

EFFECTS OF STRETCHING WARM-UP EXERCISES
IN PERFORMANCE OF SPECIFIC
TRACK AND FIELD POWER EVENTS

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Lowell Meyer

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Mey
C.V.

UNIVERSITY OF WISCONSIN--LACROSSE

GRADUATE SCHOOL

Candidate: Lowell Meyer

I recommend acceptance of this seminar paper to the Graduate School in partial fulfillment of this candidate's requirement for the degree of Master of Science. The candidate has completed his oral seminar report.

July 19, 1972
Date

William A. Floyd
Seminar Paper Advisor

This seminar paper is approved for the Graduate School:

July 19, 1972
Date

James H. Erickson
Dean, Graduate School

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Lowell Meyer

University of Wisconsin at La Crosse

ABSTRACT

This study was designed to compare the effects of warm-up on performance of tenth grade boys in the running long jump, forty yard dash, and shot put. An attempt was made to determine whether or not warm-up was of value in improving performance of the running long jump, forty yard dash, and the shot put.

The subjects were forty-one tenth grade boys enrolled in a required physical education class at Lincoln High School, Wisconsin Rapids, Wisconsin. The subjects were members of an intact physical education class. The group members followed a specific program of performance in the running long jump, forty yard dash and shot put with and without preliminary warm-up exercises for an eight week period.

The statistical technique used to indicate differences in mean scores on the warm-up and non warm-up performance for each test was a t-test for non-independent groups. The five percent level of confidence was used for acceptance or rejection of the null hypotheses. Values for

"t" indicated that there were no significant differences in the warm-up and non warm-up scores for the running long jump, forty yard dash, and shot put.

The results of this study indicate that preliminary stretching warm-up exercises as administered in this study to tenth grade boys will not significantly improve performance of the running long jump, forty yard dash, and shot put.

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CHAPTER I

INTRODUCTION

Warming up before engaging in any competitive athletic activity has been a widely accepted procedure, but experimental evidence has not been conclusive either as to the value of the warm-up or the best means of warming up for specific sports. Individual performances have been studied for years by physical educators and coaches in an effort to determine which conditions best prepare an individual for performance. His performance may or may not be significantly affected by warm-up.

Physical educators, coaches and others have done a great deal of work in the area of the effect of warm-up exercises and emphasis on the amount of time spent on warm-up exercises has focused attention on the value of this time and relationship to performance. Such studies will enable the physical educator to determine if warm-up exercises are necessary prior to performance.

I. THE PROBLEM

Statement of the problem. This study was an attempt to determine if the use of stretching warm-up exercises would improve performance of tenth grade boys in track and field power events.

Purpose. The purpose of this study was to obtain experimental evidence regarding the value of stretching warm-up exercises prior to performance of track and field power events for tenth grade boys. The use of stretching warm-up exercises was evaluated against the use of no warm-up

exercises. One group of boys with similar physical ability was used to determine whether or not stretching warm-up exercises were of value in improving performance in specific track and field power events. The results could be used as a factor in determining if stretching warm-up exercises are necessary for senior high school boys in Wisconsin Rapids, Wisconsin prior to performance in track and field power events. The present study was limited to investigating the possibility of improved physical performance as a result of preliminary stretching exercises.

Need for the study. Physical education teachers and coaches are constantly seeking accurate and efficient means to improve the performance of their students and athletes. Coaches and physical education teachers are concerned with which condition best prepares a student for skilled performance. Warm-up exercises have been one of the concerns for many years in helping to increase a student's performance in physical activity. Most physical education teachers and coaches assume that warm-up exercises are beneficial; however, a few coaches and physical education teachers have questioned the value of warm-up exercises on the basis that the student may have already exhausted a needed part of his energy when the time arrives for the maximum effort necessary for the performance of an activity. It is the purpose of this study to investigate the merits of stretching warm-up exercises on tenth grade boys' performance of the running long jump, the forty yard dash and the shot put.

Delimitations. (1) The students participating in the study will be forty-one sophomore boys at Lincoln High School in Wisconsin Rapids, Wisconsin. (2) Those students participating in the study will be members of a required physical education class. (3) Students used in this study

will be non-varsity participants.

Limitations. There are a number of factors that may place limitations on the results and their interpretations. The subjects were enrolled in a boy's physical education class at Lincoln High School and thus findings from this study only represent the subjects measured, and any attempt to apply these findings to other groups is subject to question on the basis of sampling principles. Recreational activities, motivation, sickness during testing and other unexpected occurrences are variables that could not be completely controlled in this study. Also the rapid growth spurt of boys and other maturation developments at this age level may affect the results.

Assumptions. It is assumed that a muscle is not a fixed but a constantly changing system, and its viscosity is a changing property, varying with temperature, fatigue, size of load, and speed of contraction. (23:51) Studies have been conducted in which attitude appeared to have an influence upon the degree of performance improvement and it is assumed that this could occur in this study.

Hypothesis. Preliminary stretching warm-up exercises as opposed to no warm-up exercises will significantly improve performance in track and field power events.

II. DEFINITIONS OF TERMS USED

Forty yard dash. Sprinting at maximum speed for a distance of forty yards.

Running long jump. A jump for distance made from a running start.

Shot put. An event in which a metal ball is heaved by a pushing motion.

Track and Field power events. Events referred to in this study as the running long jump, the forty yard dash, and the shot put.

Warm-up. Preparation that is carried out immediately before physical work for the purpose of producing optimum work performance by increasing muscle temperature, circulation, range of joint mobility, and producing a condition of readiness in the participant. (13)

Stretching exercises. Exercises, whereby a muscle is placed in a position of greatest possible length.

CHAPTER II

REVIEW OF THE LITERATURE

Physical educators and coaches in all educational levels have been concerned for years about the value of preliminary warm-up procedures prior to skill performance. Because of the latter it is essential that warm-up be investigated further. Performers of physical endeavors wish to execute the best possible performance for their present physical condition.

There have been a number of articles written on the subject of what happens to the body as a result of warm-up exercises. Gould and Dye (3:97) stated that in the general warming up process athletes improve their general circulation, remove the danger of early contracture, obtain the early beneficial effects of *treppe*, and produce a slight rise of body temperature. Morehouse and Miller (15:30) wrote: "Observations on the contraction of isolated muscles provide a clue to the nature of the warming up process. If the muscle is warmed, the speed with which the muscle contracts and relaxes and the force of contraction are all increased. If a previously inactive muscle is stimulated repeatedly, the first few contractions are often small and irregular and relaxation is incomplete. After this, the contractions become stronger and relaxation is complete."

In an article by Jensen (6), it was concluded that several points of argument favoring warm-up have been stated by people specializing in the study of athletic performance. These specialists advocated the importance of warm-up on the basis of the following claims:

1. Warm-up increases the rate and strength of muscular contraction.

2. Warm-up related to the particular activity increases the necessary coordination.

3. Warm-up helps to prevent injury.

Riedman (23:51) states that during the warm-up prior to strenuous activity a slight rise in the temperature of active muscles may increase effectiveness of contraction by decreasing the viscosity within the muscles. Holmola (5) supports this idea by stating that when the muscles are warmed up an increased flow of blood loosens up muscle fibers by elevating temperature which decreases the viscosity of the muscle itself. He further states that the energy for contraction of a muscle comes from glycogen which is stored in the muscle fibers and a warmed muscle contains more of the metabolic products necessary for chemical reaction that produces this energy.

Morehouse and Rasch (16:238) supported the above idea by stating that the rise in body temperature facilitates the biochemical reactions supplying energy for muscular contractions. Morehouse and Miller (15:323) state that if the muscle is warmed, the speed with which it contracts and relaxes and the force of contraction are all increased. Riedman (23:29) further states it is a well-known fact that muscles are more effective after the initial warm-up and become progressively less responsive as a result of continued activity.

Thompson (31) reviewed and summarized most of the literature done on warm-up prior to 1960. He concluded it appeared that warming up is beneficial for improved individual performance, but warned that the findings were not conclusive. He felt no one had yet determined the extent of warming up for individuals per activity and per condition. Additional research studies have sought to gain further knowledge on warm-up. In

these studies the relationship between the warming up effect and the intensity of exercise, period of rest between warm-up and performance, psychological factors, physical factors, and similarity of the preliminary exercise and the skill to be performed were investigated.

Van Grundy (32) pointed out that those research studies he investigated indicated that warm-up is beneficial to performance of motor skills; however, the effect seems to be influenced by many factors. Among these factors are:

1. Type of skill to be performed.
2. Method of warm-up used.
3. Physical condition, age, sex, and psychological condition of the performer.
4. The intensity of the warm-up.
5. The length of the rest period between warm-up and performance.

Several studies have shown significant improvement in performance following warm-up procedures. DeVries (2) investigated the merits of some of the more commonly used methods of warm-up for competitive swimmers (hot showers, calisthenics, massage, and swimming). He concluded that all swimmers improved significantly following the swimming warm-up (500 continuous yards of their choosing at a slow pace) and that swimming performance at the level of the highly skilled competitive swimmer can be improved by a proper warm-up procedure. It was also concluded that warming up by six minute hot showers, calisthenics, and massage had no significant effects on swimming performance.

In a study of vertical jumping Pacheco (20) used experienced subjects who each made 90 or more vertical jumps preceded by isometric

stretching exercises, isotonic work, or a combination. Compared with controlled conditions of no preliminary exercise, performance was improved for each individual and by each of the three exercises. Pacheco (19) also studied the results of warm-up on vertical jumping performance, using girls in grades nine and ten and found a significant improvement.

In a study by Richards (22) eighty high school girls performed the jump-reach test both with and without a preliminary exercise (15½ inch stool stepping). Subgroups used 1, 2, 4, and 6 minutes of twenty-five steps per minute. The effects were statistically significant with the greatest improvement obtained with 1 and 2 minutes of preliminary exercise. Four minutes was almost without influence and six minutes had a definite deleterious effect.

Van Huss and others (33) using members of a university freshman baseball team concluded that an overload warm-up with throwing a baseball significantly improved the velocity of throwing. Accuracy following the overload warm-up was not significantly different.

In a study by Rochelle and others (24) forty-six male students were given a softball throw for distance without warming up and with a five-minute related warm-up preceding throwing. To reduce the possibility of practice effect, learning, and other unforeseen factors, the subjects divided into two groups with the sequence of warm-up and no warm-up alternated on different days. Despite a significant increase in distance between trials one and three when no warm-up preceded throwing, the subjects threw an average of 10.2 feet farther when the throws were preceded by the five minute related warm-up. The latter was significant at the one percent level of probability.

Michael and others (14) used college men to investigate the effects

of related and unrelated warm-ups on the distance a 12-inch softball could be thrown. They threw three softballs with no preliminary warm-up, with a preliminary five minute related throwing warm-up and with a five minute non-related general warm-up. Results indicated there was no significant difference between the related and unrelated methods of warm-up. When throws were preceded by warm-ups they threw farther than when no warm-ups were taken.

The purpose of a study by Thompson (30) was to determine if warm-up affected speed in swimming a 30-yard sprint and endurance in swimming a five minute period; accuracy in basketball foul-shooting; accuracy in bowling; speed and accuracy in typing; and strength of the legs. No evidence of improvement was found from informal warm-up (free and general movement) immediately preceding testing in swimming, typing or strength. Formal warm-up (imitation of activity) did improve group performance in speed and endurance in swimming, accuracy in basketball foul-shooting, and accuracy in bowling; however, no significant difference was noted in the performance of the typists after participating in a formal warm-up prior to the testing.

The effect of warm-up intensity (no warm-up, regular warm-up, heavy warm-up) on high school distance runners was investigated by Kahler and Stern. (7) Twenty-seven high school distance runners placed in three groups on the basis of ability ran individually six two mile races at optimum speed. The three warm-up intensities were rotated so each subject performed two trials under each intensity of warm-up during the two week testing period. An analysis of the data revealed that the different intensities of warm-up had an apparent influence upon running time, but it did not establish the intensity of warm-up that would aid performance for

various levels of running ability.

Performance of the 100-yard dash and vertical jump by high school boys was beneficially affected by preliminary exercise in a study conducted by Van Grundy. (32) It was also found that the amount of work done in the warm-up will affect the amount of improvement.

Blank (1) did a study with fifty-four experienced and inexperienced track men on the effects of optimum warm-up and minimum warm-up in running the 100-yard dash and the 120-yard dash. The optimum warm-up consisted of walking and running, and several exercises. The minimum warm-up consisted of a limited amount of walking and one exercise. He alternated days for the optimum and minimum warm-ups before administering the trials. Conclusions derived from the study were: (1) an extensive warm-up is of benefit to performance in sprinting and (2) for the groups investigated, there was no apparent difference between the effect of the warm-up routines upon experienced and inexperienced individuals.

A report by Phillips (21) was concerned with the influence of various amounts of warm-up on the speed of performance of a limb. He found that severe, unrelated warm-up improved performance in speed of arm movements, related moderate warm-up tended to be ineffective in improving speed of arm movement, and that reaction time was not influenced by severe warm-up.

McGavin (13) carried out a study to determine the effect that different warm-up exercises of varying intensities had on the speed of leg movement. Results of the study revealed that warming up was significantly beneficial with the unrelated high intensity warm-up the most beneficial to the speed of leg movement.

Swegan and others (29) studied the effect of repetition upon the

speed of a simple arm extension movement from 65 to 180 degrees. Male college students were timed on repeated trials of the preferred-arm extension movement. They found that repetitions, as a form of warm-up, tended to produce faster movement times and the more repetitions that were given, the faster the movement.

There have been a number of articles written questioning the value of warming up before performance. Karpovich (8:18) questions the values of warming up. In his opinion, general warming up is overdone. He feels that unless ambient temperature is so low that the limbs are numb, there might be no need for warming up, at least not for running of distances up to 440 yards. He further states that records for longer distances have been broken without warming up and for shorter distances, warming up is probably nothing more than a ritual and perhaps the same is true for longer distances.

Karpovich and Hale (9) conducted three series of experiments to determine the effect of warm-up upon physical performance. Seven track men ran 440 yards after deep massage, exercise and digital stroking. Five men ran 440 yards without preliminary warm-up after digital stroking. Three subjects took sprint rides on the bicycle ergometer after preliminary exercise and without warm-up. They concluded that none of the warming devices improved time in running the 440, or performance on the bicycle ergometer.

Hipple (4) conducted an experiment with junior high school boys running the fifty yard dash. Each boy ran five trials and had a rest of five minutes between each trial. No warm-up preceded the first trial and the warm-up of succeeding trials were the preceding trials. He found that sprinting as a warm-up had no positive effects on sprinting speed for fifty

yards.

The effect of warm-up on the 440-yard dash by fifty high school boys over a four-week period was the purpose of a study conducted by Mathews and Snyder. (12) Each boy ran the dash sixteen times, eight as a member of the control group and eight times as a member of the experimental group. The warm-up consisted of 440-yard walking and jogging, six push-ups, six leg pulls per leg, ten toe touches, six sit-ups, three ten-yard wind sprints, and five to ten minutes of rest. The results indicated that warming up prior to performing the 440-yard dash did not significantly improve running performance.

The purpose of a study by Sills and O'Riley (26) was to compare the effects of rest, exercise (five minute walking and jogging), and cold applications upon physical performance. College male students performed five bouts of spot-running, with ten-second intervals between the bouts. After they rested, exercised or received cold applications for ten minutes, they performed another series of five bouts of spot-running. On the basis of the findings in this study, physical performance was improved more by cold applications than by either rest or exercise, and more by rest than by exercise.

Several studies opposing warm-up have found that it does not have a significant effect in the improvement of performance. The effect of passive heating with short-wave diathermy on the strength of one maximum contraction of elbow flexor muscles and the number of repetitions of a submaximal gripping exercise was investigated by Sedwick and Whalen (25) using twenty-six subjects. They discovered passive heating significantly decreased muscular strength.

Massey and others (11) tested male subjects on a bicycle ergometer

against time with and without preliminary warm-up. The subjects were in a deep hypnotic state prior to all testing, and when tested they had no conscious awareness of whether they warmed up. The findings in this investigation in no way supported the contention that warming up by overall, general bodily activity improves subsequent muscular performance of a type similar to that found in sprint running. There was also no indication that intense muscular performance at room temperature without warm-up results in muscle strain or injury.

The purpose of a study conducted by Smith (28) was to determine the effect of various warm-up techniques (stool stepping, showers at 110 degrees and at 98.6 degrees) on the speed of running. Statistically there were no significant differences between the three techniques.

Lotter (10) studied the effect of warm-up on the speed of arm movements. Twenty male students ran in place while rotating their arms for either two or four minutes prior to turning a bicycle crank as fast as possible with both hands. Statistical analysis showed no significant effect upon performance using the two types of preliminary warm-up.

The effects of light warm-up exercises on the performance of certain activities involving speed, strength, and accuracy was the purpose of a study done by Skubic and Hodgkins. (27) Neither the presence nor absence of light warm-ups of short duration appeared to significantly affect the performance of average skilled persons. Although it was not statistically significant, the scores generally improved as a result of practice. While there was no significant difference among scores in three different activities using three methods of warming up (no warm-up, general warm-up, and related warm-up), a slight tendency toward better scores were noted in tests which were preceded by related warm-up.

It appears that there has been little or no previous studies conducted comparing the effectiveness of stretching warm-up exercises to no warm-up exercises in improvement of performance in track and field power events for tenth grade boys. The lack of experimental evidence regarding the value of stretching warm-up exercises prior to performance requires further investigation. Since performance excellence is desirable the merits of warm-up procedures necessitate complete and extensive study. Studies dealing with various sprint distances have been done, but there appears to be a lack of evidence supporting warm-up procedures for the running long jump and shot put.

CHAPTER III

EXPERIMENTAL PROCEDURE

Selection of Subjects

The subjects in this study were forty-one tenth grade boys enrolled in the required physical education program at Lincoln High School, Wisconsin Rapids, Wisconsin. For the purpose of this study psychological factors such as attitude and physical factors such as age, height, and weight were not considered.

Since the subjects were from one intact sophomore class, findings from this study represent only the subjects tested, and any attempt to apply these findings to other groups, is subject to question.

Warm-up Process

All the students participated in each segment of the study. All participants used the same warm-up procedures related to each of the three different events, the running long jump, the forty yard dash, and the shot put.

On the days when testing was done without preliminary warm-up exercises the subjects were tested immediately following roll call. The subjects took no warm-up exercise prior to their performance other than walking to class. On the days when preliminary warm-up exercises were done, the students followed a specific warm-up program before being tested. The warm-up program was designed specifically for each of the three events. Neuberger and Briner (18) felt that the most adequate stretching with the least stress is accomplished when the muscles have been previously warmed.

With this in mind an easy two minute jog was performed before doing the stretching exercises as a warm-up in this study. Each subject was given a standardized set of verbal instructions before commencing the warm-up exercises. The exercises used in the warm-up procedure are described in the Appendix. A detailed outline of the training program appears in Table I. Dress for the subjects during the testing period was the school physical education uniform. If a boy was absent during the testing period he was immediately tested the day he returned to school. All the subjects were tested an equal number of times within the class period.

Selection of Tests

The tests used were the running long jump, the forty yard dash, and the shot put. The scores recorded were the distances and times achieved in each test.

Running long jump. The jumper was asked to use an approach long enough to gain maximum velocity and momentum upon take-off. An approach of approximately 100 feet was recommended. They were instructed to use a controlled and relaxed run with a decrease in length of stride three to four strides prior to the jump. The foot was to be planted heel first, with the jumping leg straight and the body weight directly over the jumper's leg at the time of maximum lift effort. While in the air the jumper was instructed to concentrate on remaining in flight as long as possible in a sitting fashion. To enable a balanced landing, the jumper was asked to keep his feet shoulder width apart with the knees breaking and body tilted up and over the feet as he landed. Distances were measured from where the student's foot left the ground to the closest point he made contact in the landing pit. The student was not required to hit the take-

off board.

Shot put. The thrower was instructed to stand toward the direction of throw with the weight over the left leg. He was then told to step forward on his right leg, pivot a quarter turn to the right, and push off with his right foot. As he pushes off his body weight will change from the right foot to the left foot and back to the right foot until the reversal of feet is completed. As the shot arm moves in a continuous motion with the shot next to the neck the thrower was told to thrust the shot up and out until his arm is straight with release occurring at approximately a 45 degree angle. Reversing the feet at the completion of the throw was stressed. Distance was measured from the toe-board to where the shot put first struck the floor.

Forty yard dash. The Patton starting method was used, whereby the front foot is approximately ten to eighteen inches behind the starting line and the rear foot is planted so the knee is slightly ahead of the front foot. The hands are placed directly behind the line, with the thumb and index finger parallel to the line. The sprinter leans forward so the upper leg is at a right angle to the ground and the elbows are straight. To "get set," the sprinter was instructed to raise his posterior, lean forward, place his hands in a tripod position, keep his head in line with the body, and look at a spot approximately three to ten feet down the track. The sprinter was instructed to think about the gun and keep his body in a crouched position with head down and not completely standing until 15 to 20 yards later. Time was measured from the moment the student started until he crossed the finish line.

Administration of Tests

All subjects observed a demonstration of the running long jump, the forty yard dash, and the shot put. During the demonstration an explanation was given of the performance method to be used by the student. In order to reduce the practice effect, the first two days of each unit were devoted to preliminary training and practice in long jumping, shot putting, and running the forty yard dash. The next six class periods of each unit were used to test the students with or without prior warm-up exercises. Scores were recorded with no preliminary warm-up exercises and with preliminary warm-up exercises on an alternating basis for the next six class periods. Each student was allowed two trials during each testing session so he had a total of six scores with preliminary warm-up exercises and six scores without preliminary warm-up exercises. The same procedure was followed for each unit.

Testing Program

The training programs for each skill were conducted during the regularly scheduled class period. The class met three times weekly with the experimental period consisting of eight weeks during the second semester. The program was conducted in the field house using the track facilities. Six class periods were devoted to skill training and practice and eighteen class periods were used for testing purposes. Two physical education instructors and two student monitors were used as assistants during the testing period.

Techniques for Analyzing the Data

Upon the completion of the tests, the results in each of the three events were analyzed to determine whether or not there was a significant

difference between the scores obtained preceded by warm-up exercises and the scores obtained preceded by no warm-up exercises. A t-test for non-independent groups was used to compare the warm-up and non warm-up scores for each event. The five percent level of confidence was arbitrarily selected since it is an acceptable level of confidence to most statisticians.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

A t-test for non-independent groups was computed to determine whether or not there was a significant improvement in performance of the running long jump, forty yard dash, and the shot put with or without preliminary warm-up exercises. The five percent level of confidence was chosen for the acceptance or rejection of the null hypotheses of no significant difference between using preliminary warm-up exercises and not using preliminary warm-up exercises.

Statement of the Null Hypotheses

1. There will be no significant difference between the warm-up scores and non warm-up scores in performance of the running long jump.
2. There will be no significant difference between the warm-up scores and non warm-up scores in performance of the forty yard dash.
3. There will be no significant difference between the warm-up scores and non warm-up scores in performance of the shot put.

Statistical Analysis

1. With regard to the first null hypothesis that there is no significant difference between the warm-up scores and non warm-up scores in performance of the running long jump, the value of "t" was .75. This was not significant at the five percent level of confidence. Therefore the null hypothesis was accepted.

2. With regard to the second null hypothesis that there is no

significant difference between the warm-up scores and non warm-up scores in performance of the forty yard dash, the value of "t" was 1.0. This was not significant at the five percent level of confidence. Therefore, the null hypothesis was accepted.

3. With regard to the third null hypothesis that there is no significant difference between the warm-up scores and non warm-up scores in performance of the shot put, the value of "t" was .26. This was not significant at the five percent level of confidence. Therefore, the null hypothesis was accepted.

Summary of Statistical Analysis

Statistically significant differences in performance of the running long jump, forty yard dash, and shot put were not noted between the warm-up and non warm-up scores. In order for there to be a significant difference at the five percent level of confidence the "t" would have had to be 2.02 in all three tests.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

Individual performances have been studied for years by physical educators and coaches in an effort to determine which conditions best prepare an individual for performance. This investigation was designed to obtain experimental evidence regarding the value of stretching warm-up exercises as compared to no warm-up in the performance of tenth grade boys in track and field power events. An attempt was made to determine whether or not warm-up was of value in improving performance of the running long jump, forty yard dash, and the shot put.

Performance was measured by tests of the running long jump, forty yard dash, and the shot put. These tests were given with and without preliminary warm-up exercise.

The subjects were forty-one tenth grade boys enrolled in a required physical education class at Lincoln High School, Wisconsin Rapids, Wisconsin. The members of the group followed a specific program of performing in the running long jump, forty yard dash and shot put with and without preliminary warm-up exercises for an eight week period.

Findings. The statistical technique used to indicate differences in mean scores on the warm-up and non warm-up performance for each test was a t-test for non-independent groups. The five percent level of confidence was used for acceptance or rejection of the null hypotheses.

Values for "t" indicated that:

1. There were not significant differences in the warm-up scores and non warm-up scores for performance in the running long jump.
2. There were not significant differences in the warm-up scores and non warm-up scores for performance in the forty yard dash.
3. There were not significant differences in the warm-up scores and non warm-up scores for performance in the shot put.

Conclusions

Within the limits of this study, the following conclusions have been formulated:

1. Preliminary stretching warm-up exercises as administered in this study will not improve performance in the running long jump.
2. Preliminary stretching warm-up exercises as administered in this study will not improve performance in the forty yard dash.
3. Preliminary stretching warm-up exercises as administered in this study will not improve performance in the shot put.

Suggestions for further studies. A similar study should be done in which different preliminary warm-up exercises are used. It would be interesting to determine what type of program would produce the greatest performance. A similar study could also be conducted using varsity track members in each of the three events. The results would be of interest to track coaches.

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APPENDIX

TABLE I

Week I	Wednesday--Demonstration and Explanation of Forty Yard Dash Friday--Practice Running Forty Yard Dash Monday--Run Forty Yard Dash without warm-up--Take two times
Week II	Wednesday--Run Forty Yard Dash with warm-up--Take two times Friday--Run Forty Yard Dash without warm-up--Take two times Monday--Run Forty Yard Dash with warm-up--Take two times
Week III	Wednesday--Run Forty Yard Dash without warm-up--Take two times Friday--Run Forty Yard Dash with warm-up--Take two times Monday--Demonstration and Explanation of Running Long Jump
Week IV	Wednesday--Practice Running Long Jump Friday--Long Jump without warm-up--Take two measurements Monday--Long Jump with warm-up--Take two measurements
Week V	Wednesday--Long Jump without warm-up--Take two measurements Friday--Long Jump with warm-up--Take two measurements Monday--Long Jump without warm-up--Take two measurements
Week VI	Wednesday--Long Jump with warm-up--Take two measurements Wednesday--Demonstration and Explanation of Shot Put Friday--Practice the Shot Put
Week VII	Monday--Shot Put without warm-up--Take two measurements Wednesday--Shot Put with warm-up--Take two measurements Friday--Shot Put without warm-up--Take two measurements
Week VIII	Monday--Shot Put with warm-up--Take two measurements Wednesday--Shot Put without warm-up--Take two measurements Friday--Shot Put with warm-up--Take two measurements

TABLE II

T-Values for the Warm-up
and Non Warm-up Scores

TEST	"t" RATIO
RUNNING LONG JUMP t-test between warm-up and non warm-up scores	.75
FORTY YARD DASH t-test between warm-up and non warm-up scores	1.00
SHOT PUT t-test between warm-up and non warm-up scores	.26

TABLE III

Warm-up Program

1. Jog for two minutes.
2. Six stretching exercises--one minute/exercise
3. Running Long Jump
6 pop-ups (run 8 to 10 yards and jump up for height
simulating actual take-off)

Forty Yard Dash
15 half squats

Shot Put
15 push-offs (lean against wall facing it, push away
from the wall with an explosive movement
of the arms)
4. Jumping Jacks--one minute

TABLE IV

Stretching Warm-up Exercises

1. Forward Leg Circles--stand on one leg and move other leg in circular motion forward (one minute)
2. Backward Leg Circles--same as number one except moving backward (one minute)
3. Figure 8 Leg Circles--same as numbers one and two except move leg in a figure 8 pattern (one minute)
4. Arm Swinging--swing arms forward and backward to stretch upper back muscles and pectoral muscles (one minute)
5. Neck Rotation--easy rolling of the head on the shoulders (one minute)
6. Toe Touches and Hip Rotation--easy rolling of upper body around the hips, touch toes when leaning forward (one minute)