful to measure aerobic fitness because, it provides a rational basis for planning training programs, teams can be strategically analyzed, it can be used as a prophylactic measure to avoid excessive strain in individuals who aren't prepared for certain levels of intensity in class or practice, or for homogenizing groups in class and sports. Mood (1980) has mentioned the following as some reasons for test and measurement application: (1) classification of students into homogeneous groups, (2) motivation, (3) measurement of improvement, (4) measurement of achievement, (5) evaluation of progress, (6) determination of potential, (7) diagnosis, (8) public relations, (9) grading, (10) evaluation of instructional methods, (11) establishment of norms, and (12) research and research evaluation. Fitness testing is a traditional component of the public and private school physical education curricula. However, teachers have administered tests of fitness without giving ample consideration to the purposes of the testing process and the appropriateness of the test batteries selected.

Laboratory Tests and Field Tests

In the exercise physiology laboratory, aerobic capacity, the maximum amount of oxygen the body can process during intense effort, can be measured directly. Aerobic capacity is determined during maximal work on either a motor-driven treadmill or a bicycle ergometer. The need for treadmills, gas analysis equipment and trained technicians make such measurements impractical for a school situation. This type of testing is necessary for research, but impractical on a large scale, due to cost of equipment, need for trained personnel, and time. In as much as laboratory determination of maximum VO2 is impractical for large groups, notable efforts have been made to develop a field test of fitness that correlates well with laboratory tests. Field tests that have been identified as reflecting cardiorespiratory functioning are step tests that measure heart rate response, speed of running long distance events, number of squat thrusts performed in a required time, and the distance covered on a track in a particular amount of time.

Maximum oxygen intake can be measured during any exercise that uses large muscle groups and that is intense and long enough to tax the aerobic fitness of the individual. An individual's aerobic capacity reflects the functioning of the heart, lungs, and vascular system in the delivery of oxygen during periods of heavy work. In addition to the delivery system, the cellular ability to extract and utilize oxygen is important. The higher the maximum oxygen uptake the more effective the cardiovascular system.

Problem

Although many physical fitness tests have been published in the United States, only a handful have been developed with an adequate concern for type of fitness, test validity, and test reliability (Safrit, 1986).

For example, the New York State Physical Fitness Test is an individual performance type test composed of four different test items. There is a total physical fitness score, and four partial scores indicating strengths and weaknesses in four basic components of physical fitness, including agility, strength, speed, and endurance. The squat-thrust test component of the New York State Physical Fitness Test purports to measure endurance. A second component, Cooper's twelve-minute run/walk test, involves measuring the distance covered by running, or running and walking, for a time of twelve minutes. The following researchers are in agreement that the twelve-minute run/walk test is a valid measure of aerobic fitness because this test is highly correlated to maximum oxygen utilization: Weiler, Lienk, Kullmer, & Kindermann (1984); Fox & Corbin (1985);

Mathews (1978); Mood (1980); McAdam (1980); Cooper (1968); Cooper (1970); Cooper (1982); Gettman (1980); Disch, Frankiewiez, and Jackson (1975); Noble (1986); and Safrit (1986). There have been suggestions, however, that the squat-thrust test does not measure endurance in the New York State Physical Fitness Test. For example, in a best effort one minute run, slightly more than sixty percent of the work is performed anaerobically (Cooper, 1972). Squat-thrusts for thirty seconds and one minute are too short in duration to test for aerobic fitness.

Many schools require the New York State Physical Fitness Test to be administered to grades four through twelve, in the beginning and at the end of the school year. This test was developed to provide school personnel with a measuring instrument to use in determining the physical fitness of pupils, and to screen for pupils who are physically underdeveloped. The New York State Physical Fitness Screening Test provides a minimum standard for the measurement of a pupil's general physical fitness on the basis of four independent components of physical fitness which show relatively little interdependence. This test can be given to many students in a relatively short period of time. Squat-thrusts are used to measure endurance in the New York State Physical Fitness Test. However, there is little evidence to support the theory that squat-thrusts for thirty seconds or for one minute may be a valid measurement of endurance. They may, instead, be an assessment of anaerobic capacity, or the lactic acid system.

The purpose of the twelve-minute run/walk test is to determine the individual's aerobic capacity. Cooper (1968) found that the twelve-minute run/walk test is a valid measure of maximum VO2, and has a correlation of .90 with the Balke treadmill test. One hundred and fifteen United States Air Force male officers and airmen were evaluated on Cooper's twelve-minute field performance test and on a treadmill maximal oxygen consumption test (Cooper, 1968). The correlation of the field test data with the laboratory-determined oxygen consumption data was 0.897.

The fitness tests addressed in this research study are the squat-thrust component of the New York State Physical Fitness Test and Cooper's Twelve-Minute Run/Walk Test. These tests are attractive because of their practicality in terms of facilities, time, and equipment. These tests will be evaluated to determine whether the Squat-Thrust Test shows a high enough correlation with Cooper's Twelve-Minute Run/Walk Test to consider it a valid measure of aerobic capacity. Cooper's test was used as the criterion measure against which to assess the validity of the squat-thrust test. Cooper (1982) states that the twelve-minute run test gives a reliable estimate of person's aerobic capacity, yet it does not require expensive laboratory equipment. An increasing number of athletic teams have been using both the twelve minute and the 1.5 mile tests in conjunction with their off-season and in-season conditioning (Cooper, 1970).

Purpose

The purpose of this study is to determine if the Squat-Thrust Test component of the New York State Physical Fitness Test is a valid test of aerobic fitness.

Limitations

One limitation that may have an affect on the reliability of the test administration is subject error in counting his/her own laps around the track during the Cooper Test.

Hypothesis

There will be a low correlation between performance on Cooper's Twelve-Minute Run/Walk Test, which will be used as a criterion measure of aerobic capacity, and performance on the Squat-Thrust Test in the New York State Physical Fitness Test.

Definitions

Aerobic. Refers to the oxidative metabolic process whereby energy is provided to drive various cellular reactions such as muscular contraction.

Aerobic Capacity or Maximum Oxygen Uptake (max. VO2). The maximum amount of oxygen an individual can utilize during a specified period of time. It is usually reported in l/min, or ml/kg/min.

Anaerobic Exercise. Anaerobic exercise involves intense effort of short duration and leads to the production of lactic acid, as a result of glycogen catabolism in the absence of oxygen.

Cardiovascular Fitness. Cardiovascular fitness is the ability of the lungs and heart to take in and transport adequate amounts of oxygen to the working muscles, allowing activities that involve large muscle masses to be performed over long periods of time (Fox and Mathews, 1981).

Ergometer. An apparatus for measuring work.

Maximal Oxygen Uptake Tests. Exercise of increasing intensity performed until no further increase of oxygen uptake occurs or until symptoms or signs of intolerance occur.

Oxygen Deficit. The time period during exercise in which the level of oxygen consumed is below the amount required for the exercise.

Squat-Thrusts. To perform this exercise one bends the knees and places the hands on the floor. The arms may be between, outside of, or in front of the bent knees (position 1.) Then one extends the legs backward keeping the arms and body straight as in the push - up position (position 2.) The performer next returns to the squat position (position 3), and then to the erect starting position (position 4) See Figure 1. One squat-thrust is completed when the performer returns to the starting position of the 4-position exercise.

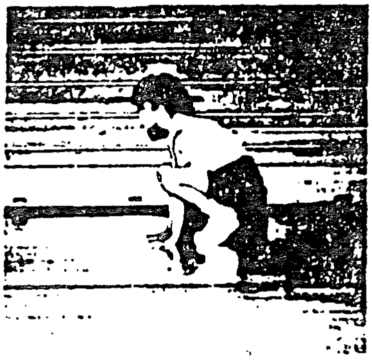
The New York State Physical Fitness Test. A test that provides a minimum standard for the measurement of a pupil's general physical fitness in grades four through twelve. It is based upon four independent components of physical fitness (side-step test for agility, sit-ups for strength, 60-and-90 yard dashes for speed, and squat-thrusts for endurance) which show relatively little interdependence. According to the New York State Physical Fitness Test Manual (1977 & 1984 Revision) the primary emphasis in this test is upon total physical fitness, and the sum total of the component scores provides a basis of identifying physically underdeveloped pupils.

Twelve-Minute Run/Walk Test. This involves measuring the distance covered by running, or running and walking, for a time of twelve minutes.

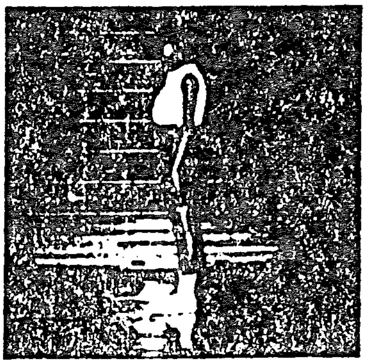
a. Erect starting position

b. Squat position

c. Legs back position



d. Return to squat position



e. Return to erect starting position

Figure 1. Pictorial breakdown of the Squat-thrust test

Chapter II

Review of Literature

Aerobic capacity is defined as the maximal amount of oxygen that can be consumed per minute during maximal exercise (Sharkey, 1984., & Noble, 1986). For comparative purposes, it is best to express aerobic capacity by taking body composition into consideration, that is, mililiters per kilogram of body weight per minute. Aerobic capacity depends upon the transport of oxygen from the atmosphere to the mitochondria of muscle cells. This transit involves basically four processes: 1) alveolar ventilation, 2) the interaction between pulmonary diffusion and blood transport, 3) blood transport, and 4) the interaction between tissue diffusion and blood transport (deVries, 1974). The most important determinants of aerobic capacity are the interaction of cardiac output and hemoglobin level which together determine the level of blood transport of oxygen (Noble, 1986).

Energy Systems

The energy used for muscular work comes from food. All three classes of nutrients - carbohydrates, fats, and proteins can provide this energy. Carbohydrate, fat, and protein in food are broken down through digestion to forms that can be used by muscle cells to synthesize ATP either anaerobically or aerobically. Noble (1986) states that the main source of energy for the muscular contraction is carbohydrate and fat from the food consumed. The order of preference for energy through food consumption is carbohydrates first, fats second and proteins last.

Various activities have specific demands for energy. For example, sprinting requires a large energy ouput over a short period of time. Conversely, running a marathon requires a large energy output over a long period of time.

Adenosine triphosphate (ATP) is the immediate source of energy for any muscular activity. ATP is stored in skeletal muscle in limited amounts and replenished, as needed, from the chemical breakdown of other substances also stored in the body. ATP is available for brief bursts of high energy output (up to thirty seconds) such as sprinting 100 meters (Noble, 1986). The energy used to develop power (for athletic events such as standing long jump, shot put, fast starts, and sprints) comes from the ATP-PC system, which does not require oxygen to form ATP. When stored ATP and PC are substantially reduced, additional short-term ATP energy is made available from the anaerobic breakdown of glycogen (stored carbohydrate) to lactic acid. The breakdown of glucose is important for several reasons: most carbohydrates are metabolized to glucose; it is the main source of energy during exercise depending upon intensity and duration; and it can yield a limited amount of ATP when oxygen supplies are inadequate. The lactic acid mechanism does not employ oxygen. Carbohydrate (in the form of glucose) is the only food used in this metabolic sequence. Essentially, glucose is broken down to pyruvate and then to lactic acid. Lactic acid is formed during exercise when sufficient oxygen is not available. ATP for high intensity activities lasting from 1-3 minutes can be supplied by the lactic acid system. Fox, Mathews, and Bairstow (1980, p. 174) state that the lactic acid system is the prime source of energy for all-out efforts that last between 90-120 seconds. A disadvantage of this system is the accumulation of lactic acid in the muscles and blood, causing fatigue.

The third pathway employed for the formation of ATP is called the oxygen system and the electron transport system. It takes two to three minutes of exercise to accelerate the oxygen consumption to the required level. Exercises of three minutes or more rely mostly on the aerobic system. All three foods (carbohydrates, fats, and proteins) may be used in the oxygen system to form ATP. This process permits ordinary activity without discomfort or fatigue, and is also the basis for meeting increased demands for energy in athletic events of long duration, for example, in running the marathon. The function of aerobic metabolism is to restore the cell's ATP and CP. When the level of oxygen consumption is below what is necessary to supply all the ATP required by an exercise then an oxygen deficit is incurred. Fox and Mathews (1983) state," it is during the oxygen deficit that the anaerobic capacity is called upon." The activity will then be performed anaerobically, and length or duration of the activity will be diminished due to fatigue.

The ATP-PC, lactic acid, and aerobic system are all sources of energy, although a specific system may predominate at different times in an event. Fox and Mathews (1976) have devised a continuum of performance times divided into four distinctive areas. Activities requiring performance times equal to or less than thirty seconds rely on the ATP-PC system. Activities requiring between 30 seconds and 1.5 minutes to perform rely mostly on the ATP-PC and the lactic acid system. Activities requiring between 1.5 and 3 minutes to perform rely on the lactic acid system and the oxygen system. Activities requiring performance times equal to or greater than 3 minutes in duration rely on the aerobic system. Very few sports are purely anaerobic or aerobic. For example, in a 1500 meter run, the anaerobic system supplies the majority of the ATP during the sprint, at both the start and finish of the race, with the aerobic system predominating during the middle or steady state period of the run.

Sharkey (1984) states that lactic acid and high levels of carbon dioxide cause labored breathing, general discomfort, and a sense of distress. Since anaerobic exercise involves high intensity and often rapid muscle contractions, it may pose a greater threat of injury.

Exercise Intensity and Duration

Cardiorespiratory endurance activities are performed at submaximal intensity for prolonged time periods and depend upon oxygen for the production of necessary energy supplies. Getchell (1979) states that most field tests of cardiorespiratory endurance utilize running, jogging, or walking. Getchell (1979) points out when an activity is performed over a sustained period of time and, correspondingly, at a submaximal effort, it is generally agreed that an activity should last for at least 10 minutes, to improve cardiorespiratory endurance. Other studies confirm that the duration of a running test must be between 10 and 20 minutes to provide reasonable estimates of aerobic capacity (Cooper, 1972). Getchell (1979) also states that continuous and rhythmic activities that can be sustained over a period of 20-30 minutes or more are the best activities for improving the function of the cardiorespiratory system.

Other studies have aimed at determining how long a person must work to provide accurate results for attaining aerobic fitness. Balke has demonstrated that an adequate estimate of aerobic capacity is possible with as few as 10 minutes of maximal work (Getchell, 1979). A significant point is that if maximum work is performed for 10-20 minutes, the predominant energy source is dependent on the utilization of oxygen; thus an adequate estimate of one' aerobic capacity will result. Cooper (1972) and Ribisil (1980) both support Balke's requirement of a minimum duration of 10 minutes.

Maintenance of a high level of work intensity is possible for only a short duration of effort due to the limited availability of immediate energy stores (Ribisil, 1980). The high energy phosphates can sustain maximal effort for less than thirty seconds, while the short term glycolytic process can extend this to about two minutes of high level work. If the duration of effort is to be further extended, then the long term oxidative process must provide the energy and the intensity must be reduced accordingly. For this reason, the duration cannot be prescribed without first considering the intensity. Duration refers to the length of time the individual works at the prescribed intensity. The duration of effort is closely related to the intensity of effort, and this interrelationship requires that both must be considered simultaneously rather than separately.

A review of literature indicates that there is an inverse, nonlinear relationship between intensity and duration of exercise. Figure 2 demonstrates this relationship between intensity and duration of exercise. Skinner and Morgan (1984, p. 32) state, "If intensity is

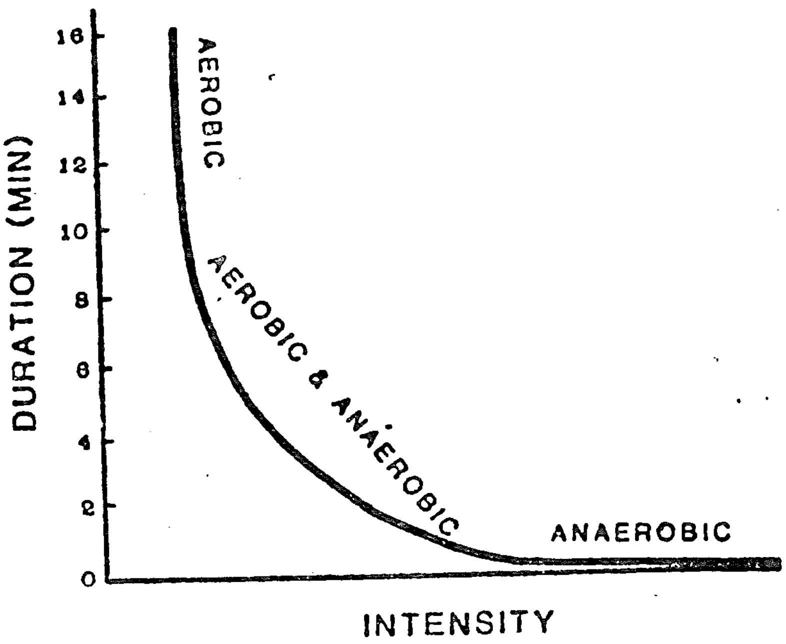


Figure 2. Relationship between intensity and duration of exercise and the corresponding energy source (Skinner & Morgan, 1984)

low, duration can be long and the activity is predominatly aerobic. Conversely, if intensity is high, duration must be brief and the activity is primarily anaerobic." Karpovich and Sinning (1971, p. 91) state, "The oxygen intake during a given exercise depends on the intensity of work and the size of the muscle groups involved."

Corbin and Lindsey (1985, p. 38) state, "True anaerobic exercise can only be continued for less than a minute at a time." Sharkey (1984) states when highly fit individuals are able to run the 1.5 mile distance in 10 minutes or less the results may reflect basic speed or anaerobic power as well as aerobic fitness.

Mass Testing of Students

Mass testing for evaluation of students and programs is still primarily left to the physical educator. The scientific value of mass testing of physical fitness has been debated frequently in recent years. There is no doubt that these tests are less accurate than those performed in research laboratory, physical performance tests. However, standardized mass testing is needed to establish national norms and to serve the purpose of international comparisons. These norms direct the individual, the teacher, and the coach in their work of enhancing physical fitness.

Self-testing and self-monitoring skills are fundamental for the diagnosis of fitness needs throughout life. The squat-thrust component of the New York State Physical

Fitness Test and Cooper's Twelve-Minute Run Test are both tools for self-testing. These tests may be performed on an individual basis or with a large number of students in class.

The New York State Physical Fitness Test

During World War II the need was felt throughout the nation for some device to both motivate and evaluate the attainment of physical fitness. In 1944 New York State attempted to meet this need with the publication by the New York State War Council and the State Department of Education of physical fitness standards for boys and girls.

After the war the interest in standards was maintained throughout the State and the New York State Department of Education, Division of Health and Physical Education, together with the New York State Association for Health, Physical Education and Recreation (NYSAHPER) combined to sponsor a long-term standard in all areas of physical education. In the spring of 1947 a conference was called at West Point to inaugurate the project. At that meeting the framework for a three-pronged study involving the setting of standards in physical education knowledge, skills, and physical fitness for secondary school boys was amended.

By the time of the next West Point Conference the following spring (1948) the standards project had mushroomed to include setting standards for boys and girls on all levels from elementary school through college in the three original areas (medical or physiological, anthropometrical, physical or motor) with a possible fourth area, social adaptability, suggested for the future.

The development of the New York State Physical Fitness Test was manifested by the long history of research by Dr. Saul Ostrow. Ostrow completed much of the basic research for this test in connection with the State Education Standards Project, sponsored by NYSAHPER and the State Education Department. This research is reported in his doctoral dissertation, which was done under the direction of Dr. Leonard A. Larson, Department of Physical Education, Health and Recreation, School of Education, New York University.

Ostrow (1951), in his doctoral dissertation entitled, "An Experimental Study To Determine Standards Of Organic Development For Use In The Boys' Physical Education Program In New York State Public Secondary Schools," identified sixty-nine components of physical fitness from the review of literature. His next step was to classify the components into three categories: medical or physiological, anthropometrical and physical or motor function. Some of the components could possibly have been placed in more than one category but for the sake of simplicity, each component was placed in only one catagory - that which seemed most fitting. Since there was duplication of components due to the diverse terminology used by various investigators, the next step became the elimination of this duplication.

Elimination of duplication reduced the sixty-nine components down to sixteen components as follows: medical (7), anthropometrical (3) and physical (6) (Table I).

Selection of components were based on limitations of physical education programs in New York State. Criteria used were: 1) leadership, 2) time, 3) scheduling, and 4) facilities. Based on these limitations eight components survived as follows: posture, body development, strength, speed, endurance, accuracy, agility, and balance (Table II). Ostrow searched the literature to find tests to measure these components. These tests were checked for reliability, validity, ease of administration, time required, equipment needed, training of personnel required for administration, scoring, and factors peculiar to measurements. These tests were then administered on an experimental basis to secondary school boys. Schools participating in the preliminary phase of testing are found in Appendix A.

The best measures of endurance from the review of literature for preliminary testing, were the mile run, quarter-mile, ratio test (forty yard dash and 200 yard shuttle run), treadmill test (student changes feet position while being in a push-up position), and the Carlson Endurance Run. Cureton found that the mile run against time was the best single measure of endurance. However, the mile run was deemed too strenuous for junior high school boys and too time consuming so it was not considered. Instead, the quarter-mile run was adopted as one endurance measure with

Table I

Synthesized Components of Organic Development
Classified According to Types of Measure Needed to Identifying Them

(Ostrow, 1951)

Medical or Physiological	Anthropometric	Physical or Motor
1. Function of Nervous System including Sensory Mechanism.	1. Body Development	1. Strength
2. Function of Heart, Circulatory System and Blood.	2. Posture	2. Speed
3. Function of Respiratory System.	3. Flexibility	3. Endurance
4. Function of Digestive System.		4. Accuracy
5. Function of Muscular System. (other than strength)		5. Agility
6. Function of the Endocrine System.		6. Balance
7. General Health including Resistance to and Freedom from Disease.		

Table II

Fitting the Components of Organic Development Into the Framework of the New York State Physical Education Program to Determine Which are Measurable

(Ostrow, 1951)

	CRITERIA			
COMPONENTS	**Leadership**	**Time**	**Scheduling**	**Facilities & Equipment**
Function of nervous system	o	o	o	o
Function of heart circulation on blood	?	o	o	o
Function of respiratory system	o	o	o	o
Function of digestive system	o	o	o	o
Function of muscular system (other than strength)	o	o	o	o
Function of endocrine system	o	o	o	o
General Health	o	o	o	o
Strength	#	#	#	#
Speed	#	#	#	#
Endurance	#	?	#	#
Accuracy	#	#	#	#
Agility	#	#	#	#
Balance	#	#	#	?
Body Development	?	?	?	?
Posture	?	?	?	?
Flexibility	?	?	?	?

Symbols —
- o — Does not meet criterion
- ? — Partially meets criterion
- # — Meets criterion fully

which to experiment. Since the quarter-mile run required considerable space, it was decided to find additional endurance measures that could be more easily administered. The tests that were administered, were the ratio test, treadmill test, 440 yard run and the Carlson Endurance Run, to find the best measure of endurance. These four tests were administered to 367 secondary school boys in three schools to determine their validity. Reliability was determined by test-retest on 30 boys for the quarter-mile run, 31 for the treadmill, 93 for the Carlson Run, 34 for the 200 yard shuttle run and 211 for the 40 yard shuttle run.

Reliability was obtained by comparing the raw scores obtained on the first testing with the raw scores on the second testing, using product-moment correlations. The standard scores for each individual were summed and the score on each test in that category which had a reliability of .70 or better were correlated with the summed score to determine the validity of the test.

A ratio test involved two shuttle runs; a forty yard shuttle dash was compared with a 200 yard shuttle run for the purpose of conserving space.

The administration of the treadmill test took one minute. The performer assumed the modified front leaning position (push-up position) with both hands on the floor and one leg extended to the rear, while the other leg was flexed so that the knee was between the arms and the thigh was against the chest. The student exchanged the position of the feet as rapidly as possible. Both feet left the floor at each change, and the chest touched the flexed thigh each time it was brought forward. The number of times each foot touched the floor in the extended position during the minute was counted.

The 440 yard run required the student to run one lap around a quarter-mile track.

And, finally, the Carlson Run involved the performer running in place as rapidly as posssible for ten seconds. The performer started with his/her left foot. The runner lifted each foot entirely off the ground on each step. A count of one was recorded each time the left foot struck the ground. The performer rested for ten seconds. This was repeated ten times. The total number of all left-footed steps, for each period, was added up for a final score.

The results from the preliminary testing were as follows: 440 yard run had a reliability of .905, the treadmill .809, the 200 yard shuttle run .945, and the Carlson Run .559.

In addition to being most reliable, the 440 yard run proved most valid, with a validity of .795. The treadmill was second in this respect with a validity of .722. The endurance ratio was third with a validity of .575. The 440 yard run and treadmill correlated as .522. The treadmill was chosen to measure endurance in the final battery. These early data seems to indicate that the squat-thrust test is not the best measure for aerobic capacity.

In the areas of strength, speed, endurance, accuracy, agility and balance, measures were tested experimentally and one was finally chosen to represent each area in the final battery to evaluate organic development (physical fitness). For strength, the measure chosen was dips; for speed the fifty-yard dash; for endurance the treadmill; for accuracy the target throw; for agility, side stepping; for balance the squat-stand; and posture and body development were visually assessed. This test battery of eight components was tested with 1,363 secondary school students throughout New York State.

The seven-item New York State Physical Fitness Test (1958) included seven out of the eight components listed in Ostrow's study (1951). The seven components were: posture, strength, speed, endurance, accuracy, balance, and agility. Twenty-six school districts in different sections of the State administered the test to 12,626 pupils in the fall of 1956 to provide data for the standardization of the test. The seven-item test battery was discouraging to some physical educators because of the time element. The New York State Physical Fitness Screening Test (1968) was then cut down to a four-item test battery, under the direction of Gerald J. Hase of the Division of Health, Physical Education and Recreation. The final manual was prepared with the assistance of William Straub and William G. Brenton of the

Bureau of Physical Education. More than thirty school districts (11,145 pupils) participated in the many pretesting procedures necessary in developing the test. The four components measured were: agility (side steps), strength (sit-ups), speed (45,60,90,120 yards), and endurance (squat-thrusts). These four components - agility, strength, speed, and endurance - are important indicators of the pupil's capacity to perform physically, and of their ability to run, jump, dodge, and perform many other fine-gross motor skills.

The 440 yard run ranked highest in reliability and validity for endurance but did not meet the administrative criterion because of the time and space required. The squat-thrust test was then chosen on the basis of administrative ease.

Today, the New York State Physical Fitness Test is an individual performance test composed of four different test items. There is a total physical fitness score and four partial scores indicating strengths and weaknesses in four basic components of physical fitness: agility, strength, speed, and endurance.

Results of the test can be used to interpret a pupil's general physical fitness on the basis of four separate components, although they show relatively little interdependence. The teacher's manual states, "The primary emphasis in this test is upon total physical fitness and the sum total of the component scores should provide an adequate basis for identifying physically underdeveloped pupils."

The New York State Physical Fitness Test was implemented by the SUNY State Education Bureau of Physical Education and Safety Services. The original norms of this test were obtained in 1962 using thirty public schools. The test-retest reliability coefficients for total and part scores (1963) are reported in Table III for boys and Table IV for girls. The test was then revised in 1975 using 48 public and nonpublic schools.

To estimate its reliability, the Physical Fitness Screening Test was administered twice during the fall of 1976, with approximately three weeks between testing, to a sample of 2,033 pupils in grades 5,8, and 11 in twenty-one public schools in the State. The test-retest reliability coefficients for total and part scores are reported in Table V for boys and Table VI for girls. The results from the Tables V and VI for the endurance component conclude reliability coefficients of 0.79, 0.89, and 0.86 for boys and 0.81, 0.88, and 0.89 for girls.

The 1983 norms for the Physical Fitness Screening Test were obtained by administering the test to a stratified random sample of 25,165 pupils in 18 public school districts and 30 nonpuplic schools. Stratification of the sample (1983) occurred at two levels. First, the State was divided into 13 geographic regions. Each region was represented in proportion to its contribution to total State enrollment

Table III

Reliability Coefficients and Standard Errors of Measurement for Boys (1963). The New York State Physical Fitness Screening Test: For Boys and Girls Grades 4-12 (1968 Revision)

Test Score	Grade	N	Means	Standard Deviations	r	SE_M
Agility	5	166	12.7	2.2	.84	0.9
	8	186	15.6	2.1	.75	1.0
	11	166	17.9	2.3	.85	0.9
Strength	5	166	25.4	6.0	.92	1.7
	8	186	49.9	12.4	.93	3.3
	11	166	54.8	10.9	.93	2.9
Speed	5	166	11.9	0.8	.88	0.3
	8	186	23.4	1.8	.78	0.8
	11	166	29.6	1.9	.95	0.4
Endurance	5	166	15.4	3.2	.86	1.2
	8	186	27.9	5.9	.83	2.4
	11	166	30.5	7.6	.96	1.5
Total	5	166	20.1	4.0	.90	1.3
	8	186	20.1	5.4	.92	1.5
	11	166	20.8	5.1	.94	1.2

Table IV

Reliability Coefficients and Standard Errors of Measurement for Girls (1963). The New York State Physical Fitness Screening Test: For Boys and Girls Grades 4-12 (1968 Revision)

Test Score	Grade	N	Means	Standard Deviations	r	SE_M
Agility	5	174	12.4	2.1	.83	0.9
	8	177	14.4	2.0	.77	1.0
	11	174	15.7	2.5	.88	0.9
Strength	5	174	20.5	5.5	.92	1.6
	8	177	22.3	6.1	.85	2.4
	11	174	22.7	5.8	.90	1.8
Speed	5	174	12.2	0.9	.91	0.3
	8	177	16.0	1.3	.95	0.3
	11	174	15.7	1.1	.87	0.4
Endurance	5	174	12.7	3.7	.88	1.3
	8	177	13.3	2.6	.91	0.8
	11	174	14.2	2.3	.82	1.0
Total	5	174	19.3	4.7	.91	1.4
	8	177	20.3	5.1	.92	1.4
	11	174	22.9	4.7	.90	1.5

Table V

Reliability Coefficients and Standard Errors of Measurement For Boys (1976). The New York State Physical Fitness Screening Test: For Boys and Girls Grades 4-12 (1977 Revision)

Test Item	Grade	N	Mean	Standard Deviation	r	SE_m
Agility	5	377	14.6	2.6	.79	1.19
	8	334	17.0	2.7	.72	1.43
	11	348	19.9	3.5	.84	1.40
Strength	5	377	31.9	8.2	.91	2.46
	8	334	40.4	9.4	.89	3.12
	11	348	42.8	8.1	.89	2.69
Speed	5	377	15.3	1.7	.92	0.48
	8	334	22.0	1.7	.85	0.66
	11	348	20.3	1.7	.93	0.45
Endurance	5	377	15.5	4.3	.79	1.97
	8	334	31.0	6.9	.89	2.29
	11	348	33.6	7.2	.86	2.69
Total	5	377	20.5	4.9	.89	1.63
	8	334	20.5	5.1	.92	1.44
	11	348	21.3	5.4	.93	1.43

Table VI

Reliability Coefficients and Standard Errors of Measurement for Girls (1976). The New York State Physical Fitness Screening Test: For Boys and Girls Grades 4-12 (1977 Revision)

Test Item	Grade	N	Mean	Standard Deviation	r	SE_m
Agility	5	333	14.3	2.5	.78	1.17
	8	321	16.2	2.4	.72	1.27
	11	320	17.1	2.4	.74	1.22
Strength	5	333	27.2	7.9	.91	2.37
	8	321	30.5	7.4	.89	2.45
	11	320	31.3	8.1	.93	2.14
Speed	5	333	16.0	1.7	.93	0.45
	8	321	23.6	2.2	.89	0.73
	11	320	22.8	2.7	.75	1.35
Endurance	5	333	15.0	3.1	.81	1.35
	8	321	24.4	5.9	.88	2.04
	11	320	25.7	6.0	.89	1.99
Total	5	333	19.8	4.8	.89	1.59
	8	321	20.4	5.0	.90	1.58
	11	320	22.3	5.0	.90	1.58

Table VII

Reliability Coefficients and Standard Errors of Measurement for Boys (1983). The New York State Physical Fitness Screening Test: For Boys and Girls Grades 4-12 (1984 Revision)

Test Item	Grade	N	Mean	Standard Deviation	r	SE_m
Agility	6	823	14.14	3.16	.69	1.8
	8	753	16.56	3.97	.81	1.7
	10	496	17.57	4.54	.67	2.6
Strength	6	823	29.80	9.74	.79	4.4
	8	753	37.43	9.51	.89	3.1
	10	496	39.38	8.53	.83	3.5
Speed	6	823	14.87	1.67	.82	0.7
	8	753	21.19	2.78	.91	0.8
	10	496	21.88	2.23	.79	1.0
Endurance	6	823	14.09	3.92	.66	2.3
	8	753	27.22	7.99	.85	3.1
	10	496	29.25	7.58	.77	3.7
Total	6	823	18.59	5.30	.81	2.3
	8	753	20.02	5.60	.89	1.9
	10	496	18.66	6.15	.86	2.3

Table VIII

Reliability Coefficients and Standard Errors of Measurement for Girls (1983). The New York State Physical Fitness Screening Test: For Boys and Girls Grades 4-12 (1984 Revision)

Test Item	Grade	N	Mean	Standard Deviation	r	SE_m
Agility	6	799	12.91	3.82	.83	1.6
	8	647	15.65	3.19	.75	1.6
	10	1011	16.03	4.20	.59	2.7
Strength	6	799	24.16	9.88	.84	3.9
	8	647	31.02	9.56	.89	3.2
	10	1011	30.84	8.53	.83	3.6
Speed	6	799	15.92	1.91	.79	0.9
	8	647	23.24	2.85	.90	0.9
	10	1011	24.60	2.60	.64	1.6
Endurance	6	799	13.52	3.78	.71	2.0
	8	647	23.90	8.13	.83	3.4
	10	1011	23.21	7.03	.81	3.0
Total	6	799	18.31	5.87	.87	2.2
	8	647	19.72	5.67	.87	2.1
	10	1011	19.84	5.74	.84	2.3

based upon 1981-82 enrollment data. Then, within these geographic regions, stratification was done by public/nonpublic schools, and minority representation. To determine its reliability, the Physical Fitness Screening Test was administered twice during the fall of 1983 with approximately three weeks between testing, to a sample of 4,530 pupils in grades 6,8, and 10 in twenty-one public and nonpublic school districts in the State. The test-retest reliability coefficients for total and part scores are reported in Table VII for boys, and Table VIII for girls. The reliability coefficients from Table VII and VIII are lower than those in Table V and VI; even though they are lower, they are still acceptable. The reliability coefficients for the endurance component were 0.66, 0.85, and 0.77 for boys and 0.71, 0.83, and 0.81 for the girls.

The test norms were changed in 1975 and 1983 because of the changed status of the youngsters. The youngsters improved not only because of exercise but because of improved physical education instruction. The test items were also changed along with the time allotment for each test.

The test is generally safe; only common sense such as preliminary stretching and care of proper spacing for each station is needed. However, the manual stresses that in no case should this test be given to pupils whose medical status is questionable. This question of medical status is left to the discrimination of the physical educators giving the test and the doctors who have excused their patients.

Squat-Thrusts Test Component of the New York State Physical Fitness Test

The Squat-Thrust test basically involves speed. The time limit for all performers in grades 4 through 6 is 30 seconds. The time limit for all performers in grades 7 through 12 is 1 minute. The performer's raw score is the total number of squat-thrusts that are sucessfully completed in the given time.

Phillips and Hornak (1979) stated the reliability of the squat-thrust test is 0.92. The reliability coefficients for squat-thrusts given in 1979 were 0.79 - 0.89. According to Fox and Corbin (1985) the squat-thrusts component of the New York State Physical Fitness Test is one of the simplest tests of aerobic fitness. According to the President's Council on Physical Fitness and Sports (1973), the squat-thrust test measures the fitness component agility. Getchell (1979) states that the purpose of the squat-thrust is to determine one's ability to move large muscle groups rapidly and to sustain this total body movement for a specific period of time.

Cooper's Twelve-Minute Run/Walk Test

Balke first developed a fifteen-minute field test, which Cooper modified to a twelve-minute run test. Cooper's twelve-minute run/walk test involves measuring the distance covered by running, or running and walking, for a time of twelve minutes. Cooper's twelve-minute run/walk test is a relative measure of aerobic capacity. Cooper has suggested that the individual can make a rough assessment of his or her aerobic capacity in milliliters per kilogram per minute by testing the distance they can run in twelve minutes. Fox, Mathews, & Bairstow (1980), in "Interval Training for Lifetime Fitness," state that Cooper suggests that the distance one travels by running, swimming, or cycling in twelve minutes correlates very well with aerobic capacity. Astrand and Rodahl (1970, p. 293) state that the maximal oxygen uptake is approximately the same whether it is measured while running on a treadmill or during cross-country skiing or bicycling. Cooper's test constitutes a valid as well as a practical field test for aerobic capacity in individuals (Weiler, Klenk, Kullmer, & Kindermann, 1984; Fox & Corbin, 1985). Doolittle and Bigbee (1968) used the test on 153 ninth grade boys and found the validity to be 0.90 when compared to the Balke Treadmill Test. Test-retest reliability correlation was 0.94. They also found the twelve-minute run/walk test to be a more valid test than the 600-yard run/walk test (r=0.62). Cooper reported a content validity of 0.90. Mathews (1978, p. 280) states,

> "Validity of the 12-minute test was determined by correlating distances covered with maximal oxygen consumption determinations obtained under laboratory conditions. Correlations of 0.90 and 0.92 have been reported."

A comparison of a field test (Twelve-Minute Running Test) and a treadmill ergometric exercise test in the assessment of the aerobic capacity by Weiler, et al., (1984) reported a coefficient correlation between the twelve-minute run test and the treadmill test of 0.90. Cooper's twelve-minute run has a correlation coefficient of 0.90 with treadmill measurements of maximum oxygen consumption (Mood, 1980; Cooper, 1970). McAdam (1980) also states that the twelve-minute run test has demonstrated a high correlation with aerobic capacity. Gettman (1980) states studies by Krahenbukl et al.(1977) and Gutin, Fogle, and Stewart (1976) have shown that running tests in the longer distances such as 1,609 meters and 1,200 yards correlate highest with max. VO2. Safrit (1973) summarized the content validity and reliability of the twelve-minute run and presents content validity coefficients of 0.65, 0.90, and 0.89 from three different studies. The criterion was maximum oxygen uptake. Reliability coefficients from four studies ranged from 0.82 to 0.94.

Cooper's completed research studies (1972), at the Institute for Aerobics Research of Dallas, have shown that in runs completed in less than 8 to 10 minutes much of the energy used comes from anaerobic energy sources. He found that after a "best-effort" one minute run, slightly more than 60 percent of the work is performed anaerobically. At 10 minutes of work, less than 10 percent of the work is anaerobic. Cooper stated that if maximum work is performed for 10 to 20 minutes, the predominant energy source is dependent on the utilization of oxygen. An adequate estimate of one's aerobic capacity will therefore result. Cooper (1972, p. 32) stated that, "The mile run - let alone the 600-yard run - is much too short to accurately test for endurance or aerobic capacity." Dorociak (1981) found coefficients of runs 4,8, & 12 minutes with max VO2 were 0.86, 0.87, and 0.89. Disch, Frankiewiez, and Jackson (1975) in their study, "Constant Validation of Distance Run Tests" concluded that the two-mile and the twelve-minute run had the highest validity in measuring aerobic capacity.

Different populations may have an effect on the reproducibility of the data and the test validity. In Cumming's study, "Correlation between the twelve-minute run and laboratory measures of endurance fitness", the results for the twelve-minute run were quite reproducible in boys with a test-retest reliability coefficient of 0.87, but they were less reproducible in girls with a test-retest reliability coefficient of 0.76. Shephard (1971) stated that tests in boys and in servicemen have shown coefficients of correlation as high as 0.90 between the directly measured aerobic power and scores on the twelve-minute test.

However, Shephard (1971) pointed out that the validity of the twelve-minute score is highly dependent upon the motivation of the subjects, and probably for this reason the correlation of results with the maximum oxygen intake drops to 0.70 or less in women. This may also be due to body fatness or running efficiency. Before the age of twelve there is no significant difference between girls and boys; thereafter the average difference in aerobic capacity between women and men amounts to 25 to 30 percent. In relation to body weight the sex difference in aerobic capacity after puberty is 15 to 20 percent. With this in mind, while testing, it is essential that all entrants compete to the limit of their aerobic capacity.

Cooper (1982) gives a chart in Figure 3 that tells a person how to rate themselves on the twelve-minute test, and in contrast to previously published test charts, this has been adjusted for different age groups. The original twelve-minute test chart was designed for male Air Force personnel whose average age was under 30.

ure 3 .

Minute Walking/Running Test

nce (Miles) Covered in 12 Minutes

oper, 1982)

ss Category		13-19	20-29	30-39	40-49	50-59	60+
				Age (years)			
Very Poor	(men)	<1.30*	<1.22	<1.18	<1.14	<1.03	< .87
	(women)	<1.0	< .96	< .94	< .88	< .84	< .78
Poor	(men)	1.30-1.37	1.22-1.31	1.18-1.30	1.14-1.24	1.03-1.16	.87-1.02
	(women)	1.00-1.18	.96-1.11	.95-1.05	.88- .98	.84- .93	.78- .86
Fair	(men)	1.38-1.56	1.32-1.49	1.31-1.45	1.25-1.39	1.17-1.30	1.03-1.20
	(women)	1.19-1.29	1.12-1.22	1.06-1.18	.99-1.11	.94-1.05	.87- .98
Good	(men)	1.57-1.72	1.50-1.64	1.46-1.56	1.40-1.53	1.31-1.44	1.21-1.32
	(women)	1.30-1.43	1.23-1.34	1.19-1.29	1.12-1.24	1.06-1.18	.99-1.09
Excellent	(men)	1.73-1.86	1.65-1.76	1.57-1.69	1.54-1.65	1.45-1.58	1.33-1.55
	(women)	1.44-1.51	1.35-1.45	1.30-1.39	1.25-1.34	1.19-1.30	1.10-1.18
Superior	(men)	>1.87	>1.77	>1.70	>1.66	>1.59	>1.56
	(women)	>1.52	>1.46	>1.40	>1.35	>1.31	>1.19

ans "less than"; > means "more than."

Requirements of a Cardiovascular Fitness Test

Astrand and Rodahl (1977, p. 342) have mentioned that ideally, any test of maximal oxygen uptake should meet at least the following general requirements:

> 1. The work in question must involve large muscle groups.
>
> 2. The work load must be measureable and reproducible.
>
> 3. The test conditions must be such that the results are comparable and repeatable.
>
> 4. The test must be tolerated by all healthy individuals.
>
> 5. The mechanical efficiency (skill) required to perform the task should be as uniform as possible in the population to be tested.

These requirements are in agreement with Safrit, (1980, p. 214), who suggests that, "Oxygen uptake for a work task depends on the amount of muscle mass active during the exercise." Allsen states (1981) that any activity that uses large muscle groups that can be maintained continuously and is rhythmical and aerobic in nature, such as running, jogging, walking, hiking, swimming, skating, bicycling, rowing, cross-country skiing, and rope skipping, will increase aerobic fitnes. Boyer (1972) states that aerobic fitness requires hundreds to thousands of repetitions of relatively easy loads in order to produce aerobic fitness. DeVries (1974, p. 190) states, "In order to make meaningful measurement of the physiological process during exercise, the exercise work load must be set up in such fashion as to be measureable and repeatable, and it should require little skill.

The AAHPERD in 1980 stated criteria important in a fitness test:

> 1. A physical fitness test should measure a range which extends from severely limiting dysfunction to high levels of functional capacity;
>
> 2. It should measure capacities that can be improved with appropriate physical activity; and
>
> 3. It should accurately reflect an individual's physical fitness status as well as changes in functional capacity by corresponding test scores and changes in these scores.

Cunningham (1980, p. 482) lists the usual criteria accepted as substantial evidence that maximum VO2 has been attained in adult populations:

> 1. The use of an exercise task in which large muscle groups are engaged;
> 2. the development of high levels of lactic acid (or blood lactate) as an indication of anaerobic metabolism; and
> 3. the establishment of a plateau in oxygen uptake with increased work at peak work levels.

Factors to be considered in determining that maximal oxygen uptake is recorded for a particular test are: exercise posture, muscle mass used in the exercise, exercise intensity, exercise duration, mechanical efficiency for the task, and the motivation of the subject (Lamb, 1984) p. 177. Posture must be upright, either sitting or standing, because the highest oxygen uptakes observed in horizontal position are less than vertical positions. Because the increased activity of skeletal muscles accounts for most of the increased oxygen uptake during exercise, it is obvious that large muscles must be used if aerobic capacity is to be attained. About fifty percent of the total muscle mass must be engaged in exercise before maximal oxygen uptake can be achieved (Lamb, 1984) p. 178. Both exercise intensity and duration must be great enough to elicit a near maximal response of the cardiovascular system if maximal oxygen uptake is to be attained. A good test of maximal oxygen uptake should not depend on the skill or motivational levels of subjects.

The Balke Progressive Treadmill Test test has been employed in physiology testing laboratories for measuring aerobic fitness. This test requires the attainment of a heart rate of 180 beats per minute as the criterion for functional maximal aerobic capacity and has been shown to be a highly reliable and valid measure (Safrit, 1980). This treadmill test involves the utilization of large muscle masses; the arms and shoulders can and do enter into the activity.

Aerobic Capacity and Children

Numerous studies, including work by (Corbin, 1980; Gallahue, 1982) now clearly indicate that a healthy child can not physiologically injure the heart permanently through exercise unless the heart is already weakened. Vigorous cardiorespiratory fitness programs are not uncommon with children 4 - 6 years of age (Gabbard & LeBlanc, 1986). Clearly, in most instances the problem is not development of fitness in children but maintenance of fitness as the individual moves into the years of early and middle adulthood.

Powers (1984) states that young children generally have a lower maximal aerobic power and less power reserve than adults. Astrand and Rodahl (1977, p. 379) state that children's muscular strength is low and so is their maximal oxygen uptake and other parameters of importance for the oxygen transport.

Astrand and Rodahl (1970) stated that Astrand's (1952) study, "Experimental Studies of Physical Working Capacity in Relation to Sex and Age" concluded that the maximal oxygen uptake in 7 to 9 year old boys averaged 1.75 liters/minute. For sixteen to eighteen year olds the average maximal oxygen uptake was 3.68 liters/minute.

Summary Statement

ATP can be supplied to the skeletal muscles in three different ways: by the ATP-PC system for short, high-intensity activities; by the lactic acid system for intense activities of intermediate length; and through the aerobic system for the long-term, low-intensity activities. Mathews (1978) states that events that take longer than four minutes to perform require oxygen to produce the needed energy. The individual running two miles or further would derive his/her energy predominately through aerobic metabolism; in runs of less than a mile, anaerobic pathways would be the primary means for deriving the necessary energy. Steinhaus (1963) states muscles are able to contract and relax without oxygen, but they soon fatigue. Oxygen is necessary for recovery from fatigue. If a muscle is supplied with sufficient oxygen, it does not become fatigued.

There is an inverse, nonlinear relationship between intensity and duration of exercise. If intensity is low, duration can be long and the activity can be predominatly aerobic. Cooper's Twelve-Minute Run/Walk Test is an example of low intensity and long duration. On the other hand, the squat-thrust test is an example of high intensity and brief duration. This suggests that the squat-thrust test is performed anaerobically.

Tests that measure maximal oxygen uptake should meet the following minimum requirements:

1. Large muscle mass is involved during the entire exercise.

2. The exercise is continuous, rhythmical and aerobic in nature.

3. It is measurable and repeatable and should require little or no skill.

Relatively few tests have been constructed to measure youth aerobic fitness exclusively. However, tests that measure maximal oxygen uptake are suitable for children, as young as four years old.

Chapter III

Methods and Procedures

The purpose of this study was to determine if the squat-thrust test component of the New York State Physical Fitness Test was a valid test of aerobic fitness. Cooper's Twelve-Minute Run/Walk Test was used as the criterion measure of aerobic capacity.

Approval for this study was granted by the Institutional Review Board at SUNY-Brockport. A full review was completed.

Eight hundred and thirty-six students were tested, and twenty students dropped out while taking Cooper's twelve-minute run/walk test. Students were tested on two fitness tests (Cooper's-Twelve Minute Run/Walk Test and the Squat-thrust Test component of the New York State Physical Fitness Test.) Students tested were in the fourth grade, eighth grade, eleventh grade and twelfth grade. Each student received a cover letter and consent form one month before the testing began (Appendix B). Subjects who had a medical history warranting their exclusion, an injury, or did not have the consent form signed were not tested. Four school districts were used in this study, including Watertown Central, South Jefferson Central, St. Gregory's School for Boys, and Ichabod Crane Central School. All school districts granted permission to testing by written consent (Appendix C).

The subjects in this study were known by number rather than by name, and the data collected for this study were saved for future studies. The parent or guardian had the right to withdraw consent and discontinue participation at any time, and had the right to request information that was received through testing. Completed research and data were maintained in a secure file. A copy of the thesis is available at the Physical Education Department, and the Library of SUNY-Brockport.

A stop watch was used for both tests. A track or gym of any size was necessary for testing purposes. Figure 4 illustrates size variations of tracks and gyms.

The order of testing consisted of, warm-ups, five minute rest period, explanation-demonstration and administration of the squat-thrust test, rest period of five minutes, explanation and administration of the twelve-minute run/walk test, and cool down.

All testing was performed during one physical education class. Classes were arranged in a circle while performing the warm-ups. The warm-up was given to prepare the body for the increased stress which was placed upon the subjects. With the warm-up the heart rate was gradually increased from the resting pulse. The warm-up exercises consisted of ten jumping jacks, a run in place for thirty seconds, four head to knee stretches, eight lunges, and four groin stretches. These exercises were chosen because of the large muscle masses involved in performing them. These exercises use

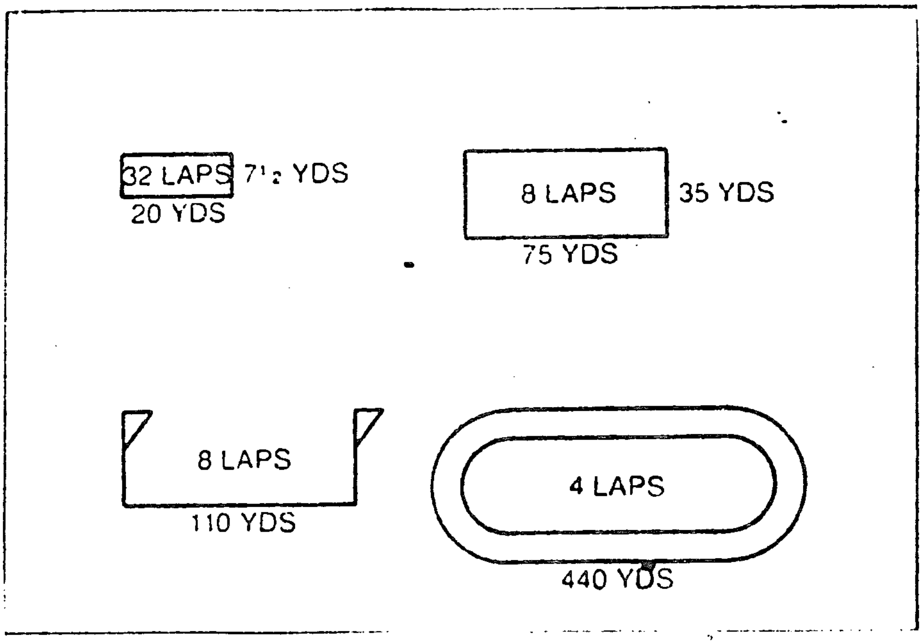


Figure 4. Course construction for distance run tests that equal 1 mile (AAHPERD, 1980)

approximately the same muscles necessary in performing the squat-thrust test and the twelve-minute run/walk test.

The head to knee stretch involved standing with the right leg crossed over the left. The student bent at the trunk and held the head as close to the knees as possible. This was held for the count of twelve. Four repetitions were used. This exercise was then reversed, with the left leg crossed over the right.

The lunges involved having the performer stand with his or her feet about shoulder width apart. The performer leaned toward the right, with weight being distributed out toward the knees. The hands were held on the hips. The right foot was about three feet away from the left foot and perpendicular to it. No bouncing occurred during this stretch. This was held for a count of twelve seconds. Then the performer leaned toward the left, and the foot position was reversed. This was repeated eight times.

The groin stretch was performed while sitting down. The students were seated with the knees bent and the soles of their feet touching in front of them. Gradually they pressed down on the knees as far as possible. They held the final stretched position for at least twelve seconds, and relaxed between each stretch. Four repetitions were used.

These warm-up exercises took five minutes to complete. During the five minute rest period, following the warm-ups, students filled out a notecard that was given to them by the researcher (Figure 5). At the conclusion of the rest period

#00

School: ____________________

Sex: ______

Age: ______

	SQUAT-THRUSTS	12 MINUTE RUN
RAW SCORE:	____________	____________

Figure 5. Notecard for data collection

the researcher proceeded to explain and demonstrate the squat-thrust test.

Squat-Thrust Test

An explanation for performing the squat-thrust test was given prior to the test. The four position squat-thrust (Figure 1) was explained in detail by the researcher. The researcher stated,"One complete squat-thrust is counted each time the performer returns to the starting position of the 4-position exercise. The performer is not allowed to stop and rest between squat-thrusts. If the performer does not assume each of the four positions during one cycle of the four count exercise, a foul is commited and the squat-thrust does not count." The researcher also told the students specifically that, "legs should be fully extended while in the push-up position; and that students should come to a complete stand in order to count it as one complete squat-thrust." The researcher demonstrated one complete squat-thrust.

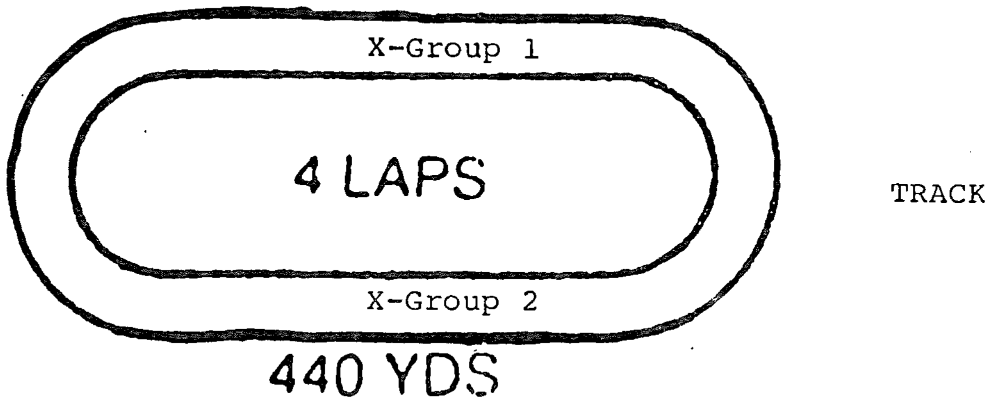
The students were grouped into pairs for the squat-thrust test. The teacher acted as the starter and the timer while the pupils acted as performers and scorers. Most students were familiar with this test since it was already given once at the beginning of the school year to grades four through twelve.

The pupils being tested took the erect standing position of attention. The scorers stood at the side of the performer, in order to observe the profile view. Before starting the test, the researcher said: "I would like you to perform as many squat-thrusts as you can do during this time (30 seconds or 1 minute). When you feel as though you want to stop try to do one more." Each subject had a partner who acted as the scorer. They were asked if they had any questions before the test. The commands were "Ready - Go." On "Go" they performed the activity. The four position squat-thrust test involved performing as many squat-thrusts as possible during the time given. At the command "Ready - Go," the performer bent at the knees and placed the hands on the floor. The arms were between, outside of, or in front of the bent knees (position 1.) Then the performer extended the legs backward keeping the arms and body straight as in the push-up position (position 2.) The performer then returned to the squat postion (position 3) and finally to the erect starting position (position 4.) Figure 1. Subjects stopped at the sound of the whistle. The researcher gave positive feedback at the fifteen-second time for subjects in the sixth grade. The subjects were told: "Fifteen seconds to go - Push hard - Do as many squat-thrusts as you can." The researcher gave positive feedback at the thirty second time for subjects in the eighth, eleventh and twelfth grades. The subjects were told: "Thirty seconds to go - Push hard - Do as many squat-thrusts as you can."

After the squat-thrust test was completed the students had a five minute rest period before starting Cooper's twelve-minute run/walk test.

Cooper's Twelve Minute Run/Walk Test

An explanation for performing the twelve-minute run/walk test was given prior to the test. The researcher said to the subjects: "The twelve minute run test involves measuring the distance covered by running, or running and walking for a time period of twelve minutes. If a subject stops during this test his/her raw score is not recorded." Students were asked to count the laps as they went around the gymnasium/track. The commands were the same as for the squat-thrust test, "Ready, Go." The researcher said to the subjects: "I would like you to do your very best running today. You may run, then walk if you get tired. I'd prefer that you walk briskly. Please do not stop - keep moving at all times. If you do stop please put a zero on your score card. Remember to count your laps as you go by from where you started. A good way to remember your laps is to use your fingers." Students were asked if they had any questions concerning the test before they started. Classes were divided into two or four small groups, and were spaced accordingly around the track and gymnasium (Figure 6). This spacing accommodated more students and prevented injuries and restriction of movement. Students were given verbal encouragement and positive feedback from the investigator at



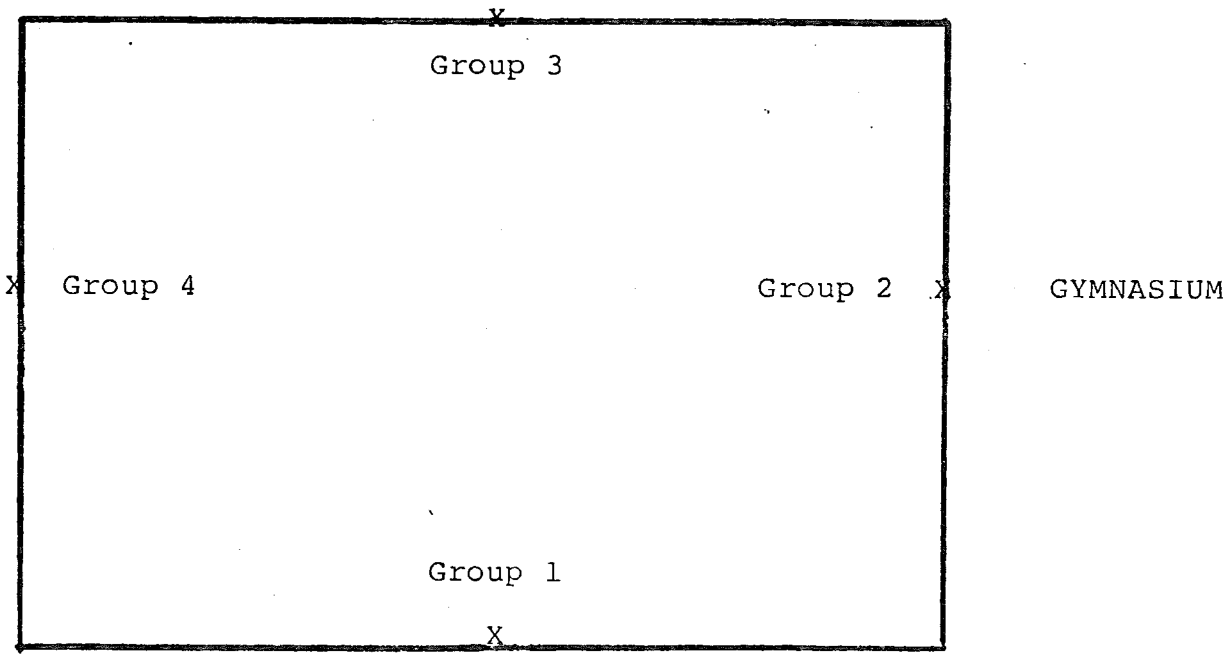


Figure 6 . Organization of subjects for the 12 Minute Run/Walk Test

intervals of 3 minutes (3rd,6th, and 9th minute). The researcher spoke these comments to the subjects during the twelve minute run (3rd, 6th, and 9th minute): " Everyone is doing a great job! Keep it up. Do your very best! Looking good! Keep moving." The investigator also stated to the subjects when six minutes had passed and when there was only one minute left in the testing. It should be realized that not everyone was able to run the entire time. The researcher stated, "Walking is acceptable if necessary." Almost all students were able to complete the test at some level. Subjects stopped at the sound of the whistle. At the conclusion of the run the students recorded their lap count on their notecard. Partial lap completions were recorded as 1/4, 1/2, or 3/4 of the track or gym, that were completed at the conclusion of the twelve-minute test (Figure 7). After they recorded their lap count the students were instructed to walk around the track for three minutes. At the conclusion of the walk the students were encouraged to again stretch.

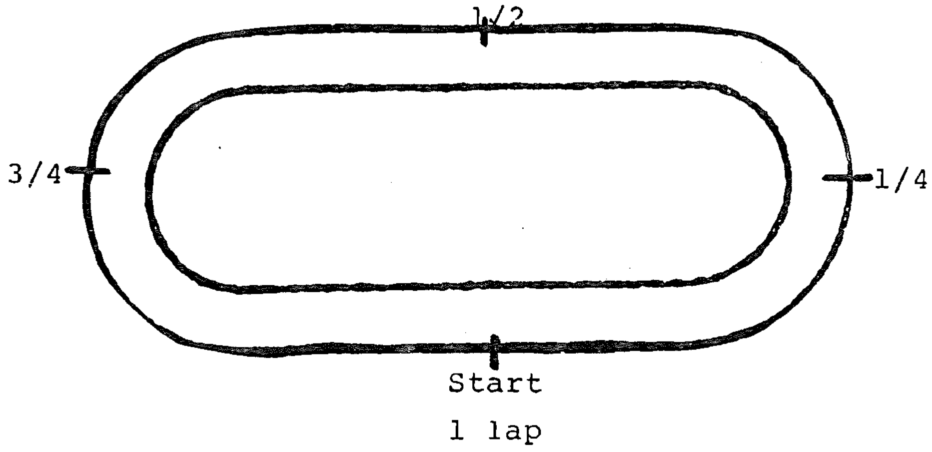


Figure 7. Recording of partial lap completions on the last lap

Adverse Reactions to Exercise

It is very important to understand reactions to exercise which may indicate possible medical problems. There are a number of observable signs which may accompany or follow exercise warranting further investigation. Students were referred for medical attention for the following symptoms:

Excessive Breathlessness: Some breathlessness is normal with exercise, but breathlessness that persists long after exercise has ceased is cause for medical attention.

Bluing of the Lips: Except in a cold wet environment, bluing of the lips or nailbeds is an unnatural reaction to exercise.

Pale or Clammy Skin: Pale or clammy skin or cold sweating following or during exercise is not a normal reaction to physical activity within the ususal temperature ranges of the gymnasium or playing field.

Persistent Shakiness: Unusual weakness or shakiness that continues for more than ten minutes following even vigorous exercise is cause for medical referral. Normally, recovery will be reasonably prompt.

If a student experiences headache, dizziness, fainting spells, pounding or uneven heartbeat while participating in physical activity he/she should be seen by the school nurse immediately. It may be wise to remember that some of the symptoms and signs mentioned above are transient and may indicate only that a boy or girl is physically unfit.

Chapter IV

Methods of Analysis

The Cooper Test was used as the criterion measure for determining the validity of the squat-thrust test as an indicator of aerobic fitness. Raw scores collected from the data were used to determine the relationship between the twelve minute run test and the squat-thrust test of the New York State Physical Fitness Test. Data were statistically analyzed by Pearson r. All data were analyzed as group data, and individual results remained anonymous. This was a correlational design research study.

Results

Eight hundred and thirty-six students were tested,and twenty students stopped while taking the twelve-minute run test. The correlation coefficient between the squat-thrust test and Cooper's Twelve-Minute Run/Walk Test was $r=+0.30$ (Appendix D). This coefficient does not indicate a relationship between the Twelve-Minute Run/Walk Test and the Squat-thrust Test. Raw scores on these tests indicate a pupil's performance without indicating how well he or she performs in comparison with others.

Conclusion

The results supported the research hypothesis, that there is a low correlation between performance on Cooper's Twelve-Minute Run/Walk Test and performance on the Squat-thrust Test in the New York State Physical Fitness Test. The correlation coefficient was $r=+0.30$. Coefficients in the 0.60's and 0.70's are usually considered adequate for group prediction purposes. With these results from the data, these two tests were significantly different.

Discussion

The twelve-minute run/walk test has the highest field validity of any measure of aerobic capacity (Noble, 1986). Results of this test, easily attained, are highly related to laboratory results in a large segment of the population from healthy children through adults, Weiler, Klenk, Kullmer & Kindermann (1984); Fox and Corbin (1985); Doolittle & Bigbee (1968); Mathews (1978); Disch, Frankiewiez, and Jackson (1975); Noble (1986); and Safrit (1986). The twelve-minute run/walk test is very practical in any public or private school setting. Further, it meets the requirements as a cardiovascular fitness test: Astrand & Rodahl (1977); Safrit (1980); AAHPERD (1980); and Lamb (1984).

Cooper (1972) found that after a "best-effort" one minute run, slightly more than sixty percent of the work was performed anaerobically. This supports the hypothesis that the squat-thrust test (thirty seconds and one minute) is too short in duration to test for aerobic fitness. The low correlation between the two tests may be due to the short duration of the squat-thrust test, preventing it from measuring aerobic fitness.; Fox & Mathews (1974); Ribisil (1980); Corbin & Lindsey (1985); and Fox & Mathews (1976).

An increasing number of athletic teams have been using both the twelve minute run/walk test and the 1.5 mile tests in conjunction with their off-season and in-season conditioning. Gettman (1980) states that the twelve-minute test has been used sucessfully in several school-aged fitness programs (Goode et al., 1976; Gutin, Fogle, & Stewart, 1976; Maksud & Coutts, 1971). Cooper and his coworkers (1975) have reported a 17.5 percent improvement in the twelve-minute run/walk test for 778 students (mean age 15.4 years) who added progressively five to fourteen minutes of jogging to their daily physical education classes.

Activities that have a strong anaerobic component such as sprinting, football, baseball, and sprint swimming are a very popular among youth, while aerobic activities are very popular among adults. Physical educators are responsible for introducing children to activities that they can engage in during their entire life span. The emphasis on physical activity for children should stress those activities which develop cardiovascular endurance.

Recommendations

The author is recommending that the Cooper Twelve-Minute Run/Walk Test be substituted for the squat-thrust test to measure aerobic fitness. This researcher would also like to recommend the history of the New York State Physical Fitness Test be put on file at the New York State Education Department in Albany. The researcher also suggests that the squat-thrust test be retained to assess anaerobic capability. This research seems to indicate that the squat-thrust test does not measure aerobic fitness.

Summary

Many physical fitness tests have been published in the United States; only a handful have been developed with an adequate concern for type of fitness, test validity, and test reliability (Safrit, 1986). The squat-thrust test component of the New York State Physical Fitness Test is no exception to this statement. Through the preliminary study of the New York State Physical Fitness Test, in the review of literature, the mile run was considered the best single measure of endurance.

Most schools require a routine physical exam in conjunction with competitive athletic programs (Selection Classification Testing). Each component tested should be successfully passed by the student; if not, the student should not participate in that sport for that academic year.

If students in junior high school (seventh and eighth grade), are interested in a junior varsity or varsity sport they are often required to do a certain number of squat-thrusts, sit-ups, and other physical performances for that particular sport, in order to participate as a team member. If students receive a poor score in the endurance category, they are told they have poor endurance. But, if the teacher has them run the twelve-minute run/walk test they find a different result. With the squat-thrust test showing a low correlation with the twelve-minute run, the selection classification testing for athletes would seem to be invalid. The squat-thrust test does not seem to measure what it purports to measure.

The researcher would like to recommend a pilot study which would include Cooper's twelve-minute run/walk test as part of the New York State Physical Fitness Test. This would then be a non-voluntary test required in physical education classes (pilot schools). This would show on a larger scale the correlation between the squat-thrust test and the Cooper Test.

Haarer (1983) suggests that educators need to keep in mind the following key points when admininstering and evaluating physical fitness tests: 1) that educators are familiar with the test and how to administer it; 2) that the test measures what it is intended to measure; 3) that more than one test is used to measure each component of fitness; 4) that they allow adequate rest between every item and follow the same order for each item; 5) that students are familiar with test items; 6) that motivation is provided; and 7) that proper scoring procedures are followed.

Aerobic fitness testing can help ensure that each student leaves the secondary school with an appreciation of lifetime fitness and understanding of the means by which it can be maintained. Whatever tests are employed in working with children it is necessary to make application of the results to the program.

Many studies may follow this one, including determining the role of practice and no practice, and motivation and silence during the testing.

The results of the data and the review of literature, indicate that the squat-thrust test does not measure endurance in the New York State Physical Fitness Test. Educators need to be aware of test validity and reliability before administering a test to students. It is the duty of physical educators to give accurate feedback to their students.

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APPENDIX A

Schools Participating in the Preliminary Phase of the Testing for the New York State Physical Fitness Test

Schools Participating in the Preliminary Phase of the Testing

Accuracy

Manhasset High School, Manhasset, N. Y.
Plandome Road School, Manhasset, N. Y.
Valley Stream High School, Valley Stream, N. Y.

Agility

Amityville High School, Amityville, N. Y.
Garden City High School, Garden City, N. Y.

Balance

Albany High School, Albany, N. Y.
Philip Livingston Junior High School, Albany, N. Y.

Endurance

Bronxville High School, Bronxville, N. Y.
Proctor High School, Utica, N. Y.

Posture

Joan of Arc Junior High School, New York, N. Y.
Midwood High School, New York, N. Y.

Speed

Bayshore High School, Bayshore, N. Y.
Central Park Junior High School, Schenectady, N. Y.
Nott Terrace High School, Schenectady, N. Y.

Strength

Bronxville High School, Bronxville, N. Y.
Scarsdale High School, Scarsdale, N. Y.
South Side High School, Rockville Centre, N. Y.

APPENDIX B

Cover Letter and Consent Form for Testing

October 26, 1987

Dear Parent/Guardian:

I am a graduate student at SUNY-Brockport. I graduated from SUNY Cortland in May of 1982. For the past four years I have been teaching physical education at Ichabod Crane Middle School (6-8) in Columbia County. I am presently involved with thesis work to complete my masters degree requirements at Brockport.

Physical fitness has always been considered an important goal in physical education. Cardiovascular fitness tests are given each year in regular physical education classes. The New York State Education Department recognizes the Squat-Thrust component of the New York State Physical Fitness Test and the Twelve Minute Run/Walk Test (Cooper's) as cardiovascular fitness tests. The purpose of this research is to determine if the squat-thrust test component of the New York State Physical Fitness Test measures cardiovascular endurance. The two tests that will be given are the squat-thrust test and the twelve minute run/walk test (Cooper's). The Cooper's Test will serve as the criterion measure against which the Squat-Thrust Test will be evaluated.

The squat-thrust test is a timed event of 30 seconds for students in grades 4-6, and one minute for grades 7-12. The object is to perform as many squat-thrusts as possible in the time allowed.

The Twelve Minute Run Test (Cooper's) involves measuring the distance covered by running, or running and wallking, for a time of 12 minutes.

All participants will have a warm-up and a warm-down. Some students may exhibit soreness and/or fatigue which is due to the demands put on the body through physical activity. Benefits of cardiovascular fitness are numerous. An example is that increased exercise is thought to reduce the risk of coronary heart disease (CHD).

If you have any questions you may call me at [redacted]). Your son/daughter is free to withdraw from the testing at any time without any prejudice to the subject.

Sincerely,

Mary Bates Dorman

Parent/Guardian Consent Form

Thesis: Validity of the Squat-Thrust Component of the New York State Physical Fitness Test as a Measure of Cardiovascular Endurance

I AM REQUESTING THAT YOU SIGN BELOW

Description of the Research

The purpose of this research study is to determine if the squat-thrust test component of the New York State Physical Fitness Test measures cardiovascular endurance. Students who voluntarily consent will participate in the squat-thrust test which is part of the New York State Physical Fitness Test and the twelve minute run/walk test (Cooper's). The Cooper's Test will serve as the criterion measure against which the squat-thrust test will be evaluated. All testing will be conducted by the author. All testing will be completed during one class session. The data collected for this study will be saved for future studies. Students will be known by number rather than by name. All data will be analyzed as group data and individual results will remain anonymous.

Certification

This is to certify that I allow my child to participate in the above testing. I understand the purpose of the research and the component of physical fitness (cardiovascular endurance) being measured. I further understand that if I have any questions I may contact the author. I hereby give my consent for:

____
Student's Name Printed

to participate in the study. I reserve the right to withdraw my consent and discontinue participation at any time.

____
Parent/Guardian's Name Printed

____
Date: ____________ Parent/Guardian's Signature

Researcher: Mary Bates Dorman

Institution: SUNY-Brockport

APPENDIX C

Consent Letters for Testing from four School Districts

1. Ichabod Crane Central School
2. South Jefferson Central
3. St. Gregory's School for Boys
4. Watertown Central

December 12,1987

To Whom it May Concern:

Mrs. Mary Dorman, a teacher at Ichabod Crane Central School, Valatie, N.Y., had permission from the school district and the Physical Education Department to use our facilites and students in helping her work on her Masters Degree.

Sincerely yours,

Stephen Shaper

Physical Education Director

SOUTH JEFFERSON CENTRAL SCHOOL DISTRICT

P.O. Box 10 • Adams, New York 13605 | District Office • 315-232-4558

Elementary:

Wilson
583-5418

Scholtz
232-4841

Mannsville-Manor
465-4281

"SPARTANS"

Senior High & Guidance
232-4531

Junior High
232-4534

Transportation
583-5221

December 22, 1987

[redacted]

Dear Mary,

On behalf of the Physical Education Department at South Jefferson Central School I grant you permission to test a portion of our school population on the New York State Physical Fitness Tests. Our staff will be happy to assist you in any way on the testing dates you mentioned in your letter.

If you have any questions, please contact me at [redacted] any school day.

Sincerely,

George P. Hyde

George P. Hyde
Athletic Director

GPH/jkd

November 30, 1987

To Whom it May Concern:

Mrs.. Mary Bates Dorman, a teacher at Ichabod Crane Middle School, has permission from St. Gregory's School for Boys to test students and to use our facilities in helping her meet her master degree requirements at SUNY-Brockport.

Sincerely,

Mark Dorman
Athletic Director

CITY SCHOOL DISTRICT
PHYSICAL EDUCATION AND ATHLETIC DEPT.
WATERTOWN HIGH SCHOOL
WATERTOWN, NEW YORK 13601

OFFICE OF THE DIRECTOR

January 14, 1988

To Whom It May Concern:

The Watertown City School District granted permission for Mary Bates Dorman to administer the 12 minute run-walk and squat thrust test to district students grades 4-12. Over 800 students were tested.

Sincerely,

Charles B. Woodell, Coordinator
Physical Education & Athletics

APPENDIX D

Statistical Data

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
5	M	8	Wiley	5.25	11	
6	M	20	Wiley	7.5	18	1.00
7	M	21	Wiley	4.5	15	0.66
8	M	23	Wiley	6.5	15	0.65
9	F	17	Wiley	3.5	19	-0.04
10	F	16	Wiley	3.5	19	-0.25
11	F	89	Wiley	4.75	14	-0.21
12	F	92	Wiley	3.25	13	-0.04
13	F	93	Wiley	4	17	-0.07
14	F	88	Wiley	4	15	-0.05
15	M	79	Wiley	1	9	0.37
16	F	15	Wiley	5.25	16	0.38
17	M	71	Wiley	4.5	17	0.37
18	F	87	Wiley	3.75	16	0.36
19	M	80	Wiley	4.5	13	0.35
20	M	78	Wiley	6	19	0.41
21	M	77	Wiley	5.5	19	0.43
22	M	75	Wiley	6.25	14	0.38
23	M	74	Wiley	7.25	15	0.33
24	F	19	Wiley	3.5	13	0.36
25	F	18	Wiley	4.75	13	0.35
26	F	9	Wiley	4.25	11	0.35
27	M	11	Wiley	8.25	9	0.09
28	M	6	Wiley	6.5	21	0.17
29	M	73	Wiley	4.5	11	0.17
30	M	4	Wiley	5	15	0.17
31	M	81	Wiley	4.5	12	0.18
32	M	2	Wiley	8.5	22	0.32
33	M	7	Wiley	3.75	13	0.33
34	M	72	Wiley	5.5	17	0.33
35	F	24	Wiley	5.25	16	0.33
36	M	86	Wiley	4.5	13	0.34
37	M	5	Wiley	6.5	16	0.34
38	M	22	Wiley	4.75	11	0.34
39	M	3	Wiley	5	17	0.34
40	F	97	Wiley	3.5	9	0.37
41	F	83	Wiley	5.5	15	0.37
42	F	14	Wiley	3.5	15	0.36
43	F	35	Wiley	5.5	18	0.36
44	F	84	Wiley	3.5	13	0.37
45	F	95	Wiley	3.25	16	0.36
46	F	76	Wiley	3.75	12	0.37
47	F	90	Wiley	4	13	0.37
48	F	91	Wiley	4	13	0.38
49	F	85	Wiley	4.25	14	0.38
50	F	98	Wiley	4.25	16	0.37

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
51	F	99	Wiley	5.25	18	0.38
52	F	96	Wiley	6.5	12	0.34
53	F	12	Wiley	6	16	0.35
54	F	25	Wiley	6	14	0.34
55	F	82	Wiley	4.5	13	0.34
56	M	1	Wiley	6.5	18	0.36
57	F	94	Wiley	3.75	15	0.36
58	M	58	Wiley	5.5	12	0.34
59	M	42	Wiley	6	17	0.35
60	M	52	Wiley	3.25	11	0.37
61	M	45	Wiley	5.5	19	0.37
62	M	44	Wiley	5	19	0.37
63	M	43	Wiley	6.5	19	0.39
64	M	41	Wiley	5	20	0.38
65	M	63	Wiley	3.75	14	0.38
66	M	46	Wiley	6.5	20	0.40
67	M	65	Wiley	6.5	21	0.42
68	M	70	Wiley	5	15	0.42
69	M	69	Wiley	5	16	0.42
70	M	66	Wiley	6.75	17	0.42
71	M	68	Wiley	5.25	21	0.42
72	M	67	Wiley	5.25	16	0.42
73	M	59	Wiley	5.25	17	0.42
74	M	60	Wiley	3	5	0.45
75	M	61	Wiley	3.75	15	0.45
76	M	62	Wiley	3.75	19	0.43
77	F	102	Wiley	5.5	13	0.42
78	F	101	Wiley	5.5	15	0.42
79	F	56	Wiley	5	14	0.42
80	F	55	Wiley	3.75	14	0.42
81	F	53	Wiley	5.5	13	0.41
82	F	10	Wiley	4.75	15	0.41
83	F	26	Wiley	4	8	0.42
84	F	54	Wiley	4.5	14	0.42
85	M	64	Wiley	5	15	0.42
86	F	48	Wiley	5	12	0.42
87	F	49	Wiley	4	12	0.42
88	M	39	Wiley	4	16	0.42
89	M	40	Wiley	5.25	17	0.42
90	F	51	Wiley	4.5	12	0.42
91	F	38	Wiley	7.75	15	0.41
92	F	50	Wiley	4.5	12	0.41
93	F	31	Wiley	4.75	14	0.41
94	F	36	Wiley	5	10	0.40
95	F	28	Wiley	4.25	12	0.41
96	F	47	Wiley	5.75	12	0.40

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
97	F	30	Wiley	4.75	12	0.40
98	F	29	Wiley	4.5	13	0.40
99	F	32	Wiley	4.5	14	0.40
100	F	33	Wiley	5.5	14	0.40
101	F	27	Wiley	5.75	16	0.40
102	F	34	Wiley	7.5	15	0.39
103	F	37	Wiley	7.5	12	0.36
104	F	208	Wiley	4.25	16	0.36
105	F	210	Wiley	5.25	21	0.36
106	F	300	Wiley	6	10	0.34
107	F	294	Wiley	4	11	0.35
108	F	296	Wiley	4.5	15	0.34
109	F	287	Wiley	4.75	17	0.34
110	F	276	Wiley	3.75	16	0.34
111	F	297	Wiley	5.5	16	0.34
112	F	291	Wiley	8	18	0.35
113	F	269	Wiley	3.75	12	0.36
114	F	245	Wiley	4	15	0.35
115	F	284	Wiley	3.5	15	0.35
116	F	271	Wiley	8	18	0.36
117	F	293	Wiley	5.75	12	0.36
118	F	289	Wiley	4.75	13	0.36
119	F	274	Wiley	6.25	13	0.35
120	M	238	Wiley	6	20	0.36
121	M	244	Wiley	7.25	23	0.38
122	M	256	Wiley	6	15	0.38
123	M	243	Wiley	6	22	0.38
124	M	253	Wiley	5.5	15	0.38
125	M	241	Wiley	6	16	0.39
126	M	262	Wiley	6	17	0.39
127	M	248	Wiley	4	9	0.39
128	M	246	Wiley	6	23	0.40
129	M	247	Wiley	6	20	0.40
130	M	249	Wiley	4.25	12	0.41
131	M	258	Wiley	6	15	0.40
132	M	242	Wiley	6	10	0.39
133	M	255	Wiley	6.75	16	0.39
134	M	257	Wiley	6	17	0.39
135	M	260	Wiley	2.5	17	0.38
136	M	252	Wiley	6	19	0.38
137	M	261	Wiley	5.75	13	0.38
138	M	240	Wiley	6	14	0.37
139	M	254	Wiley	5.25	14	0.37
140	M	239	Wiley	5.25	20	0.37
141	M	250	Wiley	6	17	0.37
142	M	263	Wiley	6	13	0.37

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
143	M	251	Wiley	6	18	0.37
144	F	292	Wiley	5	13	0.37
145	F	278	Wiley	3.5	16	0.37
146	F	298	Wiley	3.5	13	0.37
147	F	288	Wiley	6.5	11	0.36
148	F	280	Wiley	6.75	14	0.35
149	F	290	Wiley	5	12	0.35
150	F	268	Wiley	4.25	12	0.35
151	F	267	Wiley	2.75	14	0.35
152	F	285	Wiley	3.75	9	0.36
153	F	282	Wiley	3.5	16	0.36
154	M	259	Wiley	3.75	13	0.36
155	F	299	Wiley	4	15	0.36
156	F	295	Wiley	5.25	15	0.36
157	F	188	Wiley	3.75	18	0.35
158	F	213	Wiley	7.25	17	0.35
159	M	220	Wiley	6	20	0.36
160	M	221	Wiley	6.75	18	0.36
161	M	222	Wiley	4.5	19	0.36
162	M	219	Wiley	6	17	0.36
163	M	227	Wiley	6	15	0.36
164	M	228	Wiley	6.5	17	0.36
165	M	223	Wiley	6.25	15	0.36
166	M	224	Wiley	6	17	0.36
167	M	234	Wiley	6.25	22	0.37
168	M	235	Wiley	5.75	17	0.37
169	M	200	Wiley	3.75	19	0.36
170	M	233	Wiley	6	19	0.36
171	M	199	Wiley	4.5	17	0.36
172	M	195	Wiley	7.5	17	0.36
173	M	196	Wiley	5	15	0.36
174	M	236	Wiley	5.75	16	0.36
175	M	194	Wiley	6	17	0.36
176	M	193	Wiley	6.25	16	0.36
177	M	237	Wiley	6	16	0.36
178	M	229	Wiley	6	18	0.36
179	M	230	Wiley	8	20	0.38
180	M	190	Wiley	5	11	0.38
181	M	189	Wiley	3.25	17	0.37
182	M	191	Wiley	7.5	21	0.38
183	M	192	Wiley	5	25	0.37
184	M	197	Wiley	5.5	12	0.36
185	M	232	Wiley	5	18	0.36
186	M	198	Wiley	3.75	18	0.36
187	M	231	Wiley	5.25	18	0.36
188	F	184	Wiley	3.25	14	0.36

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
189	M	226	Wiley	6	15	0.36
190	F	202	Wiley	5.75	15	0.36
191	F	201	Wiley	4.5	18	0.35
192	F	209	Wiley	6.75	20	0.36
193	F	203	Wiley	4.5	16	0.36
194	F	185	Wiley	3.5	14	0.36
195	F	187	Wiley	5.25	15	0.36
196	F	212	Wiley	3.75	15	0.36
197	F	206	Wiley	5	18	0.36
198	F	186	Wiley	3.25	10	0.37
199	F	204	Wiley	6	20	0.37
200	F	182	Wiley	3.25	13	0.37
201	F	205	Wiley	3	16	0.37
202	F	180	Wiley	7.25	13	0.36
203	F	207	Wiley	4	17	0.35
204	F	214	Wiley	6	20	0.36
205	F	211	Wiley	2.75	14	0.36
206	F	217	Wiley	4	15	0.36
207	F	218	Wiley	6	14	0.36
208	M	225	Wiley	3.5	15	0.35
209	F	183	Wiley	5.25	17	0.35
210	F	216	Wiley	5.25	16	0.35
211	F	215	Wiley	6	14	0.35
212	F	313	South Jeff(elem.)	3.5	12	0.36
213	F	265	South Jeff(elem.)	5	21	0.35
214	F	303	South Jeff(elem.)	5.25	15	0.35
215	F	311	South Jeff(elem.)	4.25	15	0.35
216	F	283	South Jeff(elem.)	5.25	19	0.35
217	F	304	South Jeff(elem.)	5.25	14	0.35
218	F	264	South Jeff(elem.)	4.75	20	0.35
219	F	308	South Jeff(elem.)	3.25	14	0.35
220	F	272	South Jeff(elem.)	4.75	20	0.35
221	F	305	South Jeff(elem.)	4.5	15	0.35
222	F	301	South Jeff(elem.)	6	11	0.34
223	F	314	South Jeff(elem.)	5.75	19	0.34
224	F	312	South Jeff(elem.)	5.25	16	0.34
225	F	309	South Jeff(elem.)	5	15	0.34
226	F	310	South Jeff(elem.)	5	17	0.34
227	F	286	South Jeff(elem.)	4	16	0.34
228	F	281	South Jeff(elem.)	5.25	16	0.34
229	F	266	South Jeff(elem.)	5.5	16	0.34
230	F	270	South Jeff(elem.)	3.5	18	0.33
231	F	275	South Jeff(elem.)	4.75	17	0.33
232	M	324	South Jeff(elem.)	5.5	14	0.33
233	M	307	South Jeff(elem.)	5.75	16	0.33
234	M	315	South Jeff(elem.)	5.75	14	0.33

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
235	M	321	South Jeff(elem.)	5.75	16	0.33
236	M	302	South Jeff(elem.)	5.75	12	0.33
237	M	277	South Jeff(elem.)	5.75	12	0.32
238	M	334	South Jeff(elem.)	5.75	16	0.32
239	M	319	South Jeff(elem.)	5	16	0.32
240	M	323	South Jeff(elem.)	5	14	0.32
241	F	326	South Jeff(elem.)	5	14	0.32
242	M	320	South Jeff(elem.)	5	11	0.32
243	F	333	South Jeff(elem.)	3.25	15	0.32
244	F	332	South Jeff(elem.)	3.75	17	0.32
245	M	318	South Jeff(elem.)	4	14	0.32
246	F	329	South Jeff(elem.)	4	15	0.32
247	M	322	South Jeff(elem.)	4.25	17	0.32
248	F	328	South Jeff(elem.)	3.5	13	0.32
249	F	327	South Jeff(elem.)	3.5	14	0.32
250	M	317	South Jeff(elem.)	3.75	14	0.32
251	M	316	South Jeff(elem.)	3.75	14	0.32
252	M	273	South Jeff(elem.)	3.75	9	0.33
253	F	325	South Jeff(elem.)	4.5	15	0.33
254	F	335	South Jeff(elem.)	4.5	17	0.33
255	F	330	South Jeff(elem.)	4.5	17	0.33
256	M	306	South Jeff(elem.)	6.5	17	0.33
257	F	331	South Jeff(elem.)	4.5	13	0.33
258	M	722	St. Gregory's	4	7	0.33
259	M	719	St. Gregory's	6.5	16	0.33
260	M	723	St. Gregory's	6	19	0.33
261	M	714	St. Gregory's	6.25	16	0.33
262	M	721	St. Gregory's	4.25	18	0.33
263	M	709	St. Gregory's	5.75	14	0.33
264	M	720	St. Gregory's	5.25	17	0.33
265	M	724	St. Gregory's	6.5	13	0.33
266	M	725	St. Gregory's	6.75	17	0.33
267	M	716	St. Gregory's	6.5	22	0.33
268	M	712	St. Gregory's	7	18	0.34
269	M	713	St. Gregory's	6.75	14	0.33
270	M	711	St. Gregory's	4.25	15	0.33
271	M	715	St. Gregory's	7	16	0.33
272	M	718	St. Gregory's	7	14	0.33
273	M	710	St. Gregory's	5.75	20	0.33
274	M	708	St. Gregory's	5.25	16	0.33
275	M	717	St. Gregory's	5.75	20	0.33
276	F	693	Martin VanBuren	3.25	16	0.33
277	F	663	Martin VanBuren	3.75	18	0.32
278	M	659	Martin VanBuren	3	20	0.31
279	F	658	Martin VanBuren	4.5	20	0.31
280	M	650	Martin VanBuren	3	18	0.30

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
281	F	649	Martin VanBuren	4.25	18	0.30
282	F	647	Martin VanBuren	4.25	17	0.30
283	F	648	Martin VanBuren	3	15	0.30
284	M	644	Martin VanBuren	3.5	17	0.29
285	F	662	Martin VanBuren	3.5	19	0.29
286	F	657	Martin VanBuren	4.5	18	0.28
287	F	653	Martin VanBuren	4.25	18	0.28
288	M	660	Martin VanBuren	4.25	16	0.28
289	F	654	Martin VanBuren	4	18	0.28
290	M	664	Martin VanBuren	4.75	20	0.27
291	F	656	Martin VanBuren	3.75	17	0.27
292	F	646	Martin VanBuren	4.75	20	0.27
293	M	645	Martin VanBuren	4.5	18	0.27
294	M	651	Martin VanBuren	4.75	15	0.27
295	M	652	Martin VanBuren	3.75	15	0.27
296	M	661	Martin VanBuren	4.5	18	0.27
297	M	655	Martin VanBuren	5	18	0.27
298	M	684	Martin VanBuren	4.75	17	0.27
299	M	685	Martin VanBuren	2.5	17	0.26
300	F	666	Martin VanBuren	2.5	12	0.27
301	M	683	Martin VanBuren	3.75	13	0.27
302	F	667	Martin VanBuren	3.75	17	0.27
303	M	675	Martin VanBuren	4.25	17	0.27
304	F	682	Martin VanBuren	4	13	0.27
305	F	681	Martin VanBuren	3.5	17	0.26
306	F	679	Martin VanBuren	4	20	0.26
307	M	674	Martin VanBuren	4.25	19	0.26
308	M	677	Martin VanBuren	3.5	14	0.26
309	F	680	Martin VanBuren	3.75	19	0.25
310	F	671	Martin VanBuren	3.5	14	0.25
311	M	669	Martin VanBuren	4.75	17	0.25
312	M	672	Martin VanBuren	4	13	0.26
313	M	676	Martin VanBuren	4	14	0.26
314	M	673	Martin VanBuren	4.75	15	0.26
315	F	678	Martin VanBuren	2.25	15	0.26
316	F	668	Martin VanBuren	3.25	14	0.26
317	M	703	Martin VanBuren	4	16	0.26
318	M	696	Martin VanBuren	5.25	17	0.26
319	M	687	Martin VanBuren	5.25	23	0.26
320	F	705	Martin VanBuren	3.25	13	0.26
321	F	706	Martin VanBuren	4.5	19	0.26
322	M	704	Martin VanBuren	4.75	13	0.26
323	F	692	Martin VanBuren	3.75	17	0.26
324	M	697	Martin VanBuren	4.75	15	0.26
325	M	689	Martin VanBuren	4.75	13	0.26
326	M	699	Martin VanBuren	4.75	11	0.26

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
327	F	691	Martin VanBuren	4.75	15	0.26
328	M	690	Martin VanBuren	3.5	17	0.25
329	F	694	Martin VanBuren	3	9	0.26
330	F	686	Martin VanBuren	4	17	0.26
331	M	695	Martin VanBuren	5.5	20	0.26
332	M	698	Martin VanBuren	3.75	15	0.26
333	M	700	Martin VanBuren	5.5	12	0.26
334	M	707	Martin VanBuren	4.25	18	0.26
335	F	688	Martin VanBuren	4	14	0.26
336	M	419	South Jeff(Jr.H)	6	29	0.26
337	M	463	South Jeff(Jr.H)	6	24	0.27
338	M	352	South Jeff(Jr.H)	6	27	0.27
339	M	362	South Jeff(Jr.H)	6	33	0.27
340	M	348	South Jeff(Jr.H)	6	33	0.27
341	M	344	South Jeff(Jr.H)	6	28	0.28
342	M	346	South Jeff(Jr.H)	6	30	0.28
343	M	373	South Jeff(Jr.H)	6	32	0.29
344	M	372	South Jeff(Jr.H)	6	30	0.29
345	M	390	South Jeff(Jr.H)	6	21	0.29
346	M	379	South Jeff(Jr.H)	6	24	0.29
347	M	434	South Jeff(Jr.H)	6	25	0.30
348	M	440	South Jeff(Jr.H)	6	25	0.30
349	M	421	South Jeff(Jr.H)	6	20	0.30
350	M	428	South Jeff(Jr.H)	6	36	0.30
351	M	461	South Jeff(Jr.H)	6	29	0.31
352	M	448	South Jeff(Jr.H)	6	25	0.31
353	M	387	South Jeff(Jr.H)	8.5	32	0.33
354	M	422	South Jeff(Jr.H)	5.25	30	0.33
355	M	420	South Jeff(Jr.H)	5.75	30	0.33
356	M	336	South Jeff(Jr.H)	6	30	0.33
357	M	464	South Jeff(Jr.H)	5.25	15	0.33
358	M	456	South Jeff(Jr.H)	5.25	30	0.33
359	M	371	South Jeff(Jr.H)	5.25	34	0.32
360	M	370	South Jeff(Jr.H)	5.25	27	0.32
361	M	369	South Jeff(Jr.H)	5.25	40	0.31
362	M	368	South Jeff(Jr.H)	5.75	23	0.32
363	M	381	South Jeff(Jr.H)	5.25	30	0.31
364	M	425	South Jeff(Jr.H)	5.75	31	0.31
365	M	452	South Jeff(Jr.H)	5.25	26	0.31
366	M	462	South Jeff(Jr.H)	5.75	26	0.32
367	M	443	South Jeff(Jr.H)	5.25	28	0.31
368	M	438	South Jeff(Jr.H)	5.25	24	0.31
369	M	426	South Jeff(Jr.H)	5.25	32	0.31
370	M	380	South Jeff(Jr.H)	6	26	0.31
371	M	388	South Jeff(Jr.H)	4.5	23	0.31
372	M	406	South Jeff(Jr.H)	4.5	39	0.30

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
373	M	355	South Jeff(Jr.H)	4.5	24	0.30
374	M	357	South Jeff(Jr.H)	4.5	20	0.30
375	M	465	South Jeff(Jr.H)	4.5	26	0.29
376	M	437	South Jeff(Jr.H)	4.5	27	0.29
377	M	451	South Jeff(Jr.H)	5	27	0.29
378	M	442	South Jeff(Jr.H)	4.5	20	0.29
379	M	441	South Jeff(Jr.H)	4.5	27	0.28
380	M	382	South Jeff(Jr.H)	7	29	0.29
381	M	351	South Jeff(Jr.H)	7	33	0.30
382	M	365	South Jeff(Jr.H)	7.25	43	0.31
383	M	392	South Jeff(Jr.H)	7.5	33	0.32
384	M	395	South Jeff(Jr.H)	7.25	30	0.33
385	M	455	South Jeff(Jr.H)	7	28	0.34
386	M	467	South Jeff(Jr.H)	7.25	26	0.34
387	M	347	South Jeff(Jr.H)	4	31	0.33
388	M	367	South Jeff(Jr.H)	3.75	20	0.33
389	M	374	South Jeff(Jr.H)	3.75	25	0.33
390	M	389	South Jeff(Jr.H)	4.25	22	0.32
391	F	383	South Jeff(Jr.H)	3.75	29	0.32
392	M	429	South Jeff(Jr.H)	3.75	29	0.31
393	M	458	South Jeff(Jr.H)	3.75	20	0.31
394	F	435	South Jeff(Jr.H)	3.75	30	0.30
395	M	427	South Jeff(Jr.H)	3.75	12	0.30
396	M	376	South Jeff(Jr.H)	3.5	29	0.29
397	M	337	South Jeff(Jr.H)	9.25	32	0.31
398	M	342	South Jeff(Jr.H)	6.25	23	0.31
399	F	339	South Jeff(Jr.H)	6.25	34	0.31
400	M	460	South Jeff(Jr.H)	6.25	28	0.31
401	M	444	South Jeff(Jr.H)	6.75	27	0.32
402	M	360	South Jeff(Jr.H)	6.75	29	0.32
403	M	341	South Jeff(Jr.H)	6.5	24	0.33
404	F	436	South Jeff(Jr.H)	6.5	35	0.33
405	M	439	South Jeff(Jr.H)	6.75	22	0.33
406	M	363	South Jeff(Jr.H)	6.25	42	0.33
407	M	340	South Jeff(Jr.H)	6.5	35	0.34
408	F	338	South Jeff(Jr.H)	6.5	28	0.34
409	M	405	South Jeff(Jr.H)	8	22	0.34
410	M	349	South Jeff(Jr.H)	7.75	28	0.35
411	M	386	South Jeff(Jr.H)	8	32	0.36
412	M	378	South Jeff(Jr.H)	7.75	30	0.36
413	M	366	South Jeff(Jr.H)	8.25	38	0.38
414	M	430	South Jeff(Jr.H)	4.5	32	0.37
415	M	836	Ichabod Crane MS	5.5	26	0.37
416	F	829	Ichabod Crane MS	5	31	0.37
417	F	832	Ichabod Crane MS	5.75	31	0.37
418	F	830	Ichabod Crane MS	3.5	22	0.37

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
419	F	828	Ichabod Crane MS	3.5	24	0.36
420	F	831	Ichabod Crane MS	7	25	0.37
421	F	833	Ichabod Crane MS	3.75	23	0.36
422	M	835	Ichabod Crane MS	6	25	0.36
423	M	838	Ichabod Crane MS	4	27	0.36
424	F	828	Ichabod Crane MS	3	19	0.36
425	M	837	Ichabod Crane MS	3	22	0.36
426	F	826	Ichabod Crane MS	3.5	31	0.35
427	M	834	Ichabod Crane MS	4	30	0.34
428	F	809	Ichabod Crane MS	4.25	29	0.34
429	M	824	Ichabod Crane MS	5	33	0.34
430	M	818	Ichabod Crane MS	5.25	22	0.34
431	M	819	Ichabod Crane MS	6.25	26	0.34
432	M	822	Ichabod Crane MS	6.75	22	0.34
433	F	798	Ichabod Crane MS	3.75	35	0.33
434	F	814	Ichabod Crane MS	5.25	30	0.33
435	F	810	Ichabod Crane MS	4	31	0.32
436	F	815	Ichabod Crane MS	3.5	25	0.32
437	F	813	Ichabod Crane MS	5.25	30	0.32
438	M	823	Ichabod Crane MS	5.75	34	0.32
439	M	821	Ichabod Crane MS	5	39	0.31
440	F	811	Ichabod Crane MS	5.75	37	0.31
441	F	825	Ichabod Crane MS	4	31	0.31
442	M	817	Ichabod Crane MS	5.75	28	0.31
443	F	796	Ichabod Crane MS	3.75	35	0.30
444	F	797	Ichabod Crane MS	4.75	31	0.30
445	F	794	Ichabod Crane MS	4.75	26	0.30
446	M	820	Ichabod Crane MS	6.5	33	0.30
447	F	812	Ichabod Crane MS	5	24	0.30
448	F	799	Ichabod Crane MS	5	37	0.30
449	F	800	Ichabod Crane MS	5	43	0.29
450	F	795	Ichabod Crane MS	4.75	23	0.29
451	F	807	Ichabod Crane MS	3.5	27	0.29
452	F	805	Ichabod Crane MS	3	27	0.28
453	M	790	Ichabod Crane MS	5.75	43	0.28
454	M	793	Ichabod Crane MS	5.75	35	0.29
455	M	792	Ichabod Crane MS	7	45	0.29
456	M	791	Ichabod Crane MS	7.5	38	0.30
457	F	808	Ichabod Crane MS	3	34	0.29
458	F	802	Ichabod Crane MS	3.5	27	0.29
459	F	803	Ichabod Crane MS	3.5	27	0.28
460	F	801	Ichabod Crane MS	4.75	41	0.28
461	F	804	Ichabod Crane MS	2.5	22	0.28
462	F	806	Ichabod Crane MS	2.5	26	0.27
463	M	788	Ichabod Crane MS	4.5	24	0.27
464	M	789	Ichabod Crane MS	4.5	33	0.27

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
465	F	784	Ichabod Crane MS	5	28	0.27
466	F	783	Ichabod Crane MS	3.5	16	0.27
467	M	787	Ichabod Crane MS	4.5	34	0.26
468	F	782	Ichabod Crane MS	3.5	23	0.26
469	F	781	Ichabod Crane MS	2.25	14	0.26
470	M	785	Ichabod Crane MS	4	28	0.26
471	M	786	Ichabod Crane MS	4	22	0.26
472	M	776	Ichabod Crane MS	5.5	38	0.26
473	F	779	Ichabod Crane MS	4	24	0.26
474	M	775	Ichabod Crane MS	3.75	30	0.26
475	M	774	Ichabod Crane MS	4.5	31	0.25
476	M	777	Ichabod Crane MS	5.75	29	0.25
477	F	778	Ichabod Crane MS	2.25	26	0.25
478	F	780	Ichabod Crane MS	2.25	29	0.24
479	F	761	Ichabod Crane MS	5.75	32	0.24
480	F	757	Ichabod Crane MS	4.5	34	0.24
481	F	760	Ichabod Crane MS	4.5	24	0.24
482	F	756	Ichabod Crane MS	5.75	32	0.24
483	F	758	Ichabod Crane MS	4.5	32	0.24
484	M	771	Ichabod Crane MS	3.25	24	0.24
485	M	768	Ichabod Crane MS	6.25	33	0.24
486	M	765	Ichabod Crane MS	4	30	0.24
487	M	764	Ichabod Crane MS	5.25	29	0.24
488	F	762	Ichabod Crane MS	4.5	33	0.23
489	F	759	Ichabod Crane MS	5.5	19	0.23
490	F	763	Ichabod Crane MS	4	34	0.23
491	M	767	Ichabod Crane MS	6.75	28	0.23
492	M	769	Ichabod Crane MS	4	29	0.23
493	M	772	Ichabod Crane MS	4.25	30	0.23
494	M	770	Ichabod Crane MS	4	32	0.22
495	M	766	Ichabod Crane MS	5	25	0.22
496	M	773	Ichabod Crane MS	4	24	0.22
497	F	753	Ichabod Crane MS	3.5	30	0.22
498	F	754	Ichabod Crane MS	3.75	24	0.22
499	F	755	Ichabod Crane MS	3.5	26	0.21
500	F	752	Ichabod Crane MS	5.75	35	0.22
501	M	106	Watertown High	7.5	39	0.22
502	M	137	Watertown High	6.25	40	0.23
503	F	128	Watertown High	5.5	19	0.23
504	F	152	Watertown High	4	20	0.23
505	M	125	Watertown High	8.5	36	0.24
506	M	136	Watertown High	8.25	41	0.25
507	M	135	Watertown High	8.25	49	0.26
508	F	151	Watertown High	3.5	25	0.26
509	F	150	Watertown High	3.5	28	0.25
510	M	124	Watertown High	5	31	0.25

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
511	F	149	Watertown High	3	32	0.25
512	F	148	Watertown High	9.5	28	0.25
513	F	134	Watertown High	4	30	0.25
514	M	143	Watertown High	4	30	0.25
515	M	142	Watertown High	3.5	30	0.24
516	M	133	Watertown High	4	30	0.24
517	F	147	Watertown High	3	30	0.24
518	M	146	Watertown High	5	26	0.24
519	F	129	Watertown High	4.75	30	0.24
520	M	138	Watertown High	7	37	0.24
521	M	139	Watertown High	8.5	45	0.25
522	M	131	Watertown High	9	41	0.26
523	M	144	Watertown High	9.5	40	0.28
524	M	130	Watertown High	8	41	0.28
525	M	141	Watertown High	5	30	0.28
526	M	140	Watertown High	5	29	0.28
527	M	145	Watertown High	7.75	24	0.28
528	F	126	Watertown High	4.5	29	0.28
529	F	127	Watertown High	7.5	34	0.29
530	F	123	Watertown High	4	23	0.29
531	M	107	Watertown High	9	44	0.30
532	F	122	Watertown High	5.5	27	0.30
533	F	119	Watertown High	3	21	0.30
534	M	112	Watertown High	8	30	0.30
535	F	121	Watertown High	6	30	0.30
536	M	103	Watertown High	6.5	38	0.30
537	M	113	Watertown High	8	40	0.31
538	F	116	Watertown High	6	30	0.31
539	F	115	Watertown High	5	25	0.31
540	M	114	Watertown High	3.75	30	0.31
541	M	110	Watertown High	6.25	30	0.31
542	M	105	Watertown High	9	58	0.33
543	F	118	Watertown High	4.5	27	0.32
544	M	108	Watertown High	8.75	45	0.33
545	F	117	Watertown High	4.5	23	0.33
546	M	57	Watertown High	5.25	52	0.33
547	M	111	Watertown High	6	30	0.33
548	M	104	Watertown High	7.5	38	0.34
549	M	109	Watertown High	5	35	0.34
550	M	155	Watertown High	2.5	17	0.34
551	F	167	Watertown High	2.5	32	0.33
552	F	166	Watertown High	2.5	29	0.33
553	M	161	Watertown High	3.5	27	0.32
554	M	153	Watertown High	5.5	29	0.32
555	F	163	Watertown High	2.5	31	0.32
556	F	162	Watertown High	2.5	34	0.31

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
557	M	165	Watertown High	3.5	4	0.31
558	M	154	Watertown High	3.5	20	0.31
559	M	159	Watertown High	3	34	0.31
560	M	156	Watertown High	6.75	27	0.31
561	M	160	Watertown High	3	26	0.31
562	M	164	Watertown High	3.5	25	0.31
563	F	158	Watertown High	3.25	29	0.30
564	F	157	Watertown High	3.5	24	0.30
565	F	168	Watertown High	2	33	0.29
566	F	169	Watertown High	2	30	0.29
567	M	171	Watertown High	6.25	28	0.29
568	F	177	Watertown High	4	25	0.29
569	M	172	Watertown High	2.75	32	0.28
570	F	176	Watertown High	4	24	0.28
571	M	170	Watertown High	5.75	27	0.28
572	M	173	Watertown High	2.75	8	0.29
573	F	174	Watertown High	2.75	24	0.29
574	F	178	Watertown High	5.5	25	0.29
575	F	181	Watertown High	5.5	12	0.29
576	F	179	Watertown High	5.5	20	0.29
577	M	343	South Jeff(H.S.)	8.5	32	0.29
578	M	359	South Jeff(H.S.)	4.5	27	0.29
579	M	457	South Jeff(H.S.)	4.75	24	0.29
580	M	433	South Jeff(H.S.)	5	35	0.29
581	M	396	South Jeff(H.S.)	3	18	0.29
582	M	400	South Jeff(H.S.)	5	32	0.29
583	F	447	South Jeff(H.S.)	5.25	31	0.29
584	M	423	South Jeff(H.S.)	5.75	24	0.29
585	M	466	South Jeff(H.S.)	4.25	27	0.29
586	F	445	South Jeff(H.S.)	4.25	27	0.29
587	M	432	South Jeff(H.S.)	3.75	24	0.29
588	M	471	South Jeff(H.S.)	6	25	0.29
589	M	473	South Jeff(H.S.)	5.25	24	0.29
590	M	404	South Jeff(H.S.)	8	27	0.29
591	M	454	South Jeff(H.S.)	5.75	26	0.29
592	M	361	South Jeff(H.S.)	5.75	30	0.29
593	M	475	South Jeff(H.S.)	5.25	24	0.29
594	M	364	South Jeff(H.S.)	7	47	0.29
595	M	353	South Jeff(H.S.)	7.25	33	0.30
596	M	375	South Jeff(H.S.)	7.5	30	0.30
597	M	407	South Jeff(H.S.)	8.5	30	0.30
598	F	446	South Jeff(H.S.)	4.25	31	0.30
599	M	413	South Jeff(H.S.)	7.75	23	0.30
600	M	449	South Jeff(H.S.)	5.25	26	0.30
601	M	468	South Jeff(H.S.)	5.25	17	0.30
602	M	474	South Jeff(H.S.)	5.25	22	0.30

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
603	M	477	South Jeff(H.S.)	5.25	17	0.30
604	M	478	South Jeff(H.S.)	5.25	31	0.30
605	M	472	South Jeff(H.S.)	4.5	20	0.30
606	M	453	South Jeff(H.S.)	5.25	26	0.30
607	M	416	South Jeff(H.S.)	4.5	17	0.30
608	M	418	South Jeff(H.S.)	4.5	35	0.30
609	M	411	South Jeff(H.S.)	4.5	31	0.29
610	M	410	South Jeff(H.S.)	4.5	26	0.29
611	M	414	South Jeff(H.S.)	4.5	27	0.29
612	M	358	South Jeff(H.S.)	9.25	31	0.30
613	M	345	South Jeff(H.S.)	4	26	0.30
614	M	479	South Jeff(H.S.)	6.75	29	0.30
615	M	480	South Jeff(H.S.)	6	20	0.30
616	M	470	South Jeff(H.S.)	6	20	0.30
617	M	469	South Jeff(H.S.)	6	21	0.30
618	M	459	South Jeff(H.S.)	7	24	0.30
619	M	417	South Jeff(H.S.)	6.75	33	0.30
620	M	450	South Jeff(H.S.)	7	27	0.30
621	M	415	South Jeff(H.S.)	6	25	0.30
622	M	431	South Jeff(H.S.)	6	31	0.30
623	M	424	South Jeff(H.S.)	7	29	0.30
624	M	412	South Jeff(H.S.)	7	26	0.30
625	M	384	South Jeff(H.S.)	7	31	0.30
626	M	399	South Jeff(H.S.)	6	25	0.30
627	M	394	South Jeff(H.S.)	7	32	0.31
628	M	402	South Jeff(H.S.)	7	26	0.31
629	M	403	South Jeff(H.S.)	8.5	32	0.31
630	M	350	South Jeff(H.S.)	6	30	0.31
631	M	354	South Jeff(H.S.)	6	24	0.31
632	M	401	South Jeff(H.S.)	7	29	0.31
633	M	377	South Jeff(H.S.)	6.75	23	0.31
634	M	356	South Jeff(H.S.)	6	30	0.31
635	M	476	South Jeff(H.S.)	6.25	14	0.31
636	F	626	Ich. Crane (H.S.)	4	27	0.31
637	F	625	Ich. Crane (H.S.)	4	31	0.31
638	F	627	Ich. Crane (H.S.)	4	25	0.31
639	F	629	Ich. Crane (H.S.)	3	20	0.31
640	F	620	Ich. Crane (H.S.)	5.75	40	0.31
641	M	630	Ich. Crane (H.S.)	6	37	0.31
642	M	617	Ich. Crane (H.S.)	6.75	41	0.31
643	F	702	Ich. Crane (H.S.)	3.5	26	0.31
644	M	619	Ich. Crane (H.S.)	6.5	45	0.31
645	M	622	Ich. Crane (H.S.)	4.5	35	0.31
646	F	623	Ich. Crane (H.S.)	4	25	0.31
647	F	628	Ich. Crane (H.S.)	4	24	0.31
648	F	624	Ich. Crane (H.S.)	4	22	0.31

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
649	M	621	Ich. Crane (H.S.)	4.5	28	0.31
650	M	618	Ich. Crane (H.S.)	5.75	32	0.31
651	M	701	Ich. Crane (H.S.)	6.5	27	0.31
652	F	604	Ich. Crane (H.S.)	4	30	0.31
653	F	605	Ich. Crane (H.S.)	4	40	0.30
654	F	607	Ich. Crane (H.S.)	5.75	35	0.30
655	F	595	Ich. Crane (H.S.)	4.5	37	0.30
656	M	600	Ich. Crane (H.S.)	7.5	41	0.31
657	M	608	Ich. Crane (H.S.)	5.75	41	0.31
658	M	599	Ich. Crane (H.S.)	7	44	0.31
659	F	606	Ich. Crane (H.S.)	4.25	30	0.31
660	M	596	Ich. Crane (H.S.)	4.5	38	0.31
661	M	593	Ich. Crane (H.S.)	4.5	37	0.31
662	F	597	Ich. Crane (H.S.)	4	23	0.31
663	F	598	Ich. Crane (H.S.)	7.5	45	0.31
664	F	594	Ich. Crane (H.S.)	4.75	23	0.31
665	F	615	Ich. Crane (H.S.)	5.5	37	0.31
666	M	613	Ich. Crane (H.S.)	5.5	40	0.31
667	M	592	Ich. Crane (H.S.)	5.75	40	0.31
668	M	609	Ich. Crane (H.S.)	5	37	0.31
669	M	611	Ich. Crane (H.S.)	4	30	0.31
670	M	610	Ich. Crane (H.S.)	3.75	40	0.30
671	M	614	Ich. Crane (H.S.)	2.75	25	0.30
672	M	616	Ich. Crane (H.S.)	4.25	31	0.30
673	M	612	Ich. Crane (H.S.)	4.75	33	0.30
674	M	568	Ich. Crane (H.S.)	8	39	0.30
675	M	569	Ich. Crane (H.S.)	7	45	0.31
676	M	573	Ich. Crane (H.S.)	7	49	0.31
677	M	603	Ich. Crane (H.S.)	5	37	0.31
678	M	591	Ich. Crane (H.S.)	7.5	40	0.31
679	M	570	Ich. Crane (H.S.)	6.5	41	0.32
680	M	575	Ich. Crane (H.S.)	6	39	0.32
681	M	590	Ich. Crane (H.S.)	4	31	0.32
682	M	581	Ich. Crane (H.S.)	4	30	0.31
683	F	577	Ich. Crane (H.S.)	4.25	33	0.31
684	F	565	Ich. Crane (H.S.)	5.25	22	0.31
685	F	584	Ich. Crane (H.S.)	4	22	0.31
686	F	578	Ich. Crane (H.S.)	4	25	0.31
687	F	589	Ich. Crane (H.S.)	4	28	0.31
688	F	588	Ich. Crane (H.S.)	4	26	0.31
689	M	576	Ich. Crane (H.S.)	5.75	44	0.31
690	M	562	Ich. Crane (H.S.)	5.75	38	0.31
691	M	580	Ich. Crane (H.S.)	7.75	32	0.31
692	F	572	Ich. Crane (H.S.)	4.5	38	0.31
693	F	571	Ich. Crane (H.S.)	6.5	30	0.31
694	M	567	Ich. Crane (H.S.)	7.25	31	0.31

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
695	M	583	Ich. Crane (H.S.)	4.75	40	0.31
696	F	586	Ich. Crane (H.S.)	3.75	28	0.31
697	F	582	Ich. Crane (H.S.)	3.75	26	0.31
698	F	563	Ich. Crane (H.S.)	5	35	0.31
699	M	585	Ich. Crane (H.S.)	4.25	28	0.31
700	F	561	Ich. Crane (H.S.)	4.5	30	0.31
701	F	564	Ich. Crane (H.S.)	4.75	35	0.31
702	F	566	Ich. Crane (H.S.)	6	40	0.31
703	M	579	Ich. Crane (H.S.)	4.75	41	0.31
704	M	559	Ich. Crane (H.S.)	6.25	35	0.31
705	F	552	Ich. Crane (H.S.)	3.5	29	0.31
706	M	547	Ich. Crane (H.S.)	5.75	34	0.31
707	M	548	Ich. Crane (H.S.)	4.75	39	0.30
708	M	556	Ich. Crane (H.S.)	5.25	33	0.30
709	M	555	Ich. Crane (H.S.)	5.75	36	0.31
710	F	558	Ich. Crane (H.S.)	4.5	30	0.30
711	M	546	Ich. Crane (H.S.)	5.25	25	0.30
712	F	601	Ich. Crane (H.S.)	4.25	31	0.30
713	F	554	Ich. Crane (H.S.)	3.5	30	0.30
714	F	602	Ich. Crane (H.S.)	3.5	27	0.30
715	F	553	Ich. Crane (H.S.)	4.5	35	0.30
716	M	550	Ich. Crane (H.S.)	5.25	36	0.30
717	F	549	Ich. Crane (H.S.)	4	29	0.30
718	F	551	Ich. Crane (H.S.)	4	27	0.30
719	M	560	Ich. Crane (H.S.)	6	35	0.30
720	M	557	Ich. Crane (H.S.)	6.75	32	0.30
721	M	545	Ich. Crane (H.S.)	3	34	0.30
722	F	543	Ich. Crane (H.S.)	3.75	25	0.30
723	F	544	Ich. Crane (H.S.)	3.75	28	0.30
724	M	541	Ich. Crane (H.S.)	6.25	31	0.30
725	M	540	Ich. Crane (H.S.)	6	33	0.30
726	M	538	Ich. Crane (H.S.)	7.75	34	0.30
727	M	539	Ich. Crane (H.S.)	5.75	40	0.30
728	M	542	Ich. Crane (H.S.)	5	31	0.30
729	M	521	Ich. Crane (H.S.)	5.25	34	0.30
730	M	514	Ich. Crane (H.S.)	4.25	35	0.30
731	M	518	Ich. Crane (H.S.)	5	24	0.30
732	F	532	Ich. Crane (H.S.)	5.25	36	0.30
733	M	536	Ich. Crane (H.S.)	5.25	28	0.30
734	F	535	Ich. Crane (H.S.)	4.75	34	0.30
735	F	533	Ich. Crane (H.S.)	4.5	33	0.30
736	M	517	Ich. Crane (H.S.)	7.5	40	0.30
737	M	525	Ich. Crane (H.S.)	4.75	28	0.30
738	M	524	Ich. Crane (H.S.)	5.25	29	0.30
739	M	516	Ich. Crane (H.S.)	4.25	33	0.30
740	M	512	Ich. Crane (H.S.)	8.5	34	0.30

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		{12 min	Thrusts (y)	
741	M	519	Ich. Crane (H.S.)	6.5	42	0.30
742	F	527	Ich. Crane (H.S.)	4	27	0.30
743	F	534	Ich. Crane (H.S.)	3.25	27	0.30
744	F	528	Ich. Crane (H.S.)	4	28	0.30
745	F	529	Ich. Crane (H.S.)	5.5	34	0.30
746	M	522	Ich. Crane (H.S.)	5.25	31	0.30
747	M	531	Ich. Crane (H.S.)	7	30	0.30
748	M	537	Ich. Crane (H.S.)	4.25	32	0.30
749	M	530	Ich. Crane (H.S.)	6.5	43	0.30
750	F	642	Ich. Crane (H.S.)	3.25	28	0.30
751	F	643	Ich. Crane (H.S.)	3.25	30	0.30
752	F	632	Ich. Crane (H.S.)	4.5	32	0.30
753	M	631	Ich. Crane (H.S.)	6.75	29	0.30
754	F	634	Ich. Crane (H.S.)	4	27	0.30
755	F	633	Ich. Crane (H.S.)	7.75	34	0.30
756	M	641	Ich. Crane (H.S.)	5	34	0.30
757	M	638	Ich. Crane (H.S.)	8.25	37	0.30
758	F	635	Ich. Crane (H.S.)	5.5	25	0.30
759	M	640	Ich. Crane (H.S.)	7.75	34	0.30
760	M	639	Ich. Crane (H.S.)	8	31	0.30
761	M	637	Ich. Crane (H.S.)	8	31	0.31
762	F	636	Ich. Crane (H.S.)	4.75	21	0.31
763	M	498	South Jeff(elem)	5	12	0.31
764	M	501	South Jeff(elem)	4.25	16	0.31
765	M	487	South Jeff(elem)	5.75	17	0.31
766	M	488	South Jeff(elem)	5.25	17	0.31
767	M	507	South Jeff(elem)	5.75	16	0.30
768	M	510	South Jeff(elem)	4.5	14	0.31
769	M	483	South Jeff(elem)	5	19	0.31
770	M	511	South Jeff(elem)	5	15	0.31
771	M	495	South Jeff(elem)	4.25	15	0.31
772	M	502	South Jeff(elem)	5.75	17	0.31
773	M	485	South Jeff(elem)	4.5	18	0.31
774	M	508	South Jeff(elem)	4.75	15	0.31
775	M	497	South Jeff(elem)	4.5	19	0.31
776	M	500	South Jeff(elem)	4	16	0.31
777	M	506	South Jeff(elem)	5.75	20	0.31
778	M	494	South Jeff(elem)	5	21	0.31
779	M	481	South Jeff(elem)	5	19	0.31
780	M	484	South Jeff(elem)	6.25	18	0.31
781	M	505	South Jeff(elem)	3.75	13	0.31
782	M	503	South Jeff(elem)	4.5	19	0.31
783	M	491	South Jeff(elem)	4.5	21	0.31
784	M	492	South Jeff(elem)	6.25	22	0.31
785	M	499	South Jeff(elem)	4.75	19	0.31
786	M	486	South Jeff(elem)	5.5	19	0.31

	B	C	D	E	F	G
2	sex	Subject	School	laps (x)	Squat	Pearson (r)
3		Number		(12 min	Thrusts (y)	
787	M	509	South Jeff(elem)	5	18	0.31
788	M	490	South Jeff(elem)	5	18	0.31
789	M	493	South Jeff(elem)	5.25	18	0.31
790	M	504	South Jeff(elem)	5	14	0.31
791	M	489	South Jeff(elem)	4.75	12	0.31
792	F	733	Ichabod Crane MS	4	31	0.30
793	M	750	Ichabod Crane MS	5	35	0.30
794	F	726	Ichabod Crane MS	4	26	0.30
795	F	728	Ichabod Crane MS	4.5	20	0.30
796	F	727	Ichabod Crane MS	4	27	0.30
797	F	735	Ichabod Crane MS	3.25	19	0.30
798	F	736	Ichabod Crane MS	3.5	23	0.30
799	F	737	Ichabod Crane MS	4.5	22	0.30
800	M	751	Ichabod Crane MS	4.75	37	0.30
801	F	732	Ichabod Crane MS	3.5	21	0.30
802	F	731	Ichabod Crane MS	5	29	0.30
803	F	729	Ichabod Crane MS	4.5	26	0.30
804	F	741	Ichabod Crane MS	3.5	28	0.30
805	F	746	Ichabod Crane MS	4.25	34	0.30
806	F	740	Ichabod Crane MS	3.5	22	0.30
807	F	739	Ichabod Crane MS	5	23	0.30
808	M	748	Ichabod Crane MS	5.5	32	0.30
809	M	747	Ichabod Crane MS	5	30	0.30
810	F	745	Ichabod Crane MS	4.5	32	0.30
811	F	744	Ichabod Crane MS	4.5	29	0.30
812	M	749	Ichabod Crane MS	5.25	38	0.30
813	F	742	Ichabod Crane MS	4.75	32	0.30
814	F	743	Ichabod Crane MS	4.75	23	0.30
815	F	734	Ichabod Crane MS	6	22	0.30
816	F	730	Ichabod Crane MS	5.25	31	0.30