A STUDY OF CORRELATION BETWEEN BODY WEIGHT CHANGE AND WIN-LOSS RECORD OF HIGH SCHOOL VARSITY WRESTLERS

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by

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ABSTRACT

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Dr. William Harper, Chairman
Dr. Harry Waters
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Statement of the Problem

The problems of this investigation were to determine, (1) if there is any correlation between weight loss or gain and win-loss record before certification, and (2) if there is any significant correlation between weight loss or gain and win-loss record after certification.

Summary of Procedure

Letters were mailed to coaches asking their help in obtaining information desired for this study. The coaches were asked to send the boys' weight at the start of each month beginning in September and continuing through the month of February. In December the coach not only sent in the weight, but also the certified weight and the wrestlers' records for the month of December. With the conclusion of the wrestling season in February the coach sent in the wrestlers' win-loss record for January and February. The Spearman Rank Order Correlation Coefficient (r_s) and Chi-Square were used to test for significant relationship between weight change and win-loss record.

Review of Conclusions

1. There is a significant relationship between weight change and win-loss records when the subjects were grouped together and correlated.
2. There is a correlation between weight change and win-loss records. Four weight classes showed a significant correlation and the other seven indicated a slight correlation (but not significant).

3. It was concluded that there was a correlation between the O_f's and E_f's with respect to weight change and win-loss record.

William Harper

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Approved for the Graduate Council

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INTRODUCTION

Wrestling is the oldest form of organized sport in the world. It has grown very rapidly in the colleges and high schools of the United States. As the sport of wrestling has increased, so has catalytic reaction increased in the study of weight control and weight reduction. Weight reduction, as practiced by wrestlers, is a temporary weight loss brought about by means of dehydration, withholding of food, and strenuous exercise. This voluntary weight reduction is an attempt by the wrestler to gain physical advantage over his opponent by competing in a weight classification below his normal body weight. Both the amount of weight lost and means of losing this weight has been heavily criticized in the sport of wrestling.

Opinions differ among wrestling coaches as to whether or not weight reduction is harmful. Research studies have indicated that moderate weight losses have no harmful effects on college wrestlers. However, it is possible that similar practices of weight control on the younger high school wrestler could prove to be harmful as such weight loss could have some deleterious effects upon the ongoing growth and development.

Literature has revealed that excessive weight reduction is the major problem in amateur wrestling. Weight reduction has been: (1) called the most difficult problem in conditioning; (2) cited as a cause of staleness (prolonged activity or overtraining); (3) used as a chief argument against introduction of the sport into various age levels; (4) stamped as unfair and unsportsmanlike; (5) said to cause wrestlers to be gaunt; (6) responsible for many prospective athletes shying away from the sport and causing others to drop out; and (7) suggested as a process likely to shorten longivity. Such problems have been acknowledged not only by observers outside the sport, but by those in it as well. Thus, the problem of weight reduction and control has become a major concern of coaches, parents, doctors, school administrators and the sport fan.

Because of the social pressure on the coach and wrestler to have a winning season, they have resorted to weight reduction and weight control. In view of the pressure and controversial opinions and lack of sufficient data for determining the effects of weight change on win-loss record in wrestling, the writer decided to conduct a study in this area.

THE PROBLEM

The amount of criticism directed at the sport of wrestling seems to center on the particular area of weight reduction. Wrestling coaches are not in full agreement as

to how much weight loss an individual can sustain without endangering his health. Some wrestling coaches feel an individual should not lose over 5 percent of the body weight, while others feel an individual may lose up to 10 percent of his body weight.

Research is very limited in the area of weight change and its effect on the win-loss record of high school wrestlers. The need for such a study seemed apparent. If a coach could see the correlation between weight change and win-loss record, then this might reduce some of the criticism of weight reduction and weight control.

Statement of the Problem

This study was undertaken to find what correlation, if any, exists between body weight changes and win-loss records for high school varsity wrestlers during one season of high school wrestling. Among questions to be answered were:

Is there any correlation between weight loss or gain and win-loss record before certification?

Is there any significant correlation between weight loss or gain and win-loss record after certification?

Is there any correlation when comparing the data before and after certification?

Statement of the Hypotheses

In order to investigate the above questions, the following hypotheses were tested:

There will be no significant correlation between weight loss or gain and win-loss record before certification.

There will be no significant correlation between weight loss or gain and win-loss record after certification.

There will be no significant correlation when comparing the data before and after certification.

Limitations of the Study

1. These data were concerned with the wrestlers in the first eleven weight classes, with the exclusion of the heavyweight class. The upper weight class was not used because they are not limited to weight gain or loss.

2. It is not known what influence, if any, the subjects' differing levels of physical maturity had upon the final results.

3. The writer was limited to the number of wrestlers for which to collect the data. The remaining data was collected by other coaches.

4. The original number of subjects were not able to complete the entire testing program.

5. The survey was limited to the number of wrestlers' weights returned to the investigator.

Delimitations of the Study

1. The survey was limited to varsity wrestlers which had wrestled a minimum of five matches.

2. This study was based upon material collected on the subjects from the beginning of the school year to the end of the varsity wrestling season.

3. The study covered ten high school wrestling teams in Kansas.

DEFINITION OF TERMS

Certain terms and words will be used in this study which should be clarified or defined in order to avoid confusion and misunderstanding.

Wrestling Season

The wrestling season is defined as that period of time between the first day of organized wrestling practice, November, 1970, and the last day of competition, February 21, 1971.

Varsity Wrestler

These were the wrestlers who trained for and competed in a varsity wrestling meet or meets during the wrestling season.

Weight Classes

Wrestlers are classified according to body weight. In Kansas high school wrestling there are twelve of these classes.

Certification Weight

The wrestler's weight and respective weight class, in which he will wrestle, must be on record at the office of the respective Kansas High School Activities Association.

Weight Change

In this study the amount of weight a wrestler gains or loses during the wrestling season.

Weight Cutting

The end result is most important when weight cutting is defined as it relates to this study. Without regard for the means of weight reduction, the wrestler is concerned only with achieving the weight which he desires.

PROCEDURES USED

There are one-hundred and two high schools in the state of Kansas that have varsity wrestling programs. Letters were sent to ten of the high schools which have well established varsity wrestling programs. The letters were sent to the coaches in August, 1970, asking for their help in obtaining information desired for this study. The coaches were asked to send the boys' weight at the start of each month beginning in September and continuing through the month of February. In December the coach not only sent in the weight, but also the certified weight and the wrestler's record for the month of December. With the conclusion of the wrestling season in February the coach sent in the wrestler's

win-loss record for January and February. The information was studied and after some deliberation, it was decided to use the Spearman Rank Order Correlation Coefficient (r_s) and the Chi-Square for the tests of significant relationship.

Chapter 2

REVIEW OF LITERATURE

Although research in physical education and athletics is a relatively recent development, many studies related to wrestling have been undertaken. Most of the work thus far completed has been specific to the neuromuscular, cardiovascular and respiratory responses of wrestlers. Some studies related to the problem of weight control and strength have been reported, but they are not as abundant as the above mentioned studies. In much of the research in which strength was measured, the measurements were a secondary aspect of the main problem. The amount of literature generally related to the sport of wrestling and specifically concerned with the problem of strength and weight control is limited. However, some research has been carried on in the field of weight reduction and dieting.

The review of literature has been arranged into three sections. The first section considers weight reduction in wrestling. The second section covers the nutrition of wrestlers, the hazards and recommendations. The third section is a summary of weight reduction and nutrition specific to wrestling.

WEIGHT REDUCTION IN WRESTLING

The conferees on wrestling agree that weight reduction is one of the most serious difficulties confronting those interested in the promotion of the sport of wrestling. There is evidence that a great deal of work is yet to be done on the problem of weight reduction. Weight reduction has confronted the sport of wrestling since its existence.

Kenny (11) in an article written in 1930, stated that by living on half to a quarter of his normal diet, a highly keyed wrestler can lose as much as ten pounds and by force of will power be strong for a full intercollegiate wrestling match. This Kenny calls a vicious routine that cannot help the cherished aim of every athlete, namely health. As the date of this article indicates, loss of weight in wrestling has been a concern of interested individuals for quite some time.

Effects of weight loss by dehydration and withholding of food on the physiologic response of wrestlers were investigated by Tuttle. It was found that a wrestler may safely lose, without any noticeable loss of either strength or muscular endurance, up to five percent of body weight by dehydration and by withholding of food.

Schuster (21) studied the effects of rapid weight reduction on endurance. Subjects who lost ten pounds in a seven day period were compared to control subjects not losing weight. Rapid weight loss was found to have no significant

effect on the differences in performance of the subjects or upon the wrestling ability of the subjects.

Using four subjects, Edwards (7) investigated the effects of semistarvation and dehydration on strength and endurance. Three subjects were used as the experimental group and one subject was used as the control. There were no significant changes found on strength tests, but a thirty percent decrease on the treadmill was found on subjects losing weight. Because of the small sample used in the study, the results were considered difficult to evaluate.

Harold Nichols (16), wrestling coach of Iowa State University, conducted an experiment showing the physiologic effects of rapid weight reduction in wrestling with freshman and varsity wrestling squads from Iowa State University. An experimental and a control group, each consisting of twenty-one subjects, were used. The experimental group consisted of those wrestlers who took part in rapid weight reduction. The control group consisted of wrestlers who did not reduce their weights. Tests were selected which would measure the five attributes considered common to wrestling and physical fitness, namely strength, balance, endurance, explosive power, and reaction time.

The battery of tests selected for this experiment were administered to both groups each day of the first week of the experiment to acquaint the subjects with the testing procedure and to establish base line figures for the subjects on each test. After the base line had been established, both

groups were tested twice each week during the period of the experiment. Nichols concluded that each of the tests differed in the means favoring the wrestlers reducing their body weight.

Doschner (6) sent out a questionnaire to thirty-two college coaches who were considered to be experts in wrestling and boxing. Twenty-two of the coaches indicated that losing weight quickly during the college career had no effect on the longivity or health of an athlete. The coaches who stated that quick weight reduction caused a deterioration in quality of performance believed that a certain amount of weight could be lost rapidly without any ill effect. Some believed that up to ten percent of the normal body weight could be lost. Doschner concluded, from the opinions expressed in his survey, that college coaches believe a certain percentage--although there is not much agreement as to what percentage--of the body weight may be lost without affecting performance in physical activities.

Sheldon (21) asserts that team physicians, trainers, and physical educators report that nearly all "topflight" or professional athletes "train down" in order to reach a weight where they will perform at maximal efficiency.

> The endorphic-mesomorphic from the Northwest part of the United States drop back in weight as much as 15 to 18 percent in order to reach their optimal muscular efficiency. (22:21)

If an individual sheds weight beyond 18 percent of the average weight of his somatotype, he tends to run into trouble by losing weight.

Rothacher (19) found that the weight of the non-athlete shows very little variation. During the fall, a study of football men showed their weight gained or remained the same. In the winter, the athletic group was found to lose, but when separated into swimming, track, and basketball groups, the swimming group gained weight for the season while the track and basketball group lost weight. On checking weight after varsity practice, track showed the greatest loss in weight of any of the winter groups.

In a study prepared by Rasch and Kroll (18) a great deal of consideration was given to the problem of weight reduction. When a group of high school wrestlers who lost 4.4 percent to 6.9 percent of their body weight were compared to a group that did not have to reduce to make their weight classification, no significant differences were found. The basis for the comparisons were pulse rate, systolic blood pressure, disatolic blood pressure, and scores on the Carlson Fatigue-Curve Test.

Another study was also completed by Rasch and Kroll (18) on a group of wrestlers who lost an overall average of 10.29 pounds, or 6.78 percent, of their body weight. The maximum lost was 11.11 percent. This study revealed that weight loss within these limits did not affect a wrestler with respect to: the wrestler's strength, his speed in reaction time, body balance when in motion, and endurance.

A study by Brown and Ober (3) was based upon the experience in the field of coaching wrestling. The feeling

was that when wrestlers were properly conditioned, the coach would have to decide in what weight class he qualified for upon reaching good physical condition. If both the coach and the wrestler felt the boy's best interest would be served in a lower weight class, a physician was consulted to determine whether further weight reduction would jeopardize the boy's health.

Gonino (9) concentrated on a study to determine various methods and the frequency used by high school coaches for weight reduction for wrestlers. Wrestlers used several methods for reducing their body weight. This study was of a questionnaire type. Two hundred questionnaires were sent to high school wrestling coaches in the United States to discover their weight reduction methods for squad members. The following table indicates the methods used and their frequency in relationship to the 150 returned questionnaires.

Methods of Weight Reduction	Frequency
Physical Workouts	142
Dieting	123
Dehydration	52
Heat Devices	21
Other	8

Some of the other important conclusions which resulted from this study were:

1. A wrestler may safely lose 5 to 10 percent of his body weight without suffering any ill effects.
2. The coach should only practice weight reduction in terms of each individual's physical make-up.

3. Five factors should be taken into consideration in determining a wrestler's diet:

   A. Age
   B. Body Build
   C. Height
   D. Physical Activity
   E. Type of Food

Gonino compared the results of his study with a similar one conducted 25 years ago. He found the methods of losing weight have not changed, only frequency of their use has changed.

NUTRITION SPECIFIC TO WRESTLING

Weight control and the classification of wrestlers seems to have had genuine problems for a long time. Many high school boys have subjected themselves to continuous and long pre-season and season dieting.

The diet program became especially pronounced for the wrestler who lost a considerable amount of weight before the first weigh-in and he was then required to follow a stringent diet for the remainder of the season.

"Crash diets and drying out by high school wrestlers and boxers trying to make a certain weight class are to be condemned," according to the American Medical Associations Committee on Injury to Sports. In a statement in the American Medical Association News, the committee, along with the National Federation of State High School Athletic Associations, called for an unannounced "weigh-in" at the beginning of the season and an increased number of weight classes.

The American Medical Association News said:

> Under the strong motivation and appeal of sports, the diet and drying out may be carried to great extremes. Such efforts are not consistent with the spirit of sport in that they tend to defeat regulations designed to insure fair and equitable competition. The crash diet sometimes approaching the starvation level, also is condemned from a health standpoint. Disturbing the fluid balance of the body by drying out holds serious health hazards. These dangers are intensified in the immature organism of the growing adolescent athlete. They are also intensified by periodic weighings which encourage the athlete to resort to such practices at frequent intervals during the season. (1:1)

In conclusion, the article said that "no plan is infallible," but wrestling coaches should "provide the best guarantee of equitable competition with a healthful experience for the participants."

Bullen, Mayer, and Stare (4) have done considerable work in the area of nutrition and athletics. These authors emphasize that the diet should comply with the needs of individuals in terms of growth and maintenance prior to the season, the nutritional status of the athlete should be assessed to determine the specific needs for weight gain or loss so that the diet may be planned accordingly. "While it may be desirable for an overweight person to lose weight, a 'crash diet' is not the method to be recommended," added the authors. The authors also reported:

> More often the intention of those athletes is not to attain their most 'desirable' weight for competition, but rather to compete with advantage against those who really belong in a lower weight class. When such weight classifications have been set up to provide competition on the equitable basis, the violation of these dehydration serves no more the

> ethics of sportsmanship that it does the health of the people concerned. (4:343)

The authors concluded that it appears that eating no less than three meals a day represents a desirable pattern for athletes. "When the sports practices are particularly protracted and exhausting, up to five lighter meals may be preferrable."

Hoffman pointed out:

> Champions are those men who train conscientiously, practice long hours, follow closely the rules of good living, and supply their bodies with the elements it needs for building maintenance, and bodily repair. (10:36)

The first rule of nutrition should be, have some complete protein every time anything is eaten, whether it be a full meal or a snack. Stromgren said that good diet, nutrition, and beneficial sports participation can make a reciprocal contribution. "Good diet can contribute to improve physical fitness and performance, and a well organized athletic program can contribute to improved eating attitudes, practices, and habits (23:32)."

Mayer and Bullen (16) pointed out that younger athletes, particularly those of high school age, should have normal increments in weight for growth and increased caloric allowance should be made accordingly. These authors concluded:

> To determine the desirable weight for a given athlete the best guide is the composition of his body, rather than the standard height-weight age tables which too often lead to errors of interpretation. Athletes are often mis-classified by such tables because of the high proportion of muscular content in their total body composition. (16:376)

Eppright, Swanson, and Iverson (8) conducted a study of the nutrient intake relationship to body size. The study of the Iowa school children was conducted cooperatively with the Human Nutrition Research Branch of the Agricultural Research Service. A sample of 61 schools was drawn. Within the schools random samples totaling 1,200 children were chosen. The investigators first plotted weight and height. From this information a measure of body size called "developmental level" was obtained. When the "developmental level" was considered in relation to the chronological age, placement could be made on a scale according to the above three factors. Careful records of the body intake of the individuals were kept.

Some of the important findings of the study were:

1. At the age of 12, body variations were the greatest.
2. Changes, such as food habits, environmental conditions, genetic influences and habits of living, should be considered in terms of food intake.
3. Undersized children generally had lower daily intake of most nutrients than had the oversized children.
4. Average sized boys were the only group in which the increase in intake of all nutrients was highly related to the increase in body size throughout the school age.

The following comments come from a study by the National Federation of State High School Athletic Associations and the Committee on the Medical Aspects of Sports of the American Medical Association (5). The reason for the study stemmed from the misconceptions of body weight in

relationship to strength. This misconception, simply stated, was that an athlete who is not overweight can undergo a great weight loss dieting and dehydration without a noticeable loss of strength. This study proved that starvation results in dehydration even though water is allowed. Under these conditions created in boys, endurance is decreased, speed deteriorates and hand-eye coordination is impaired. The subjects also complain of fatigue, muscle soreness, and weakness.

Some of the proposals made by the committee concerned with placing wrestlers into appropriate weight classes are listed below:

1. All wrestlers are to be weighed on an unannounced day.
2. Percentage allowance is to be made for additional weight increase during the season.
3. Wrestlers are to be assigned to a weight class which they will keep throughout the entire season.
4. There are to be no further weigh-ins during the season.
5. Wrestlers will not be allowed to make any weight reduction in excess of 5 percent of the normal body weight.

The necessity of making weight has been a serious handicap to wrestling since the sport made its debut on the high school level (5:11-14).

SUMMARY

Wrestling is a sport of such a competitive nature that it is a common practice among wrestlers, in high school

and college to voluntarily reduce their body weight to wrestle at the lowest weight considered endurable by the wrestler. Reducing weight in wrestling is usually accomplished by dehydration and restrictions of diet and has raised the question many times as to its effect upon the physical growth of the individual concerned.

Most research done on college wrestlers seems to indicate that weight loss, even up to 10 percent of body weight, has little effect upon the wrestlers strength, speed in reaction time, body balance, or endurance.

Weight reduction is possible and some of its dangers eliminated if certain basic principles are followed:

1. When properly conditioned, a physician should be consulted to determine if further weight reduction is advisable.
2. Reduction of weight should be over an extended period of time.
3. The wrestler should eat three meals a day, but reduce the diet and eat some type of protein with each meal.

It should be noted that high school wrestlers may undergo weight reduction during the onset of a growth period. This growth period must be taken into careful consideration by coaches in respect to the amount of weight a boy is required to lose.

From the review of literature, it appears that even high school wrestlers may lose 6 percent of their total body weight if the above mentioned principles are included in their program of weight reduction.

Chapter 3

METHODS AND PROCEDURES

The purpose of this study was to determine the correlation, if any, between weight change and win-loss record of varsity high school wrestlers. The Spearman Rank Order Correlation Coefficient and Chi-Square were used to obtain the correlation levels. This chapter has been subdivided into four sections and discusses nature and selection of subjects, equipment and facilities, testing procedure and statistical procedure.

NATURE AND SELECTION OF SUBJECTS

Weight change and win-loss records were obtained from varsity wrestling programs of ten different high schools in Kansas. However, only those wrestlers that wrestled eight matches were selected. Wrestlers came from AA schools, AAA schools, and AAAA schools, with most of them located in western Kansas. (See Appendix C, Sources of Sampling, page 66.

The number of wrestlers from the schools totaled 110. Eleven wrestlers were eliminated because the coach did not return the information, ten failed to make the varsity wrestling team, five eliminated themselves from the team, and seven had to drop-out because of injury.

Weights for the wrestlers were obtained at three different times during the school year. The first weight was taken in September, or as soon after school started as possible. The second weight that was recorded was the wrestler's certified wrestling weight. The third weight was obtained in January. This is the time when wrestlers in Kansas are given a five pound growth allowance. The win-loss records were collected at two different times, the first in December when the wrestler is reducing weight to be certified and the other at the end of the wrestling season. With this collection of data it was possible to correlate weight change and win-loss record for two different times during the wrestling season.

EQUIPMENT AND FACILITIES

The equipment used in this study consisted of: (1) a Continental adjustable weight and height scale: (2) a 3 x 5 card for each school reporting (Appendix A). The scales used for the weight checks were not of the same make but they resembled the Continental model.

The schools' varsity locker room was used as the weight check site. The varsity locker room is used by the varsity athletes during their season of inter-scholastic competition.

TESTING PROCEDURE

The varsity wrestling coach was in charge of all the weight checks. To comply with the wrestling rules the

subjects were instructed to completely disrobe prior to each weight check. The readings were taken to the nearest pound. The weight check was administered between three and four o'clock in the afternoon. This was after school was out and before the subjects participated in practice for a varsity sport.

The first weight check period was September, at the beginning of school. There was no reference to weight loss or gain at this time because most of the subjects were participating in another varsity sport. The information received from the first weighing was the subject's name and weight.

The second weight check was in December. At this time the information received was the subject's name, certified weight, and win-loss record for the first part of the season. In Kansas a high school wrestler has until the end of the third week in December to certify his weight. This means that if a wrestler wishes to wrestle at ninety-eight pounds then he must be down to this weight on or before the final certifying date. This weight is then turned in to the Kansas State High School Activities Association.

The third weight check was in January. The wrestler's name and weight was received at this time. After January 1, the wrestler is then allowed five additional pounds for a growth factor. The final information received from the coach was the wrestler's record for the last part of the season.

STATISTICAL PROCEDURES

Following the weight check periods the information was transferred from the 3 x 5 cards to weight charts. The information was recorded on eleven charts, for the eleven weight classifications in high school wrestling. The information on these charts consisted of the subject's weight at the first weight check, his certified wrestling weight, his January weight, his win-loss records for December and after January 1. From the charts the weight lost or gained was determined and his win-loss records for the two check periods. (Appendix B, Tables 9-19)

Spearman's Rank Order Correlation Coefficient (r_s)

The information was taken from the charts and ranked accordingly to Spearman's rank order correlation coefficient. Spearman's rank order correlation formula:

$$r_s = 1\frac{6\Sigma d^2}{N^3-N}$$

d^2 = sum of the differences squared
N = sample size

In this analysis, the coefficient of correlation was employed to determine if there was a significant relationship between weight lost or gained and the win-loss record of the wrestlers. See Chapter 4, Analysis of Data, for specific data.

Chi-Square

To determine if there was a significant difference between the responses to the above criteria, chi-square was used. Chi-square provides a way to analyze data that are expressed as frequencies. Since it was necessary to use sampling in this study, chi-square was used to judge whether deviations of sample frequencies from those expected or hypothesized were due to sampling error or if such deviations were significantly different from those expected.

The formula for finding chi-square is as follows:

$$X^2 = \frac{(O_f - Ef)^2}{E_f}$$

O_f represents each observed frequency and E_f is the symbol for the expected frequencies that correspond with those observed. The formula indicates that these steps are to be carried out:

1. The difference between each observed frequency and its corresponding expected frequency is found by subtracting the latter from the former.
2. Each difference is squared and then divided by the expected frequency in each case.
3. The values found in step 2 are summed.

The amount that observed frequency (O_f) deviates from expected frequency (E_f) was found.

If chi-square X^2 was large enough, the null hypothesis would be rejected at some prescribed level of confidence. Null is hypothesized since if E_f's were the same as O_f's, X^2 would equal zero. Sampling error can cause O_f's to differ

from E_f's to some extent; but when differences between observed frequencies and expected frequencies are great--as measured by X^2--in comparison to the expected frequency, a conclusion was drawn that the differences probably are not a result of sampling error: the null hypothesis is rejected. When $O_f - E_f$ differences are small compared to E_f's it is concluded that the differences are probably a result of sampling error.

Degrees of freedom (df) are found by taking the number of rows minus one times the number of columns minus one. The formula used was as follows: $df = (r-1)(c-1)$. See Chapter 4, Analysis of Data for specific data.

Chapter 4

ANALYSIS OF DATA

The correlation between weight change and win-loss record for high school wrestlers was the data gathered for this study. The weight change from September to December (certification weight), and the win-loss record for December were correlated for significance. The same correlation was analyzed for January (after certification) data.

RESPONSE ANALYSIS

The data for this research were received from ten Kansas High School coaches. Each coach sent in eleven boys for the first weigh-in period, which gave an original number of one-hundred and ten. With the conclusion of the weigh-ins the total was seventy-seven, which was 70 percent of the original number.

STATISTICAL ANALYSIS

The Spearman Rank Order Correlation Coefficient was a statistical tool, as well as the chi-square, to test the null hypotheses of this study. The formula for the Spearman Rank Order Correlation Coefficient is as follows:

$$r_S = 1\frac{6\Sigma d^2}{N^3-N}$$

This formula represents the sum of the differences in the variables squared, and N represents the sample size. The coefficient of correlation shows the degree of relationship of two variables.

The critical values of the Pearson Correlation Coefficient were used to determine the relationship between weight change and win-loss records as computed by the Spearman Rank Order Correlation Coefficient.

The writer arranged the subjects into the first eleven high school weight classes, excluding the heavyweight class. These classes are defined as: 98, 107, 115, 123, 130, 137, 145, 155, 165, 175, and 185. Each of these eleven groups was evaluated in terms of weight change and win-loss record for December and January. Data for each weight class in December can be found in Table 1, page 28. Data is also found in Table 2, page 30, for January. The tables show correlations of weight change and win-loss records. With eight degrees of freedom, .623 was necessary for correlation to be statistically significant at the .05 level; and .765 was needed for significance at the .01 level.

98 Pound Class - December

A correlation of 0.1845 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

Table 1

Coefficient of Correlation for All Weight Classes in December

Group	d_2	r	P
98	68.50	0.1845	---
107	30.00	0.4642	---
115	61.30	0.0946	---
123	40.50	0.5178	---
130	34.00	0.3928	---
137	37.00	0.5595	---
145	33.50	0.0428	---
155	15.50	0.7232	.05
165	30.50	0.4553	---
175	33.50	0.0438	---
185	12.00	0.6571	.05

.632 was needed for significance at the .05 level with eight degrees of freedom.

.765 was needed for significance at the .01 level with eight degrees of freedom.

98 Pound Class - January

A correlation of 0.9345 was found between weight change and win-loss record, which indicated a statistically significant relationship at the .01 level.

107 Pound Class - December

A correlation of 0.4642 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

107 Pound Class - January

A correlation of 0.1785 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

115 Pound Class - December

A correlation of 0.0946 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

115 Pound Class - January

A correlation of 0.0000 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

123 Pound Class - December

A correlation of 0.5178 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

Table 2

Coefficient of Correlation for All Weight Classes in January

Group	d_2	r	P
98	5.50	0.9345	.01
107	46.00	0.1785	---
115	56.00	0.0000	---
123	72.50	0.1369	---
130	28.00	0.5000	---
137	82.00	0.0238	---
145	29.50	0.1571	---
155	13.50	0.7589	.05
165	66.50	0.1875	---
175	28.50	0.1869	---
185	50.00	0.4285	---

.632 was needed for significance at the .05 level with eight degrees of freedom.

.765 was needed for significance at the .01 level with eight degrees of freedom.

123 Pound Class - January

A correlation of 0.1369 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

130 Pound Class - December

A correlation of 0.3928 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

130 Pound Class - January

A correlation of 0.5000 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

137 Pound Class - December

A correlation of 0.5595 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

137 Pound Class - January

A correlation of 0.0238 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

145 Pound Class - December

A correlation of 0.0428 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

145 Pound Class - January

A correlation of 0.1571 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

155 Pound Class - December

A correlation of 0.7232 was found between weight change and win-loss record. A statistically significant relationship was not found to exist at the .01 level. However, a significant relationship was found at the .05 level since .632 was necessary at that level.

155 Pound Class - January

A correlation of 0.7589 was found between weight change and win-loss record. A statistically significant relationship was not found to exist at the .01 level. However, a significant relationship was found at the .05 level since .632 was necessary at that level.

165 Pound Class - December

A correlation of 0.4553 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

165 Pound Class - January

A correlation of 0.1869 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

175 Pound Class - December

A correlation of 0.0438 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

175 Pound Class - January

A correlation of 0.1869 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

185 Pound Class - December

A correlation of 0.6571 was found between weight change and win-loss record. A statistically significant relationship was not found to exist at the .01 level. However, a significant relationship was found at the .05 level since .632 was necessary at that level.

185 Pound Class - January

A correlation of 0.4285 was found between weight change and win-loss record, which indicated no significant relationship at the .01 level.

The subjects were then put into two large groups. A December group and January group to determine if there was a significant relationship in weight change and win-loss records for the whole group. The coefficient of correlation was used to determine if there was a statistical significance. There were seventy-seven subjects in each group. The following table gives correlations of weight change and win-

loss record. With seventy-seven degrees of freedom, .232 was necessary for the correlations to be statistically significant at the .05 level, and .303 was needed for significance at the .01 level.

Table 3

Comparisons of the December and January Groups For Weight Change and Win-Loss Records

Group	d_2	r	P
December	51,908,000	0.318	.01
January	65,143,000	0.144	---

.232 was needed for significance at the .05 level with 77 degrees of freedom.

.303 was needed for significance at the .01 level with 77 degrees of freedom.

Since sampling was used in this study, chi square was also selected to determine if deviation was significantly different from those expected. The formula for chi-square is as follows:

$$X^2 = \frac{(O_f - E_f)^2}{E_f}$$

O_f represents the observed frequency and E_f is the symbol for the expected frequencies that correspond with those observed. Chi-square represents the amount that observed frequency (O_f) deviates from the expected frequency (E_f) regarding the responses to given data. A chi-square table was used to give

the necessary value at a given probability level at the calculated degrees of freedom.

Degrees of freedom were found by taking the number of rows minus one, times the number of columns minus one. The formula is: $df = (r-1)(c-1)$. One row or one column in an analysis table are fixed by the number of responses and therefore are not free to vary.

It would appear that the differences between the observed frequencies are too great to be accounted for on the basis of chance factors. However, the expected frequencies were computed on the assumption that there was no relationship between the variables. However, it must be concluded that the assumption is probably not true.

If from the computation of the above chi-square, the value is large enough, the null hypothesis is rejected at some level of confidence. Null is hypothesized since if expected frequencies were the same as observed frequencies the chi-square value would be zero.

Table 4

Chi-Square of the December Weight Change and Win-Loss Record

	Winners	Losers	Total
Lost Weight	52 (50.71)	19 (24.90)	71
Gained Weight	3 (4.29)	3 (2.10)	6
Total	55	22	77

(O_f) Observed frequency $X^2 = 4.023$ df = 1
(E_f) Expected frequency is in parenthesis.

A chi-square value of 4.023 ($X^2 = 4.023$) was obtained. Using one degree of freedom (df = 1), a value of 3.84 was needed to reject the null hypothesis. Therefore, it was concluded that there was a significance between the O_f's and E_f's of weight change and win-loss records for December.

Table 5

Chi-Square of the January Weight Change and Win-Loss Record

	Winners	Losers	Total
Lost Weight	49 (45.90)	13 (16.10)	62
Gained Weight	8 (11.10)	7 (3.90)	15
Total	57	20	77

(O_f) Observed frequency.
(E_f) Expected frequency is in parenthesis.

A chi-square value of 4.114 ($X^2 = 4.14$) was obtained using one degree of freedom (df = 1), a value of 3.84 was needed to reject the null hypothesis. Therefore, it was concluded that there was a significance between the O_f's and E_f's of weight change and win-loss records for January.

Table 6

Chi-Square of Weight Loss and Win-Loss Records for December and January

	Winners	Losers	Total
December Lost Weight	52 (53.93)	19 (17.08)	71
January Lost Weight	49 (47.08)	13 (14.92)	62
Total	101	32	133

(O_f) Observed frequency $X^2 = 0.610$ df = 1
(E_f) Expected frequency is in parenthesis.

A chi-square value of 0.610 ($X^2 = 0.610$) was obtained. Using one degree of freedom (df = 1), a value of 3.84 was needed to reject the null hypothesis. Therefore, it was concluded that there was no significance between the O_f's and E_f's of the weight losers and win-loss records of December and January.

Table 7

Chi-Square of Weight Gain and Win-Loss Records for December and January

	Winners	Losers	Total
December Weight Gain	3 (3.14)	3 (2.86)	6
January Weight Gain	8 (7.86)	7 (7.14)	15
Total	11	10	21

(O_f) Observed frequency $X^2 = 0.018$ df = 1
(E_f) Expected frequency is in parenthesis.

A chi-square value of 0.018 ($X^2 = 0.018$) was obtained. Using one degree of freedom (df = 1), a value of 3.84 was needed to reject the null hypothesis. Therefore, it was concluded that there was no significance between O_f's and E_f's of weight gains and win-loss records for December and January.

SUMMARY

Tables 1 and 2 have shown that four of the eleven weight classes, when correlated, did show a significant correlation. Although some of the other seven weight classes showed some correlation, such correlation was not significant.

Table 3 has shown that when the eleven weight classes were combined and correlated there was a significant correlation between weight change and win-loss records for December. January did show some degree of correlation, but it was not significant.

From the seventy-seven wrestlers that were used for this study, a chi-square test was correlated to determine if there was a significant difference between observed frequency (O_f's) and the expected frequencies (E_f's). Tables 4, 5, 6, and 7 have been developed to indicate observed frequencies (O_f's) and expected frequencies (E_f's).

Chapter 5

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

It was the purpose of this study to determine the effect of weight change among high school varsity wrestlers upon their win-loss record.

The subjects for this study were seventy-seven Kansas high school wrestlers, eligible under the rules of their school and the Kansas State High School Activities Association. All subjects were weighed each month from September to February of the 1970-1971 wrestling season. There were two win-loss records kept for each wrestler. The first was recorded before certification and the second after certification.

The computations for this study were the Spearman Rank Order Correlation Coefficient and the chi-square. The combined weight change and win-loss records for all wrestlers in each of the eleven weight classes were used for the correlation. A second procedure involved placing the wrestlers into December and January groups for an over-all correlation between the two groups.

FINDINGS

The findings of this study were as follows:

1. A significant relationship at the .01 level was found to exist between weight change and win-loss record for the 98 pound class for January.

2. A lesser significance at the .05 level was found between weight change and win-loss record for the 155 pound class in January and 185 pound class for December.

3. Eight of the weight classes failed to show a significant relationship between weight change and win-loss records, December or January. These were 107, 115, 123, 130, 137, 145, 165, and 175 pound weight classes.

4. Significant relationship at the .01 level was found between weight change and win-loss record for the combined group of December.

5. The combined group of January did not show a significant relationship.

6. For December there was a correlation between weight loss and win-loss record compared to weight gain and win-loss record. Chi-square indicated a .01 level of significant relationship.

7. For January there was a correlation between weight loss and win-loss records compared to weight gain and win-loss record. This showed a significant relationship at the .01 level.

8. When comparing the weight gainers and weight losers against one another, between the two groups there was no significant relationship.

CONCLUSIONS

Within the limits of this study the following conclusions are justified:

1. There is a significant relationship between weight change and win-loss records when the subjects were grouped together and correlated.

2. There is a correlation between weight change and win-loss records. Four weight classes showed a significant correlation and the other seven indicated a slight correlation (but not significant).

3. It was concluded that there was a correlation between the O_f's and E_f's with respect to weight change and win-loss record.

DISCUSSION

The need for fact finding studies on both the true incidence and magnitude of weight reduction practices among wrestlers as well as demonstrable effects upon athletic performance was the reason for this study. Universal agreement that excessive weight reduction is a problem in wrestling is simply not sound evidence for excessive weight reduction being a universal practice.

The researcher noted that it was interesting that the percentage of weight loss seemed to vary among the wrestlers from the schools that returned the information for the study. Although not statistically proven, it seems that the percentage of weight loss has a bearing on the win-loss percentage of wrestlers. Taking the wrestlers in this study and comparing their weight loss percentage and win-loss percentage showed that those losing weight had a higher win-loss percentage as indicated in Table 8.

Table 8

Weight Loss Percentage Vs. Win-Loss Percentage

Percentage of Weight Loss	Winners	Losers	Percentage Winners
0-5	61	26	70
5-10	32	8	80
Over 10	6	0	100

The table shows that the greater the weight loss the higher win-loss percentage. This agrees with the statistical analysis of the study that there is a correlation between weight change, more particularly weight loss, and win-loss record.

Even though the weight loss, proven within the limits of this study, has a correlation with win-loss records, the writer feels this could be misleading. Certain factors must be given strong consideration in attempting to justify proper

weight reduction. Some of these considerations are: the wrestler's body build, his normal body weight, his age, and the possibility of growth which would occur during the wrestling season. It is this writer's opinion that a program of mandatory weight loss at the high school age level must be undertaken with extreme caution.

RECOMMENDATIONS FOR FURTHER STUDY

As a result of this study, the following recommendations are made for further study:

1. A study employing similar procedure, but using a larger number of wrestlers.

2. A study comparing the different types of weight reduction and their effects upon high school boys, including wrestlers.

3. A study of a random sampling of high school boys to investigate the effects of weight cutting through clinical examination.

4. A similar study should be conducted on weight loss and win-loss record as it relates to somatotype of body build.

5. A similar study using weight loss and win-loss records as compared to wrestlers who maintain normal weight and win-loss records.

6. A similar study, but putting wrestlers in age groups to see if maturity has any effect upon weight loss or gain and win-loss record.

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APPENDIX A

Information Cards
(Cards 1-4)

Card 1

September Weight

Name	September Weight
Roush	103
McAfee	100
Kisner	121
Austin	124
Paulson	137
Yust	146
McCarty	147
Metz	160
Piland	158
Howver	185
Litchfield	190

Stafford

Sample

Card 2

December Weight and Win-Loss

Name	December Weight	Win-Loss
Roush	98	2-3
McAfee	107	0-5
Kisner	115	2-3
Austin	123	2-1
Paulson	130	3-1
Yust	137	0-2
McCarty	145	4-2
Metz	155	3-1
Piland	165	2-3
Howver	175	3-2
Litchfield	185	1-4

Stafford

Sample

Card 3

January Weight

Name	January Weight
Roush	103
McAfee	112
Kisner	120
Austin	128
Paulson	135
Yust	142
McCarty	150
Metz	150
Piland	170
Howver	180
Litchfield	190
	Stafford

Sample

Card 4

January Win-Loss

Name	January Win-Loss
Roush	5-3
McAfee	3-5
Kisner	7-2
Austin	4-2
Paulson	6-5
Yust	3-3
McCarty	11-1
Metz	4-2
Piland	6-7
Howver	7-4
Litchfield	3-7

Stafford

Sample

APPENDIX B

Weight Classes
(Tables 9-19)

Table 9

98 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	105	98	-7	103	-2	2-2	7-4
B	115	98	-17	103	-12	2-3	2-4
C	104	98	-6	103	-1	2-3	5-3
D	97	98	+1	98	0	3-1	1-1
E	105	98	-7	103	-2	1-2	2-3
F	103	98	-5	103	0	2-3	5-3
G	107	98	-9	103	-4	3-0	7-1
H	105	98	-7	103	-2	9-0	10-3

Table 10

107 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	112	107	-5	112	0	2-2	1-6
B	120	107	-13	112	-8	5-3	10-8
C	120	107	-13	112	-8	2-1	4-1
D	107	107	0	107	0	0-5	3-5
E	113	107	-6	112	-1	7-2	7-1
F	115	107	-8	110	-5	3-3	5-2
G	118	107	-11	112	-6	5-6	5-2

Table 11

115 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	116	115	-1	115	0	3-1	14-3
B	121	115	-6	120	-1	2-3	7-2
C	122	115	-7	120	-2	6-2	12-5
D	118	115	-3	120	+2	2-1	3-2
E	124	115	-9	120	-4	3-3	5-2
F	123	115	-8	120	-3	5-2	8-3
G	124	115	-8	120	-4	6-2	8-1

Table 12

123 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	127	123	-4	127	0	2-1	6-3
B	125	123	-2	126	+1	7-2	2-4
C	135	123	-12	127	-8	6-0	4-0
D	132	123	-9	127	-5	1-3	5-7
E	135	123	-12	128	-5	5-0	6-0
F	136	123	-13	128	-8	4-1	11-7
G	131	123	-8	128	-3	3-0	4-0
H	128	123	-5	128	0	5-3	9-4

Table 13

130 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	140	130	-10	135	-5	1-3	5-6
B	144	130	-14	134	-10	4-1	8-2
C	137	130	-7	132	-5	3-0	7-1
D	137	130	-7	135	-2	3-1	9-6
E	140	130	-10	135	-5	10-0	18-4
F	139	130	-9	135	-4	2-2	13-3
G	131	130	-1	132	+1	1-6	1-8

Table 14

137 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	144	137	-7	142	-2	3-4	6-8
B	143	137	-6	142	-1	8-1	14-1
C	144	137	-7	137	-7	1-1	2-2
D	155	137	-18	140	-15	5-1	10-4
E	142	137	-5	140	-2	1-2	5-5
F	146	137	-9	142	-4	0-2	3-3
G	147	137	-10	142	-5	1-0	5-2
H	145	137	-8	142	-3	1-2	1-4

Table 15

145 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	147	145	-2	148	+1	4-2	15-3
B	153	145	-8	150	-3	2-1	6-1
C	150	145	-5	150	0	1-3	5-7
D	161	145	-16	150	-11	3-3	6-7
E	143	145	+2	147	+4	0-3	0-7
F	145	145	0	145	0	3-2	7-3

Table 16

155 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	149	155	+6	152	+3	1-1	6-2
B	160	155	-5	155	-5	3-1	7-3
C	155	155	0	155	0	2-3	4-5
D	174	155	-19	160	-14	5-0	12-4
E	160	155	-5	158	-2	1-2	5-4
F	155	155	0	155	0	2-2	9-4
G	167	155	-12	160	-7	9-0	14-0

Table 17

165 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	158	165	+7	166	+8	2-3	8-10
B	167	165	-2	167	0	9-0	15-0
C	160	165	+5	165	+5	2-1	5-3
D	167	165	-2	168	+1	2-2	6-7
E	178	165	-13	170	-8	5-2	9-4
F	165	165	0	165	0	1-7	2-10
G	170	165	-5	170	0	5-0	10-1

Table 18

175 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	185	175	-10	180	-5	3-2	10-6
B	176	175	-1	180	+4	9-0	12-1
C	181	175	-6	180	-1	2-1	8-3
D	171	175	+4	176	+5	2-2	13-3
E	180	175	-5	180	0	3-2	7-4
F	178	175	-3	180	+2	1-3	2-8

Table 19

185 Pound Class

Subject	September	December	(+-)	January	(+-)	Win-Loss December	Win-Loss January
A	191	185	-6	190	-1	1-4	3-7
B	183	185	+2	190	+7	0-2	2-7
C	195	185	-10	190	-5	2-3	4-7
D	191	185	-6	190	-1	5-1	9-2
E	186	185	-1	187	+1	1-3	7-11
F	193	185	-8	190	-3	5-0	8-3

APPENDIX C

Sources of Sampling

Table 20

Sources of Sampling

School	Classification	Coach
Hays	4A	Sidney Cooley
Ulysses	3A	Don Keller
Abiline	3A	Bob Halman
Stafford	2A	Jim Christen
Kinsley	2A	Lee Martin
Russell	3A	Vic Lyezak
Hoisington	3A	Elton Brown
Garden City	4A	Lee Albert
Hays Cadets	3A	Gerald Sadowski
Hoxie	3A	Bill Pickenpaugh
Ellsworth	2A	John Friesen