

1980

The effects of varied weight loss on the components of strength, power and cardiovascular endurance of high school wrestlers

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THE EFFECTS OF VARIED WEIGHT LOSS ON
THE COMPONENTS OF STRENGTH, POWER
AND CARDIOVASCULAR ENDURANCE
OF HIGH SCHOOL WRESTLERS

by

Gary A. Bucci

An Abstract

of a project submitted in partial fulfillment
of the requirements for the degree of
Master of Science in the School
of Health, Physical Education
and Recreation at
Ithaca College

September 1980

Project Advisor: Dr. A. Craig Fisher

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ABSTRACT

The effects of varied weight reduction on the components of strength, power, and cardiovascular endurance of high school wrestlers was examined. Subjects for this study were high school junior varsity and varsity wrestlers from Ithaca High School, Ithaca, New York, Groton Central School, Groton, New York, and Lansing Central School, Lansing, New York. The subjects were randomly assigned to either a 0-2.5%, 2.5-5.9% loss group, or greater than 5.9% weight loss group according to the amount of weight loss. The subjects were weighed and tested during the week of their first practice and then reweighed and retested during the week of their first wrestling match, approximately 3 weeks from the first test date. MANCOVA was performed on the data between the test and the retest to determine significant differences in performances within weight loss groups. The selected confidence level for significance was .05. The major hypotheses for this investigation were accepted due to findings of no significant differences within groups. Wrestlers who lost 0-2.5%, 2.5%-5.9%, and greater than 5.9% body weight did not have scores that were significantly different than scores received when first tested.

Ithaca College
School of Health, Physical Education and Recreation
Ithaca, New York

CERTIFICATE OF APPROVAL

MASTER OF SCIENCE RESEARCH PROJECT

This is to certify that the Research Project of

Gary A. Bucci

submitted in partial fulfillment of the requirements
for the degree of Master of Science in the School of
Health, Physical Education, and Recreation at Ithaca
College has been approved.

Research Project

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July 8, 1980

Physical Education Department

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THE COMPONENTS OF STRENGTH, POWER
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OF HIGH SCHOOL WRESTLERS

A Research Project Presented to the Faculty
of the School of Health, Physical
Education and Recreation
Ithaca College

In Partial Fulfillment of the
Requirements for the Degree
Master of Science

by
Gary A. Bucci
September 1980

ACKNOWLEDGMENTS

The investigator would like to extend his appreciation to the following people for their assistance in the completion of this project.

1. Mr. Orlando Turco, Mr. David Remick, and Mr. Charles Weaver for their understanding and patience in allowing me the use of their wrestling teams.

2. The wrestlers of Groton Central School, Lansing Central School, and Ithaca High School for their time and effort during testing.

3. Chip, Rex, Fergie, Joe, Steve, Tom, and Jamie, my close friends, for without them this project may never have been completed.

4. Dr. A. Craig Fisher, who picked up this study and helped me to complete it.

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Chapter 1

INTRODUCTION

Wrestling is one of the oldest sports known and presently includes amateur participants ranging from elementary school age to middle age. Public interest and the popularity of both scholastic and collegiate wrestling have increased greatly during the last decade. With the rapid growth in the number of participants has come more widespread concern from the medical profession, parents, and educators regarding the common practice of excessive weight reduction in a short period of time (Herbert & Ribisl, 1972).

Many coaches feel that, for the following reasons, it is desirable for contestants to lose weight to compete in as low a weight class as possible: (a) to balance the squad's representation in all weight classes, (b) to gain an advantage by wrestling an opponent lighter than oneself, (c) because everyone does it, therefore "we have to," and (d) because it really does not hurt anyone (Floyd, 1968).

The whole controversy over "making weight" is an underlying problem of the system of weight classifications. Uniform rules governing tournaments and weight classification were established shortly after 1908 and were designed to promote fair competition between individuals of similar body size. The reasons cited by Floyd (1968) seem to contradict the purpose for which weight classifications were established. Many of the unsuccessful wrestlers who are involved in weight loss practices feel that part of the failure is due to losses in strength and power. They also experience a reduction in their cardiovascular endurance.

Sasahara (1960) claimed that great physical strength is no doubt the first prerequisite for a wrestler. Berger's (1972) research suggests that development in the strength area should be included in a good conditioning program for wrestling, and that wrestling is a sport that necessitates the maximal amount of both strength and muscular endurance. Carson (1973) agreed and places strength as the most important single factor in wrestling success.

Another major concern of the majority of wrestling coaches is the cardiovascular endurance of their wrestlers. The cardiovascular condition of a wrestler is of extreme importance even though in a single match he usually will not wrestle more than 6 minutes without rest (Gaalaas, 1975). Several authors (Berger, 1972; Lorence, 1968; Ream, 1958; Spackman, 1974; Weiss, 1964) consider some type of cardiovascular conditioning as an integral part of an athlete's conditioning program. The wrestling coach must take special care in preparing the cardiovascular system of each of his wrestlers so that each may perform at his optimum level.

Lorence (1968) summarized the keys to successful wrestling. He said, not only is strength, power, cardiovascular endurance important, but a knowledge of moves and holds is imperative.

Scope of Problem

The 1977-78 high school wrestling teams from Ithaca High School, Ithaca, New York, Groton Central School, Groton, New York, and Lansing Central School, Lansing, New York were used to ascertain the effects of varied weight loss in a 3-week period on strength, power, and cardiovascular endurance. Each subject was weighed and then tested for strength utilizing a hand dynamometer, for power by pullups in 20 seconds, and for cardiovascular endurance by the 600-yard run-walk. The subjects were reweighed

and retested after 3 weeks of practice. Groups were established on the basis of the amount of weight lost during the testing period, categorized as 0-2.5%, 2.5-5.9%, and greater than 5.9% weight loss.

Statement of Problem

The effects of varied weight loss on strength, power, and cardiovascular endurance of high school wrestlers were investigated.

Null Hypothesis

There will be no significant differences in strength, power, or cardiovascular endurance among the 0-2.5%, 2.5%-5.9%, and over 5.9% weight loss groups.

Assumptions of Study

The following assumptions were made for the purpose of this investigation:

1. Subjects performed each test at their optimum level.
2. The tests of strength, power, and cardiovascular endurance selected for this study accurately measured those parameters of physical fitness.

Definition of Terms

The following terms were defined for the purpose of this study:

1. Strength is the maximum force exerted in a single muscular effort.
2. Power is the ability to exert maximum force in the time allotted.
3. Cardiovascular endurance is the ability to employ the oxygen metabolic pathways for a long period of time.
4. Rapid weight loss is that weight lost in a short duration of time through an intense effort to attain a prescribed weight for forthcoming competition.
5. Hand dynamometer is an instrument used in the measurement of

maximal grip strength.

6. Making weight is a term used to describe situations in which wrestlers attempt to qualify for a weight class.

Delimitations of Study

The following were the delimitations of this study:

1. Subjects were junior varsity and varsity high school wrestlers.
2. Subjects were tested for strength by a hand dynamometer, for power by pullups in 20 seconds, and for cardiovascular endurance by the 600-yard run-walk.

Limitations of Study

The following were the limitations of this investigation:

1. The findings related to these tests can only be applied to high school junior varsity and varsity wrestlers.
2. The conclusions determined from the results found in the strength, power, and cardiovascular endurance tests apply only to those tests used in this study.

Chapter 2

REVIEW OF RELATED LITERATURE

The review of related literature for the purpose of this study focused on the variables strength, power, and cardiovascular endurance. The areas of weight reduction and rapid weight reduction were also reviewed.

Strength

Strength plays an important role in the success of the wrestler. One of the most reliable dynamometrical measures of human strength is grip strength. Bookwalter (1950) states that grip strength tests are economical measures, easily administered and a direct measure of applied force. Phillips (1949) and Larsen (1974) agree that grip strength tests are convenient, common, valid, and reliable measures of general strength. As early as 1934 Blakeman and Rogers found the hand dynamometer to be an effective and accurate form of measuring grip strength. Fleishman (1964) and Simons (1969), using hand dynamometers, reported identical and excellent reliability coefficients in test-retest results of grip strength ($r = .91$) Fleishman's (1964) results were compiled from data collected at the Great Lakes Naval Center, where the mean age of the subjects was 18 years. An earlier study by Metheny (1940) concluded that reliable results may be obtained from tests of grip strength given over 6 days to children from 2.5 to 6.5 years. She also stated that such results are no less reliable than those obtained when the test is administered to older children. Ishiko (1967) confirmed her results as he stated that hand-grip tests are reliable forms of strength tests from age 6 upward.

Power

Strength and speed are key factors in power output. A wrestler may possess great strength but, unless he can exert that strength quickly, he will not be powerful. Since power includes the important factors of strength and speed of movement, athletic power tests are sometimes confused with strength tests. In fact, Fleishman (1964) stated that dynamic strength is analogous to power. The common requirement of all tests of dynamic strength is for the muscles involved to propel, support, or move the body repeatedly or support it continuously over time. Whereas strength tests are concerned only with the force exerted or the number of pounds successfully lifted, speed tests are concerned with the amount of time taken to cover a specified distance. In power tests the distance, force, and time factors are specified while the resistance is usually body weight (Johnson & Nelson, 1974).

According to Fleishman (1964), in those tasks that are timed, such as pullups in 20 seconds, the rate of responding is most directly seen related to a power concept. A test of this nature is a test of upperbody power, which is a key component of successful wrestling.

Cardiovascular Endurance

According to Fleishman (1964) the 600-yard run-walk is a measure of stamina or cardiovascular endurance. Many authors, including Fleishman, found the 600-yard run-walk to have a high index of reliability. In one study, Wilgoose, Askew, & Askew (1961) tested the reliability of the 600-yard run-walk at the junior high level. They tested 76 females and 70 males from the eighth grade and found a test-retest reliability coefficient of .92. Askew (1966) did a followup test on 85% of the subjects who participated in Wilgoose et al. (1961) study. He tested

46 high school females and 71 high school males and found no significant difference in the scores on the test-retest, compared to the initial study. This led him to conclude that the 600-yard run-walk is a reliable measure of the individual's ability to endure the event. Fleishman (1964) also found that test-retest results in the 600-yard run-walk vary little from the ages of 12 to 18 years. In another study to determine the ability to estimate VO_2 max from the AAHPER Youth Fitness Test, Falls, Ismail, and MacLeod (1966) found that the best single estimator of VO_2 max among the youth fitness items was the 600-yard run-walk.

Weight Reduction

There are few problems in athletics that cause as much concern to as many individuals as the "making of weight" by wrestlers. The ramifications of this problem appear to be as important at the interscholastic level as they are at the intercollegiate level (Tipton & Tchong, 1970). Excessive rapid weight reduction can become a vicious practice. In isolated cases throughout the country misguided coaches have permitted weight reduction to such an extent that it jeopardizes the health of a growing boy.

There seems to be a disagreement among coaches, wrestlers, researchers, and professional opinions on the effects of weight loss. Some professional opinions are examined in the following paragraphs.

Dawson (1965) viewed making weight as little more than a subterfuge whereby one wrestler is able to secure over another unfair advantage in height, reach, and leverage. According to Blyth and Lovingood (1963), many opponents of crash dieting believe that wrestling is one of the few sports where the athletes can be injured physically and mentally without practicing or participating in the sport.

Eckfelt (1956) indicated that excessive weight reduction is one of the

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chief targets of critics of amateur wrestling. School administrators have cited weight reduction as a logical argument against the introduction and continuance of the sport in scholastic institutions.

Kenny and Law (1952), in their book on wrestling, stated, "Many wrestlers in order to compete in a lower weight division reduce their weight more than is best for them. This not only takes the joy out of the sport for the individual but also to some extent endangers health. A wrestler should compete in a division that is as near as possible to his normal weight. (p. 19)

The American Medical Association (1965) made the following statement:

"From a health standpoint, crash diets desired to produce rapid or extreme weight loss are to be condemned. Also, disturbing the fluid balance of the body, another common weight reduction practice by drying out, holds serious health hazards. (p. 541)

Researchers have found that many of the professional opinions concerning weight loss contradict their findings concerning this problem. However, researchers Craig and Cummings (1966), and Elfenbaum (1967) found results similar to the opinions expressed by the professionals. Craig and Cummings (1966) found that VO_2 max and cardiovascular endurance in a treadmill test were significantly impaired after dehydration amounting only to 4.3% of body weight. Elfenbaum (1967) dehydrated three college wrestlers 3.98%, 6.63%, and 9.26% of body weight, respectively, and subjected them to rides on a bike ergometer. He found that strength was affected at 3.98% loss.

On the other hand, studies have indicated that rapid weight loss up to 11% has no deleterious effects upon measures that are considered important to wrestling (Byram, 1953; Taylor, 1957).

In 1940 Gillum prepared a questionnaire, which he administered to 35 Big Ten wrestlers and all Big Ten wrestling coaches. Each wrestler and coach was asked about weight reduction and its effects on muscular strength. Over 70% claimed that weight reduction does not affect strength. Many other coaches, however, continue to argue that weight reduction affects strength and, if continued week after week, leads to staleness. As a supplement to the questionnaire, muscular strength of 20 varsity wrestlers was tested on Friday after "making weight", and again on Monday when each wrestler's weight returned to normal. In each case except one, every athlete had a higher average strength score on Friday than Monday. Therefore Gillum (1940) concluded that an individual is stronger physically when below his normal wrestling season weight than at his normal wrestling season weight

Tuttle (1943) studied the effects of weight reduction by withholding food and by dehydration of 13 wrestlers. Eighteen responses involving the neuromuscular, cardiovascular, and respiratory systems, and oxygen requirements were measured in this study. The subjects performed each test five times on different days over a period of 1 month. A comparison of the data collected after weight loss up to 5% with the data collected before weight loss justified the conclusion that the weight loss experienced within the limits of the study had no detrimental effects on the physiologic responses investigated, except that there was a slight increase in heart rate and a slight decrease in vital capacity. Tuttle's findings were later supported by Doscher (1944), who stated that subjects may lose up to 5% of their weight without any detrimental effects.

In 1963, Bowers investigated the effects of rapid weight reduction on the strength, balance, endurance, power, and reaction time of high

school wrestlers. Thirty-two wrestlers served as subjects for the study and were divided into equal control and experimental groups. The tests were administered on Monday and Friday of each week for 13 weeks. In comparing the data collected before and after the weight loss, it was found that the weight loss did not significantly affect strength, reaction time, ability to maintain balance in motion, endurance as measured by a pulse index, or power measured by a vertical jump. It was concluded that a wrestler may safely lose 3% to 4% of his body weight without adversely affecting certain physiological responses.

Edwards (1951) had three college wrestlers lose 5.6%, 6.4%, and 7.82% of body weight, respectively. Measurements were taken on strength by use of pushups, pullups, and hand dynamometer; and on endurance by exhaustion runs on a treadmill. Readings were made at (a) the beginning of weight loss, (b) the end of the 4th day, and (c) the end of the 7th day. Edwards' study is pertinent in that endurance decreased an average of 30% as measured by exhaustion runs on a treadmill. Strength was again found to be unaffected. However, in 1953, Byram conducted a study which contradicted Edwards' findings with reference to endurance. An adaptation of the Carlson Fatigue Test was used to measure cardiovascular endurance. The group lost a mean weight of 5%, with the upper limit being 11.04%. Results allowed the conclusion that a weight loss of 5% had no detrimental effects on strength, nor on muscular or cardiovascular endurance.

Schuster (1954) also verified the findings of Byram in a study designed to ascertain the effects of rapid weight loss on endurance and performance of wrestlers. Twenty subjects were divided equally into two groups. Both groups were subjected to pushups, squat thrusts, rides on a bicycle ergometer, and evaluation of performance by a jury of experts. No

significant differences were found between the measurements before and after the weight loss period. In the opinion of judges weight loss had no effect on wrestling performance. Therefore, it was concluded that conditioned wrestlers may safely lose 7% body weight in a 7-day period without affecting performance.

Taylor (1957), in his study on performance capacity and effects of calorie restriction, found no significant difference in strength measurements up to 10% weight loss. There are several similar studies that concur with the previous findings. Nichols (1957), in perhaps the most critical study in the area of rapid weight reduction, administered a battery of tests in five main areas of (a) balance, (b) reaction time, (c) strength, (d) power, and (e) endurance to two groups of wrestlers. The control group practiced no weight control measures. The experimental groups lost from 3 to 18 lbs. or 1.67% to 11.11% body weight with a mean weight loss of 10.29 lbs. or 6.78% of body weight. No significant differences were found between the groups.

Englund (1962) undertook a study to assess the effects of rapid and extreme weight loss on the efficiency of wrestlers. His testing device was an adapted Harvard Step Test of 36 steps/min. on a 12-in. step. Sixty-six wrestlers were studied at the beginning and end of each week for a 3-week period. The wrestlers in the experimental group lost a mean weight of 4%. A heart rate recovery index was established at the beginning and at the end of each of the 3-week periods. No significant differences were revealed in physical efficiency between 4.4% mean weight loss and normal body weight.

Singer and Weiss (1968) and Manahan (1971) found similar results with weight reduction as it applies to certain physical and performance

measures. Singer and Weiss' (1968) study of 10 college wrestlers, who on the average lost up to 7.10% of their body weight, revealed that up to 7% weight loss did not adversely affect strength or cardiovascular endurance. Manahan's (1971) study had identical findings on the same performance measures and he similarly concluded that rapid weight reduction does not significantly affect strength and cardiovascular endurance of wrestlers up to 7% body weight loss.

Summary

A review of professional opinions as to the effects of weight reduction on wrestlers indicated that rapid or extreme weight reduction is considered an undesirable practice. The professionals claim that possible deleterious effects result from excessive reduction in body weight.

Actually, convincing scientific evidence pertaining to the harmful effects of "making weight," to the extent customary among interscholastic and intercollegiate wrestlers, was not found to support the professional opinions. Research studies reveal that up to 7% and in one case an upper limit of 11% of body weight could be lost without detrimental effects on the physiological, physical, or performance measures of wrestlers.

Chapter 3

METHODS AND PROCEDURES

This chapter defines the selection of subjects, assignment of subjects to groups, testing instruments, methods of data collection, scoring of data, and treatment of data.

Selection of Subjects

The subjects for this investigation were 48 1977-78 junior varsity and varsity wrestlers from Ithaca High School, Ithaca, New York, Groton Central School, Groton, New York, and Lansing Central School, Lansing, New York. Subjects were assigned to either a 0-2.5%, 2.5-5.9%, or greater than 5.9% weight loss group according to the amount of weight lost during the 3-week testing period.

Testing Instruments

Scales certified by the Tompkins County Bureau of Weights and Measures were used to record the weight of each subject. A Jamar Adjustable Dynamometer was used to measure grip strength of each subject. Subjects' dominant hand grip strength was recorded three times at 30-second intervals. A pullup bar approximately 8 ft. off the ground was utilized to measure power. The subjects also performed a 600-yard run-walk in their respective gymnasiums as a measure of cardiovascular endurance.

Method of Data Collection

Subjects were tested twice during this investigation. They were tested during the 1st week of practice and were retested during the week of their first wrestling match, approximately 3 weeks later.

All subjects in this investigation were weighed in gym shorts, and then tested for grip strength by a hand dynamometer. The subjects were instructed to grip the dynamometer with their dominant hand. The test was performed three times at 30-second intervals and all scores were recorded. The subjects then performed pullups for a total of 20 sec. The final test involved a 600-yard run-walk in which each subject ran around his respective gymnasium a prescribed number of times according to gymnasium dimensions.

Scoring of Data

Data collected from grip strength tests were scored in kg of force. Data collected from the 600-yard run-walk were changed to seconds for data analysis purposes.

Treatment of Data

Means and standard deviations were calculated for the three dependent measures--grip strength, pullups, and 600-yard run-walk. Data were subjected to multivariate analysis of covariance (MANCOVA), using pretest scores as covariates, to assess the varied weight loss treatment effects.

Chapter 4

ANALYSIS OF DATA

This chapter will report test reliability, descriptive statistics, and treatment effects.

Reliability of Tests

The tests used in this study have acceptable reliability. Grip strength, one of the most common measurements of strength, was found to have identical reliability coefficients ($r = .91$) on test-retest results by both Fleishman (1964) and Simons (1969). Wilgoose et al. (1961) reported a $r = .92$ on test-retest results for the 600-yard run-walk test of cardiovascular endurance. Askew (1966) did a followup study on his 1961 study and found no significant differences on the reliability score, compared to the earlier data.

Descriptive Statistics

The means and standard deviations of strength, power, and cardiovascular endurance scores for the three weight loss groups are reported in Table 1. Pretest means of 46.94 kg, 8.81, and 143.31 sec. were found for strength, power, and cardiovascular endurance, respectively, for the 0-2.5% weight loss group. Posttest means for the 0-2.5% group were 46.67 kg, 8.69, 133.75 sec. The 2.5-5.9% weight loss group revealed pretest means of 47.34 kg, 9.38, 137.19 sec. for the variables of strength, power, and cardiovascular endurance. Posttest means were 47.49kg, 9.38, 137.19 secs, respectively. The 5.9% and above weight loss group revealed pretest means of 49.36 kg, 10.44, and 138 sec., for strength, power, and cardiovascular endurance. Posttest means for the 5.9% and above group were 48.18 kg,

Table 1
Means and Standard Deviations of Strength, Power,
and Cardiovascular Endurance Scores
for Weight Loss Groups

Weight Loss Groups	Grip Strength				Pullups				600-yard Run-walk			
	Pretest		Posttest		Pretest		Posttest		Pretest		Posttest	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
0-2.5%	46.94	13.24	46.67	13.13	8.81	3.45	8.69	3.24	143.31	13.64	133.75	19.72
2.5-5.9%	47.34	7.70	47.49	7.56	9.13	3.26	9.38	3.40	144.38	17.84	137.19	19.67
5.9%-above	49.36	6.93	48.18	6.57	10.44	3.33	10.00	3.01	138.00	15.50	131.19	13.08

10.00, and 131.19 sec.

Treatment Effects

MANCOVA revealed no overall weight loss group differences in strength, power, and cardiovascular endurance, $F(3, 2, 42) = .65, p > .05$. This led to the acceptance of the null hypothesis, that there will be no significant difference in strength, power, or cardiovascular endurance among the 0-2.5%, 2.5-5.9%, and over 5.9% weight loss groups.

Chapter 5

DISCUSSION OF RESULTS

This chapter includes a discussion of the controversy surrounding weight loss and the results from this study.

Weight reduction has been a subject of controversy since its inception into athletic programs. The controversy centers on the point of how much weight may be reduced over a certain period of time and still maintain the safety of the wrestler.

The controversy also lies in the fact that research disagrees with medical, parental, and some coaches' opinions on the effects of weight loss. Authors, such as Blyth and Lovingood (1963), Dawson (1965), and Eckfelt (1956) claim that weight reduction, as a means of qualifying for a lower weight class, is an unfair advantage. They also agree that wrestling may be the only sport in which participants may be injured mentally and physically without actually competing. This argument has been so severe, that in some cases, school administrators have disallowed wrestling programs in their school systems. Many people believe that junior high and high school students, while still in their growth and development stages, need a balanced diet and any practice that disturbs normal nutrition will disturb their normal growth pattern. Parents become alarmed when their child suddenly reduces his food and fluid consumption by drastic measures. Their parental instincts tell them that this cannot be a healthy practice. They often describe mood and habit changes, which they attribute to weight reduction and crash dieting. Coaches claim that their wrestlers become stale and lose their will to compete.

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The American Medical Association (1965) takes a firm stand against dehydration, which is a common form of weight reduction. They proclaim, "any form of dehydration will impair performance, cause premature fatigue and eventually clinical illness, more rapidly than deficiency of any other nutrient." Some research has proven to be in agreement with this fact. Craig and Cummings (1966) found that endurance was affected when their subjects lost 4.3% body weight by dehydration. Elfenbaum (1967) found that, when dehydration was used as a means of weight reduction, his subjects' strength was affected at 3.98% weight loss.

The fact that this current study produced no significant differences only supports the overwhelming research that shows no distinct growth and development problems or significant differences in strength, power, or cardiovascular endurance when weight reduction takes place.

Nelson (1962) conducted a study of 10th, 11th, and 12th grade wrestlers and reported no distinct developmental differences between those who made weight and those who did not. Similarly, Alitz (1959) reported that both the wrestlers who dieted and those who did not made usual gains in weight and strength during the season and 3 months hence.

The majority of the investigations on rapid weight loss studies its effects on some form of strength, power, or cardiovascular endurance (Bowers, 1963; Byram, 1953; Manahan, 1970; Nichols, 1957). Researchers have conducted studies in which treatment ranges from 3 days to 1 month with weight loss from 0% to 11%, all revealing no significant differences in test-retest or among weight loss groups. In this current study the testing period was the first 3 weeks of the season, the time in which subjects who desired to reduce their weight would lose the greatest amount.

The testing devices throughout the literature are fairly consistent.

Strength measurements were generally conducted using a hand dynamometer and cardiovascular endurance tests were of the treadmill nature. Results that were assessed in this study readily agree with the literature and reveal no significant differences. The major difference in testing devices was the tool used to measure power. For the most part, vertical jumps and other tests of leg power were used as a power measurement. This author assessed upper body power, a component more specific to wrestling. The results from this test did not produce a significant difference.

Likewise, Edwards (1951), using a hand dynamometer to measure strength and exhaustion runs on a treadmill to measure cardiovascular endurance, had three wrestlers lose 5.6%, 6.4%, and 7.82% body weight, respectively. He reported no subsequent significant difference in strength, but endurance scores decreased by 30%. Byram (1953) studied rapid weight loss and its effects on strength and cardiovascular endurance. He concluded that 5% weight loss had no detrimental effects. Another study that supports the majority of the research in regard to the null effects of rapid weight loss is Schuster's (1954) week-long study. He supports his conclusions that a 7% body weight loss will not affect strength, power, or cardiovascular endurance.

Many comparison studies between weight loss and control, and between weight loss groups similar to this current 3-week study support the earlier studies with reference to the effects of weight loss. Englund (1961) found no difference in strength measures between weight loss and control groups he tested weekly for 3 weeks. He concluded that 4% body weight loss produced no deleterious effects. Studies from Singer and Weiss (1968) and Manahan (1971) showed that weight losses as high as 7%

body weight did not significantly affect strength and cardiovascular endurance.

Summary

Although the controversy surrounding the safety of weight loss is still prevalent, research consistently points to the fact that up to 7% body weight loss is safe. The only studies that show a significant decrement are studies that involved dehydration as the means of weight loss.

I also believe that dehydration can be a harmful practice, but weight loss by a well conceived diet, as research supports, will not harm the safety, growth or development of the junior high or high school wrestler.

Chapter 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

Summary

This investigation ascertained the effects of varied weight loss on the components of strength, power, and cardiovascular endurance of high school wrestlers.

The subjects who participated in this study were junior varsity and varsity wrestlers from Ithaca High School, Ithaca, New York, Groton Central School, Groton, New York, and Lansing Central School, Lansing, New York. Subjects were arranged in either 0-2.5%, 2.5-5.9%, or greater than 5.9% weight loss groups according to the amount of weight lost during the testing period. Subjects were weighed and tested during their 1st week of practice and then reweighed and retested approximately 3 weeks later, during the week of their first wrestling match.

MANCOVA was used to assess significant group differences in strength, power, and cardiovascular endurance. No significant differences were found within groups over a 3-week period. This led to an acceptance of the null hypothesis that there would be no significant differences in strength, power, or cardiovascular endurance among the 0-2.5%, 2.5-5.9%, and over 5.9% weight loss groups.

Conclusions

On the basis of the findings presented by this investigation, the following conclusion was supplied:

1. Wrestlers may lose up to 5.9% of their body weight without adversely affecting their strength, power, and cardiovascular endurance.

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Recommendations for Further Study

The following recommendations are offered for further investigation.

1. A follow-up study of this investigation could be conducted on the subjects at the completion of the season.
2. Further study of the effects of the dehydration method of weight loss should be studied.

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