1982

Menstrual Cycle Effects on Blood Pressure, Body Weight and Heart Rates During Rest, Exercise and Recovery on College Athletes

Dawn J. Shutter
Eastern Illinois University

THESIS REPRODUCTION CERTIFICATE

TO: Graduate Degree Candidates who have written formal theses.

SUBJECT: Permission to reproduce theses.

The University Library is receiving a number of requests from other institutions asking permission to reproduce dissertations for inclusion in their library holdings. Although no copyright laws are involved, we feel that professional courtesy demands that permission be obtained from the author before we allow theses to be copied.

Please sign one of the following statements:

Booth Library of Eastern Illinois University has my permission to lend my thesis to a reputable college or university for the purpose of copying it for inclusion in that institution's library or research holdings.

August 9, 1982
Date

I respectfully request Booth Library of Eastern Illinois University not allow my thesis be reproduced because _____

_____

_____

_____ _____

Date Author

m

MENSTRUAL CYCLE EFFECTS ON BLOOD PRESSURE, BODY WEIGHT AND HEART RATES DURING REST, EXERCISE AND RECOVERY ON COLLEGE ATHLETES

(TITLE)

BY

DAWN J. SHUTTER

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

MASTER OF SCIENCE

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1982
YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

8-9-82
DATE

8-9-82
DATE

8-9-82
DATE

8/9/82
DATE

THESIS ABSTRACT

Ten members of the Eastern Illinois University women's track team were used as subjects to determine the relationship of body weight, blood pressure and heart rate during rest, exercise and recovery to menstruation.

The subjects were tested on two different occasions. The first test was administered within twenty-four hours of the onset of menstruation. The second test was conducted seven days later. During both testing periods blood pressure, body weight and resting heart rate measurements were taken before beginning the treadmill protocol (progressive grade and speed increases up to 4% and 8 mph, respectively). The subjects ran on a motor driven treadmill for five minutes while their heart rates were being monitored every minute. Within two minutes of the completion of the treadmill protocol, a seated recovery blood pressure measurement was taken. Recovery heart rates were also monitored every minute for five minutes.

The BMDP2V- analysis of variance program, including repeated measures, was used to determine whether there was any difference between each minute of exercise and recovery between the two tests.

A *t*-test was used to determine the differences between mean blood pressures taken before and after exercise as well as body weight and heart rates for both test days.

The study revealed that menstruation had no significant effect on blood pressure, body weight or heart rate responses at rest, during exercise or in recovery from exercise.

ACKNOWLEDGEMENTS

The writer wishes to express sincere appreciation to Dr. William Buckellew for his guidance, instruction and motivation in the completion of this paper.

Appreciation is also extended to Dr. Thomas Woodall for his guidance in the laboratory and in preparing this paper, and to Dr. Dorothy Hart and Dr. Walter Lowell for their valuable guidance.

The writer also wishes to express her appreciation to the members of the Eastern Illinois women's track team, and to John Craft, Julie Curry and Gina Sperry. Their efforts and participation have made this paper possible.

TABLE OF CONTENTS

Page

TABLES

FIGURES

CHAPTER I

INTRODUCTION

The relationship of menstruation, exercise, and sports participation for women has become an increasing concern among teachers and coaches in recent years. Although studies generally show the onset of the menstrual cycle does not affect performance, there remains the question of physiological effects such as blood pressure and heart rate.

Trained individuals experience a long range decrease in resting heart rate, but with the onset of exercise, their heart rates rise quickly in order to meet the oxygen demands of the body before eventually reaching a steady state (9). During recovery, the heart rate decreases greatly within the first two minutes and gradually levels off or drops slightly below the pre-exercising heart rate (9).

Blood pressure is also affected by training. During exercise, systolic blood pressure increases as a result of an increase in cardiac output (9). Vasodialation occurs within the arterioles causing a decrease in resistance. Blood can flow more freely, causing the diastolic phase to decrease (2, 9).

Since blood pressure and heart rate are affected by training, women are concerned about the problems associated with menstruation and the possible changes in their exercise efficiency.

Purpose of the Study

The purpose of this study was to determine whether menstruation affected a trained athlete's blood pressure and heart rate while exercising.

Null Hypothesis

The onset of menstruation does not alter a trained athlete's blood pressure or heart rate.

Need for the Study

Menstruation has commonly been thought to be a limiting factor in athletic performance. The mode of exercise may also have an effect on menstruation as suggested by Wilmore, Drinkwater, Foreman and Shangold (31) and Malina (15). Erdelyi (6, 7) suggested that women performed better during later days of the menstrual cycle than on the first day. It would therefore be of interest to compare how blood pressure and heart rate are affected by menstruation in regard to exercise in the first and later phases of the menstrual cycle.

Limitations

This study was limited to ten members of the Eastern Illinois women's track team who were basically unfamiliar with treadmill exercise, except for a brief orientation prior to the initiation of the investigation.

The time period was limited to two months and one menstrual cycle, thus allowing no comparison between months or trend development.

Room temperature fluctuated from day to day during the testing period, which may have caused higher heart rates.

Blood pressures were determined manually by the researcher which may have accounted for some of the variations in the readings.

Assumptions

The researcher assumed that all subjects came into the lab to be tested within twenty-four hours of the first noticeable sign of menstruation.

It was also assumed that the subjects participated in no activity or eating at least two hours before each test.

CHAPTER II

REVIEW OF RELATED LITERATURE

This study was concerned with the effects menstruation had on blood pressure and heart rates during exercise and recovery. The studies that follow provide information in the area of menstrual research including the effects of exercise and sports participation.

Menstruation and Exercise

Interest in the area of menstrual research began in the early 1870's when women were allowed to enter universities. Jacobi (12) observed temperature, pulse, and urea excretion trends in women in relationship to their menstrual periods. Trend relationships were found, but Jacobi concluded there were no significant effects that would endanger a woman during activity participation.

During the late 1920's, Tuesdall (27) studied the effects of menstruation on exercising women. The women's pulse and blood pressure were monitored after stepping on a chair five times. She found a fluctuation in pulse and blood pressure, but this fluctuation was not significant.

In 1932 Scott and Tuttle (20) compared physical efficiency and pulse rate to four menstrual stages. They found a slight variation between the different phases. This variation did not affect physical efficiency, and the fluctuation in pulse rate was insignificant. They concluded that any fluctuation during these stages was due to factors other than menstruation.

Phillips (16) studied twenty-four collegiate women who were examined during four menstrual phases to determine menstrual effects on pulse rate and blood pressure before and after exercise. The subjects participated in a one minute step test on a seventeen inch bench at a rate of ninety steps per minute. Some variation was found between the four phases, but the numbers were insignificant. Phillips concluded that pulse rates and

blood pressures were not affected by menstruation.

Doolittle and Engebretsen (4) also found similar results in subjects who participated in various performance tests (12 minute run, maximum oxygen consumption, 600 yard run-walk and 1.5 mile run-walk) during four menstrual stages. The results indicated that there was no variation in performance due to the menstrual cycle.

Garlick and Bernard (10) found when studying undergraduate students that menstruation brought about a decrease in heart rate, blood hematocrit and hemoglobin, and an increase in blood pressure at rest. Changes in resting systolic and diastolic blood pressures were negatively related to heart rate. They concluded that menstrual effects were evident during rest, but may be hidden during activity by the body's response to exercise.

After studying nine women during midfollicular and midluteal menstrual phases at various exercise loads, Jurkowski and co-workers (14) found a difference in heart rate response between the two phases during light and heavy workloads, but no difference at the point of exhaustion. When cardiac output was measured, no difference was found between the phases. They concluded that aerobic capacity was the same during these menstrual stages due to the cardiovascular responses to exercise. During the follicular phase, however, exhaustive exercise was maintained for a shorter period of time than during the luteal phase.

Schoene and co-workers (19) also studied women during midluteal and midfollicular phases in relation to exercise performance and ventilary drive. They showed that exercise performance in athletes was not decreased in the luteal phase as it was for nonathletes. During this phase, increases in ventilary drives and exercise ventilation were exhibited.

After administering four Max $\dot{V}O_2$ tests during four menstrual phases, Richardson (18) found no significant difference in oxygen uptake between the four menstrual stages when she studied twenty-one collegiate students.

Stephenson and co-workers (26) studied four women during various work intensities at five menstrual phases. They measured oxygen uptake, ventilary volumes and rates and rectal

and skin temperatures during rest and various work intensities. The results showed no change in maximal ventilary volumes, heart rate or aerobic power as well as oxygen uptake and temperatures during submaximal work.

Sports Participation and Menstruation

Because of the increasing number of women in sports, recent studies are being directed toward the type of activity and menstrual irregularity.

Erdelyi (6, 7) found that 42-48% of the women he studied showed no change in athletic performances during menstruation. In contrast, 33% of the athletes showed a poorer performance during menstruating days than nonmenstruating days. He also found that women training in the later days of menstruation performed better than those during the first day of menstruation. He suggested that irregularity was related to the physical exertion and endurance required by the sport.

Bloomberg (3) cited in his article two researchers who suggested that a direct relationship can be found between training intensity and menstrual irregularities in cross country runners. They concluded that the more intense the training, the greater the chance of menstrual irregularity.

Harris (11) surveyed 200 women athletes with menstrual problems and high stress levels. The athletes fell into three stress type groups: the first group lost a significant amount of weight in a short period of time; the second group underwent severe psychological trauma; and the third group's training schedule was overly demanding. She found that once the stress was relieved or the body adapted to the level of stress, menstruation was regained. A consistent correlation between body fat and hormone imbalance to stress was not found.

After studying American athletes at the Montreal Olympic Games, Webb, Millan and Stolz (29) found that 59% of the athletes experienced delayed or missed periods during the competitive season. They also found that women who participated in intensive sports before menarche usually had a higher incidence of menstrual disorder. Most menstrual changes occurred in the characteristics

and not in the course of the cycle. They associated irregularity in athletes to overtraining and excessive weight loss.

Dunlevie (5) also attributed menstrual irregularity to a reduction in body fat. He stated in a 1979 article that an increase in weight and a reduction in training will help women regain their cycles.

Pinkerton (17) stated that athletic performance was not hampered by menstrual phases, but amenorrhea did occur in women who trained at high mileage (running 60 miles/week). She cited Ullyot (28) in her article who attributed menstrual irregularity to a reduction in body fat.

Sheehan (24) agreed that menstrual irregularity may be a result of body fat loss as well as a hormonal imbalance. He also suggested in his article that heavy training causes a decrease in menstrual flow and even the absence of periods, but menstruation reoccurred after a reduction in mileage.

Shangold (21, 22) attributed menstrual irregularity to physical and emotional factors and not to exercise. She believed that the physical and emotional stress of training as well as low body fat and weight attributed to menstrual irregularities.

After surveying women following the Portland Marathon, Speroff and Redwine (25) found that runners who experienced irregularity before running were more likely to develop secondary amenorrhea as well as those women who had been running for an extended period of time. They also attributed secondary amenorrhea to weight loss. They therefore concluded that energy expenditure and body fat would affect menstrual function.

In a recent article, Wilmore, Shangold, Foreman and Drinkwater (31) discussed menstrual irregularity in athletes. They felt that menstrual irregularity was stress induced, and in some instances intense training caused menstruation to stop. They stated that personal stress was more critical than training, and this pressure and stress had a direct effect on menstruation.

Shangold (23) stated recently that disorders begin with diet, lifestyle and body composition changes before an exercise program began. Even though athletes have a higher incidence of secondary amenorrhea and irregularities, she concluded that exercise may be totally unrelated to dysfunction.

Summary

A review of literature reveals that menstruation has no significant effect on blood pressure, pulse rate, or oxygen consumption. However, recent studies suggest that the intensity and type of training as well as body fat percentage play an important role in menstrual irregularity.

CHAPTER III

METHODOLOGY

This study was concerned with investigating the relationship of the menstrual cycle, blood pressure, and heart rate during exercise and recovery. The methods used in collecting and analyzing the data, subject selection, and testing procedures are explained in the following sections.

Subjects

Of the thirty women on the Eastern Illinois University women's track team, only ten athletes were used as subjects due to the irregularity of the menstrual flow during the two month time frame of this study.

The subjects ranged in age from 18 to 21 years, while the age at which menstruation began for these subjects ranged from 12 to 15 years. The number of years of track participation was five to seven years, with an average of 5.8 years.

Design of Study

In order to test the athletes while they were in top physical condition, this study was conducted during the final competitive weeks of the 1982 track and field season.

Each subject visited the Human Performance Laboratory on three occasions. The first time, a treadmill orientation was given to each subject. The second visit was the first testing period, which occurred within twenty-four hours of the first noticeable sign of menstruation. The final testing period was held seven days following the first test. Similar tests were given on both occasions.

Testing Procedures

The subjects were instructed to abstain from exercise, smoking, eating and drinking for at least two hours before the

tests. Each woman was consistently tested at the same time of day in the Human Performance Laboratory at Eastern Illinois University.

Blood pressure and body weight measurements were taken before the treadmill run, and heart rates were monitored during rest, exercise, and recovery. Another blood pressure measurement was taken within the first two minutes of recovery.

Blood Pressure

The change in blood pressure was determined by readings taken before and after exercise. A sphygnomanometer and stethoscope were used to determine indirect pressures measured on the right arm.

The reading before exercise was taken after the subject had been seated for five minutes to allow for a resting blood pressure. The reading taken after exercise was measured within two minutes after the cessation of the treadmill run.

Body Weight

This test required that the subject be weighed in shorts and a T-shirt. All other articles were removed from the body, and the weight was measured after the first blood pressure was taken. Weight was recorded to the nearest one-fourth pound.

Heart Rate

The procedure for monitoring heart rates was the same in both tests. A Sandborn visocardiette electrocardiograph machine was used to monitor resting, exercising, and recovering heart rates. The chest was abrated with an alcohol swab. Bilateral surface electrodes were placed in the V_5 and V_5R positions on the chest. The electrodes were then attached to a Becton-Dickenson patient cable. The base of the cable was pinned to the subject's shorts to limit electrode wire movement.

The electrocardiograph machine was calibrated to 1 mv before the test began, while the paper speed was set at 25 mm/second.

A seated resting heart rate was taken prior to exercise. Exercise and recovery heart rates were taken during the last fifteen seconds of each minute for a ten minute period.

Treadmill Protocol

The treadmill run consisted of five minutes of running. The grade and/or speed increased during this time. The subject stood on the treadmill for a ten second countdown. At the command "Ready . . . Go," the treadmill was started. The subject continued running until the commands "Ready . . . Stop" were given. A Graylab timer was used to document running time. The format for the treadmill run was as follows:

Minute	Grade	Speed
0-1	0	7.09 mph
1-2	0	7.09 mph
2-3	2	7.09 mph
3-4	2	8.00 mph
4-5	4	8.00 mph

Method of Recording Data

Blood pressures and body weight for each subject were recorded on a chart corresponding to the subject's name. Heart rates were monitored by a electrocardiograph machine and recorded on electrocardiograph paper. The results were transferred to each subject's chart.

Statistical Treatment

The data collected were recorded for statistical treatment on IBM cards, and calculations were completed on the IBM 360 computer at Eastern Illinois University. The BMDP2V- analysis of variance program for repeated observations on the same subjects was used to determine whether the difference in heart rates during the exercise and recovery periods.

A *t*-test was used to determine the significance of difference of mean scores between blood pressures taken before and after exercise, body weight, and heart rates at rest, exercise, and recovery on the first day of menstruation and a week later. The .05 level of significance was selected to test the difference for both the analysis of variance and the *t*-test.

Summary

Ten members of the Eastern Illinois University women's track team served as subjects and were given a treadmill orientation prior to the initiation of the study. Within twenty-four hours of the first sign of menstruation, the subject came into the lab. Blood pressure, body weight, and a resting heart rate were taken before the treadmill protocol began. Following the five minute treadmill protocol, another blood pressure measurement was taken, while the recovering heart rate was being monitored for five minutes. Identical test procedures were followed seven days later.

CHAPTER IV

ANALYSIS OF DATA

Ten female subjects were studied to determine the effects of menstruation on exercise and recovery. Each subject participated in three treadmill experiences including a walk-run orientation. Test one was performed on the first day of menstruation, and on the seventh day the second test was administered. Blood pressures were measured before and after exercise while heart rates were monitored at rest, during exercise and in recovery. The information was recorded and analyzed to determine whether the differences between the testing days was significant.

Presentation of Data

The results from the blood pressure, body weight and heart rate data have been presented in this section. The data were analyzed primarily to determine the effects of the onset of menstruation during the exercise and recovery periods.

A *t*-score of 2.26 at the .05 level of significance and nine degrees of freedom was needed to determine a significant difference in body weight before and after exercise on test one at the onset of menstruation and test two occurring seven days later.

Using the .05 level of significance at one and eighteen degrees of freedom, an F-score of 4.41 was needed for a significant difference between test one and test two data.

Blood Pressures

The blood pressure readings collected for each subject may be found in Appendix A. Mean systolic and diastolic blood pressure scores are shown in Figures one and two.

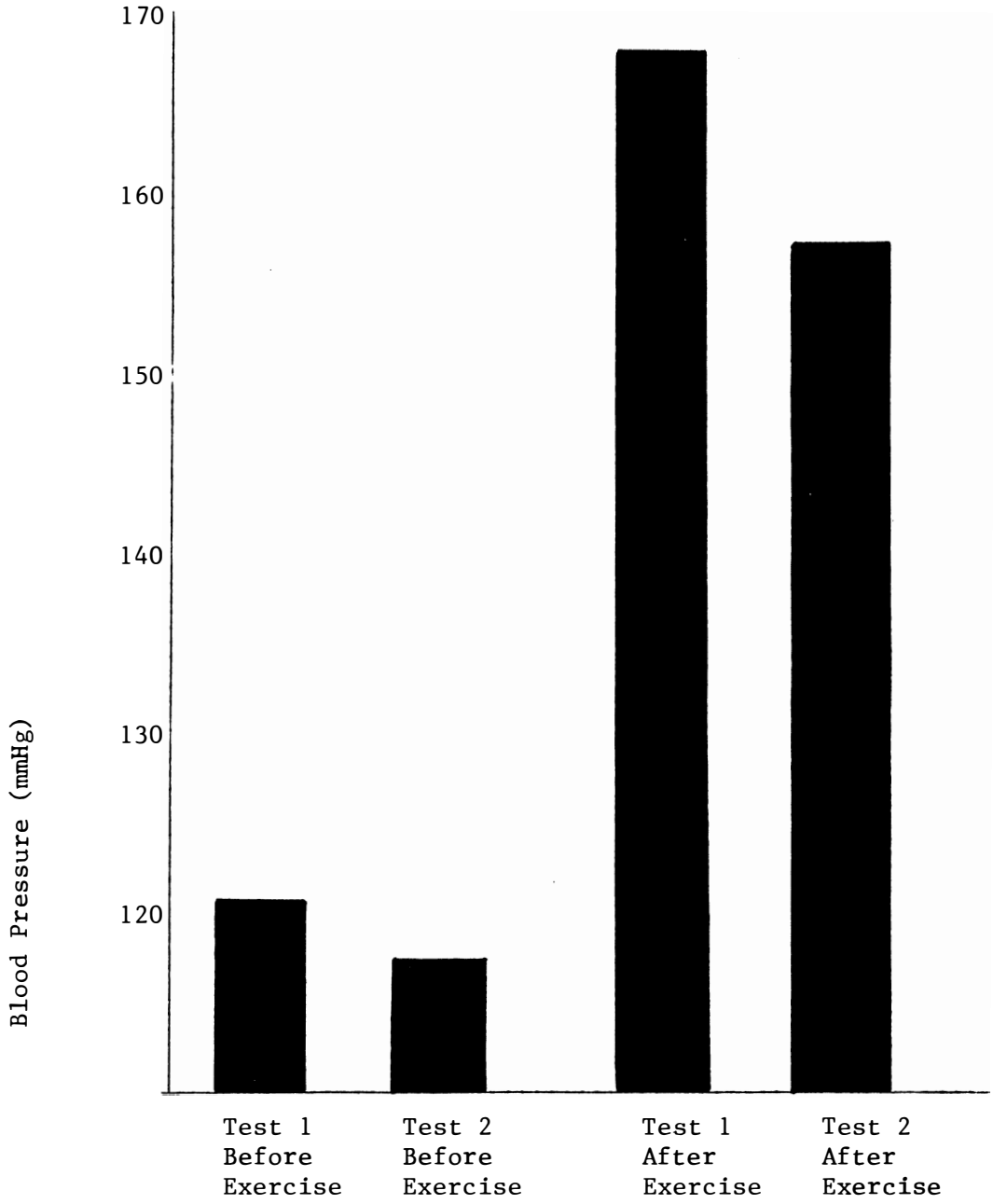

Figure 1

Mean Systolic Blood Pressure Measurements for the First Day of Menstruation (test one) and Seven Days Later (test two)

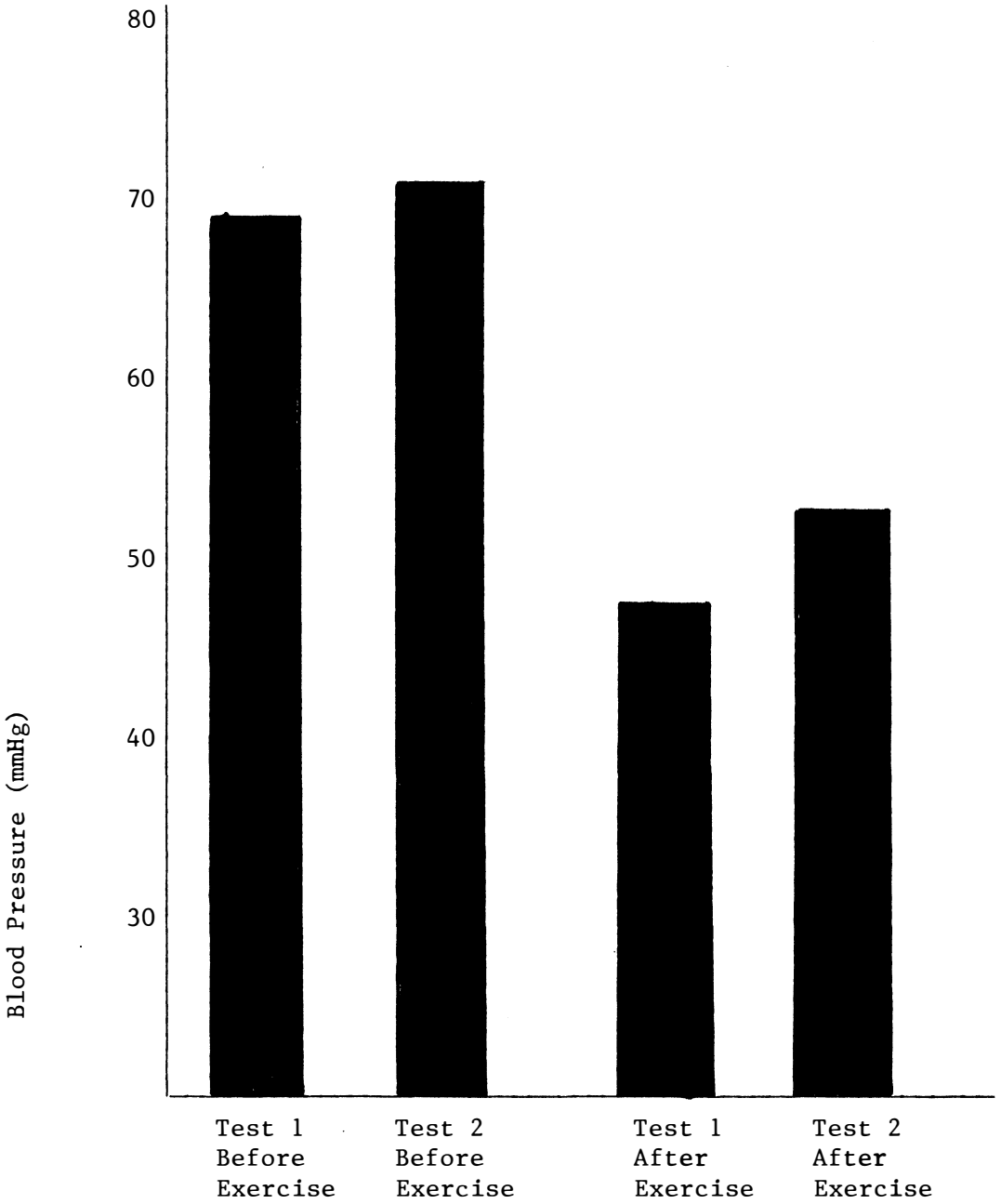

Figure 2

Mean Diastolic Blood Pressure Measurements for the First Day of Menstruation (test one) and Seven Days Later (test two)

Systolic Blood Pressure

The mean systolic blood pressure recorded before exercise on the first day of menstruation was 120.8 mmHg, while the mean reading on the seventh day after one was 117.8 mmHg. The *t*-score for the difference between mean readings was 1.45, indicating no significant statistical difference.

The mean systolic blood pressure recorded after exercise was 167.6 mmHg on the first day of menstruation. The seventh day test resulted in a mean of 157.6 mmHg after exercise. The *t*-score for the difference was 1.50, indicating no statistical significant difference.

	First day of menstruation	Seven days later	*t*-score
Mean SBP before exercise	120.8	117.8	1.45
Mean SBP after exercise	167.6	157.6	1.50

Diastolic Blood Pressure

The mean diastolic blood pressure calculated for the first day of menstruation before exercising was 69.4 mmHg. The pressure recorded before exercise seven days later was 71.2 mmHg. The *t*-score was calculated at .83, indicating no significant difference.

After exercising, the mean diastolic blood pressure on the first menstrual day was 46.4 mmHg, while a mean of 50.8 mmHg was calculated for the seventh day. The resulting *t*-score was .59, indicating no statistical significant difference.

	First day of menstruation	Seven days later	*t*-score
Mean DBP before exercise	69.4	71.2	.83
Mean DBP after exercise	46.4	50.8	.59

Body Weight

The body weight measurements for each subject are found in Appendix A. Figure three, on page seventeen, illustrates the mean body weights calculated for the two tests.

On day one of menstruation, the mean body weight for the subjects was 126.98 pounds, while the range was 116.26 to 137.70 pounds. Seven days later the mean weight for the subjects was 127.40 pounds, with a range from 115.06 to 139.74 pounds. A t-score of .45 indicated no statistical significant difference between the means.

Mean body weight First day of menstruation	Mean body weight Seven days later	t-score
126.98	127.40	.45

Heart Rates

The resting, exercising and recovery heart rates for each subject have been placed in Appendices B, C, D and E. These scores were analyzed statistically and reported in the following sections.

Resting Heart Rate

The mean resting heart rate for the first day of menstruation was calculated at 76.9 bpm, as shown in Figure four on page eighteen. The mean score rose to 85.3 bpm seven days later, resulting in a t-score of 1.15 with no statistical significant difference.

Mean resting h.r. First day of menstruation	Mean resting h.r. Seven days later	t-score
76.9	85.3	1.15

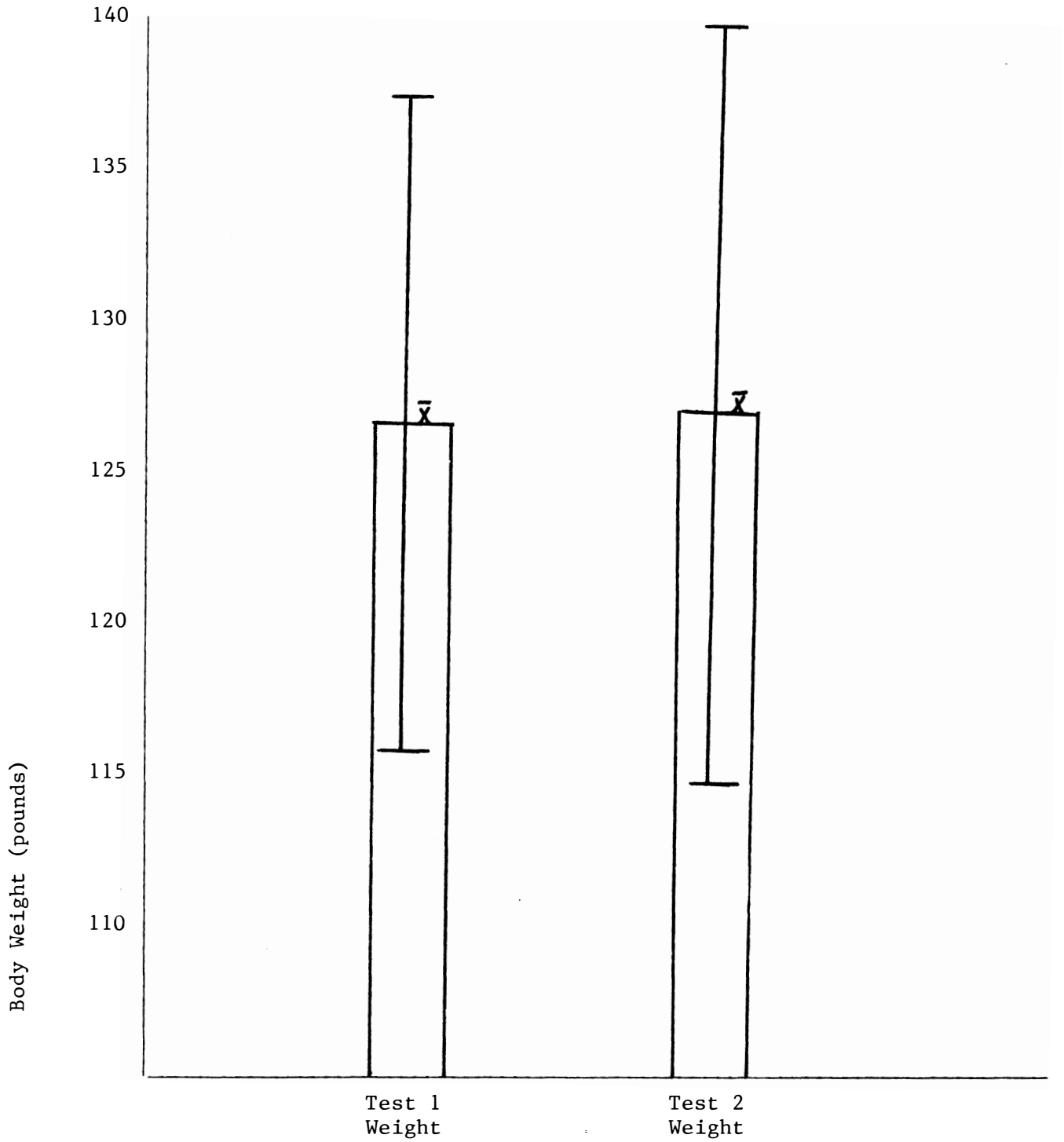

Figure 3

Mean Body Weight and Standard Deviation for
the First Day of Menstruation (test one)
and Seven Days Later (test two)

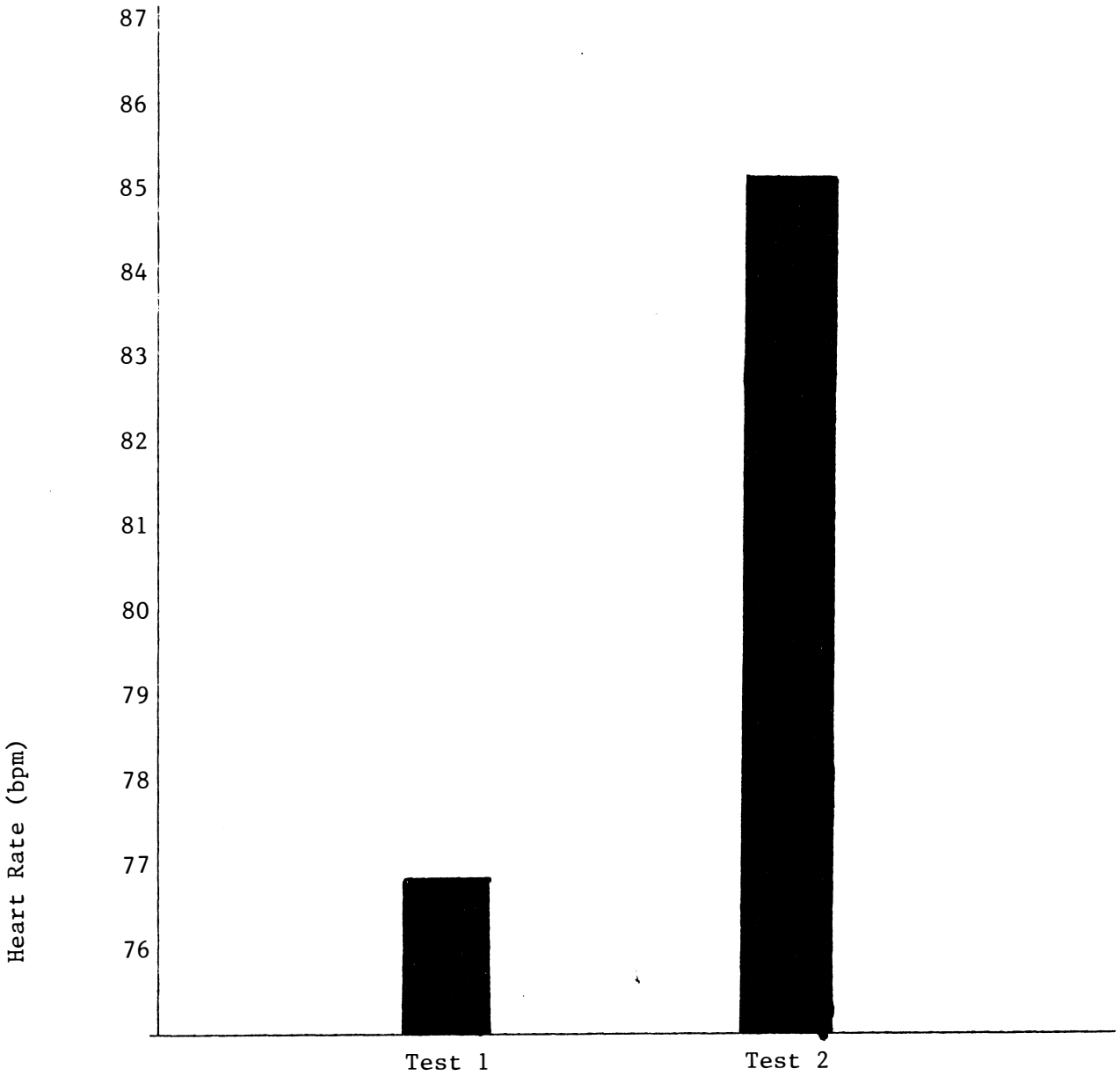

Figure 4

Mean Resting Heart Rate Scores for First Day of Menstruation (test one) and Seven Days Later (test two)

Exercising Heart Rate

The mean heart rate for five minutes of exercise on the first day of menstruation was 165.2 bpm, with a range from 150.0 to 180.4 bpm. The mean score calculated for the seventh day following this test was 164.1 bpm with a range from 147.2 to 181.0 bpm. The t-score was calculated at .33, indicating no statistical significant difference.

Mean exercising h.r. First day of menstruation	Mean exercising h.r. Seven days later	t-score
165.2	164.1	.33

To determine the difference between heart rates on both testing days, an analysis of variance was used. The results for exercising heart rates are shown in Table one, on page twenty. They indicate that there was no significant variation between the heart rates on the first day of menstruation and seven days later in regard to exercise. An F-score of .02 showed no significant difference between testing days and between heart rates achieved each minute. The mean scores for each minute of exercise for both tests are found in Table two and depicted in Figure five, on pages twenty-one and twenty-two.

Recovery Heart Rate

The mean recovery heart rate for a five minute period on the first day of menstruation was 103.5 bpm. Seven days later the mean recovery rate dropped to 100.0 bpm. The heart rate range was 72.4 to 134.7 bpm for the former and 75.6 to 124.4 bpm for the latter test. A t-score of 1.08 was calculated for the difference between the means.

Mean recovery h.r. First day of menstruation	Mean recovery h.r. Seven days later	t-score
103.5	100.0	1.08

Table 1

Results of the Analysis of Variance for Repeated Measures for the First Day of Menstruation and Seven Days Later on Exercising Heart Rate Responses in 5 Minutes

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio
Type: Activity	1	29.16	29.16	.02
Subject/Group	18	23292.68	1294.04	
Minutes	4	11208.94	2802.24	64.40
Minutes X Type	4	109.14	27.29	.63
Error: Minute X Subject within/groups	72	3133.12	43.52	

Table 2

Results of Mean Exercising Heart Rate Scores
for the First Day of Menstruation and
Seven Days Later

Minute	First Day of Menstruation Heart Rate (BPM)	Seven Days Later Heart Rate (BPM)
1:00	151.3	147.9
2:00	157.2	156.8
3:00	164.9	165.8
4:00	170.9	172.1
5:00	181.6	177.9

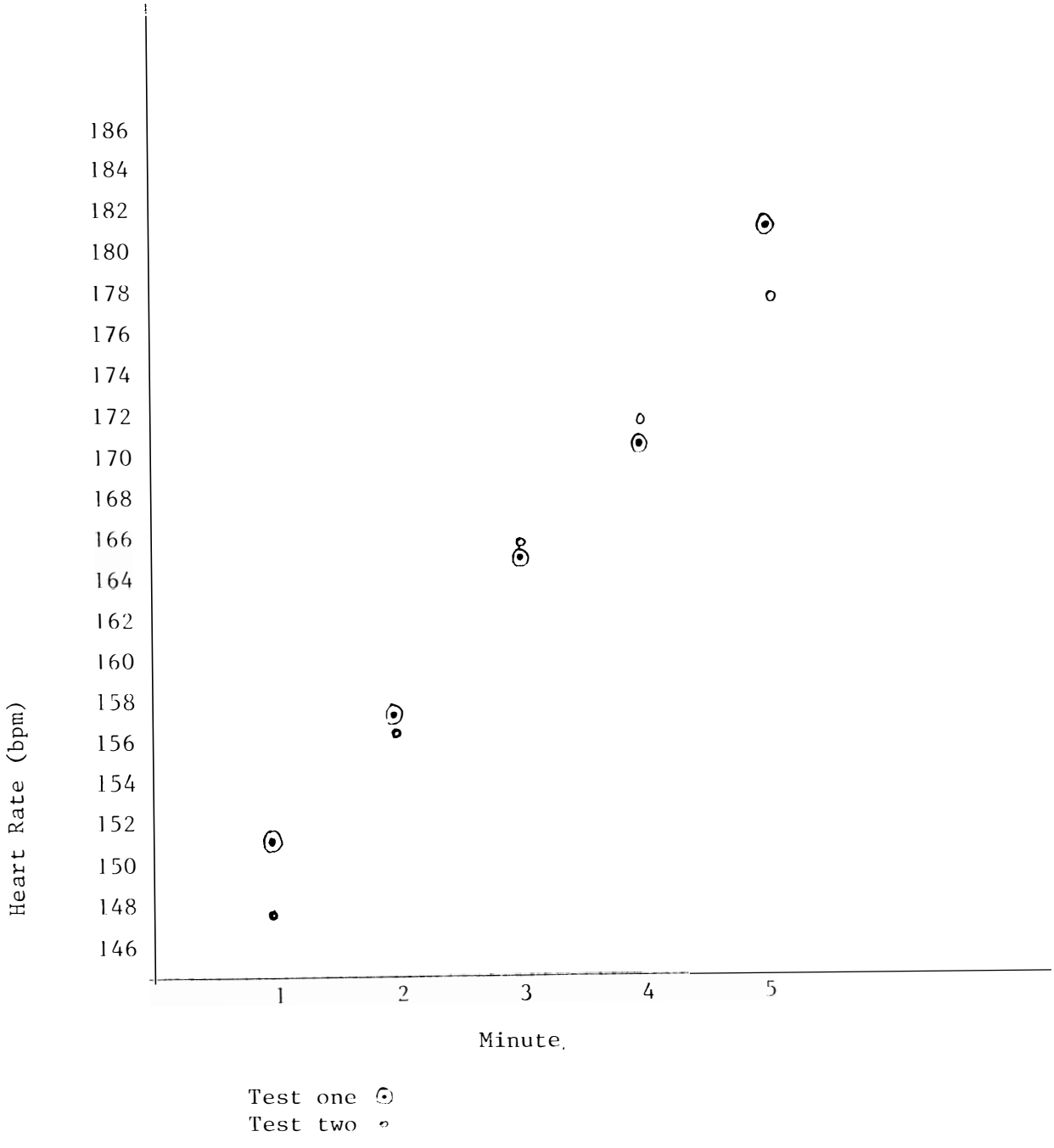

Figure 5

Minute by Minute Mean Exercise Heart Rate Scores
For First Day of Menstruation (Test one)
and Seven Days Later (Test two)

An analysis of variance test was used to determine the difference between heart rates on both tests. The results for recovery heart rates are found in Table three, on page twenty-four. They indicate that there was no significant difference between test days. An F-score of .08 showed no significant difference between testing days and heart rates achieved each minute. The mean scores for each minute of recovery follow on Table four, on page twenty-five and Figure six, on page twenty-six.

Discussion of Findings

According to the results found in this study, no significant difference was evident between blood pressures either before or after exercise. However, systolic blood pressure was found to be slightly higher on the first day of menstruation in both measurements, while diastolic readings were higher seven days later. These slight fluctuations may be due to factors other than menstruation, such as stress or body fat reduction as indicated by Scott and Tuttle (20) and others (11, 21, 29, 31).

The results also showed no significant difference in body weight between day one of menstruation and seven days later, even though the mean body weight for the subjects increased slightly by the last day of testing.

On the first day of testing, mean resting heart rates were higher than on the second testing day. Mean exercising and recovery heart rates did not vary significantly between the two testing days. The results agree with results from other selected studies, which indicated that menstruation had no significant effect on heart rate or physical efficiency (16, 20, 26).

Table 3

Results of the Analysis of Variance for Repeated Measures for the First Day of Menstruation and Seven Days Later on Recovery Heart Rate Responses in 5 Minutes

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio
Type: Activity	1	313.29	313.29	.08
Subject/Group	18	70381.62	3910.09	
Minutes	4	37733.06	9433.27	100.75*
Minutes X Type	4	84.66	21.17	.23
Error: Minute X Subject within/groups	72	6741.08	93.63	

*significant ($p < .05$)

Table 4

Results of Mean Recovery Heart Rate Scores
for the First Day of Menstruation and
Seven Days Later

Minute	First Day of Menstruation Heart Rate (BPM)	Seven Days Later Heart Rate (BPM)
1:00	142.9	137.5
2:00	98.5	95.4
3:00	93.5	92.8
4:00	90.7	87.9
5:00	92.1	86.4

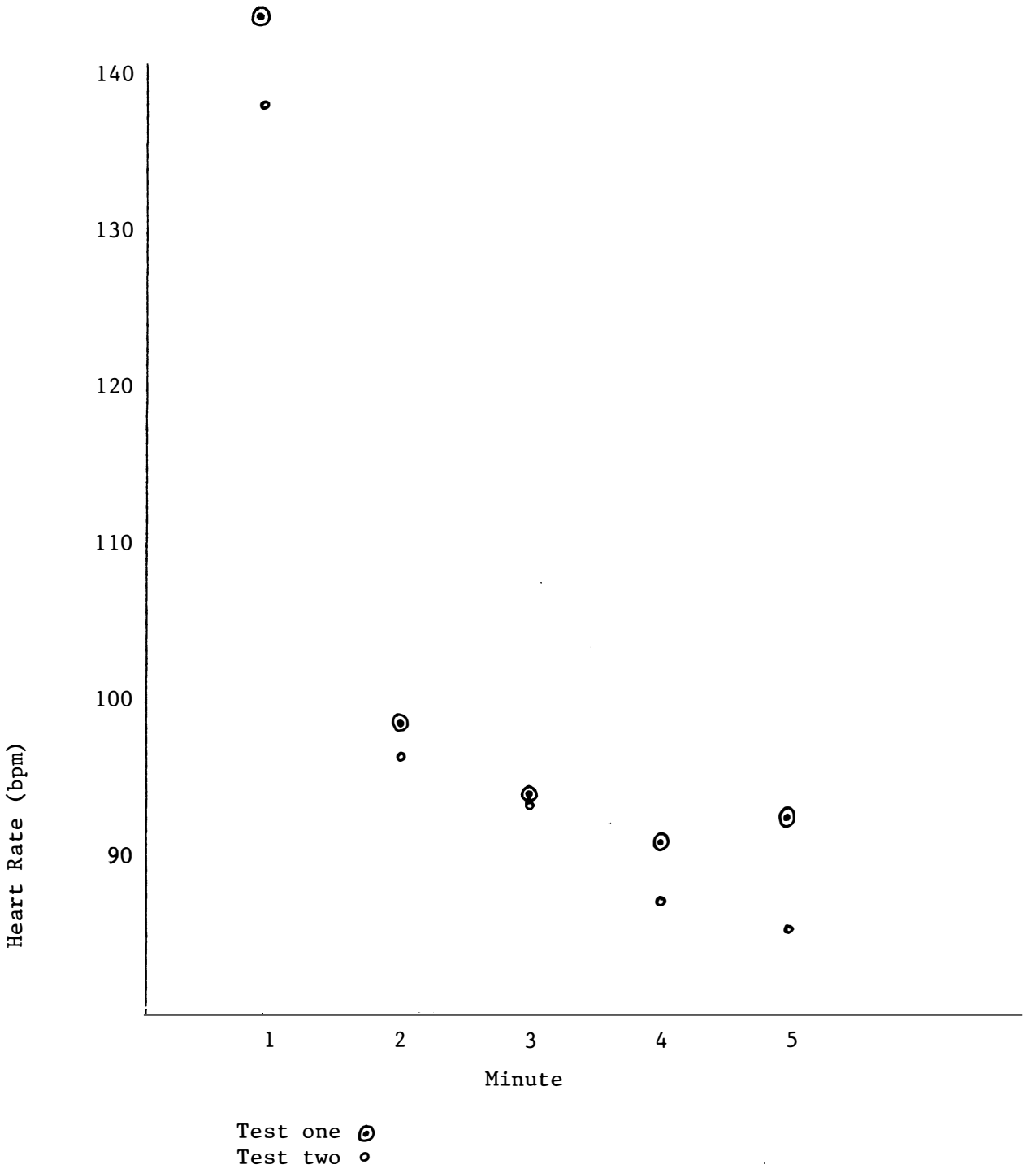

Figure 6

Minute by Minute Mean Recovery Heart Rate Scores
for First Day of Menstruation (Test one)
and Seven Days Later (Test two)

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the effects of menstruation on blood pressure, body weight and heart rates during rest, exercise and recovery.

Ten women from the Eastern Illinois University track team were chosen as subjects.

The subjects were tested on two different occasions, following a treadmill orientation. For the first test, the women came into the lab randomly within twenty-four hours of the onset of menstruation. The second test was conducted seven days after the first test. On both lab visits blood pressures, body weights and resting heart rate measurements were taken before the exercise protocol began. The subjects ran on a motor driven treadmill for five minutes while their heart rates were monitored on an electrocardiograph machine every minute. At the end of the five minute exercise protocol (progressive grades and speed increases up to 4% and 8 mph, respectively), a seated recovery blood pressure measurement was taken. Recovery heart rates were also monitored every minute for five minutes.

The BMDP2V- analysis of variance program, including repeated measures, was used to determine whether there were any differences between each minute of exercise and recovery between the two tests.

A *t*-test was used to determine the differences between mean blood pressures taken before and after exercise as well as body weight and heart rates for both test days.

Conclusion

Based on the results of this study, the following conclusion is presented:

1. Menstruation has no significant effect on blood

pressure, body weight or heart rate responses at rest, during exercise or in recovery from exercise.

Recommendations for Further Study

The following recommendations are made as a result of this study:

1. It would be interesting to follow the long term effects of intense training on menstruation.

2. A study investigating the relationship between perceived menstrual discomfort and actual athletic performance should be completed.

REFERENCES

1. Anderson, T.W. "Swimming and exercise during menstruation." JOHPER. 36: 66-68, 1965.

2. Anthony, C. and P. Klothoff. Anatomy and Physiology. St. Louis: C.V. Mosby Co., 1975.

3. Bloomberg, R. "Coach says running affects menstruation." Physician Sportsmed. 5: 15, 1977.

4. Doolittle, T.L. and J. Engebretsen. "Performance variations during the menstrual cycle." J. Sports Med. Phys. Fit. 12: 54-58, 1972.

5. Dunlevie, R. "Your training period." Wms Track World. 2: 32, 1979.

6. Erdelyi, G.J. "Gynecological survey of female athletes." J. Sports Med. Phys. Fit. 2: 174-179, 1962.

7. _____. "Effects of exercise of the menstrual cycle." Physician Sportsmed. 4: 79-81, 1976.

8. Ferstle, J. Lutters. "Combined interests in running and sports research." Physician Sportsmed. 9: 124-127, 1981.

9. Fox, E. and D. Mathews. Physiological Basis of Physical Education and Athletes. Philadelphia: CBS College Publishing, 1981.

10. Garlick, M.A. and E.M. Bernauer. "Exercise during the menstrual cycle: variations in physiological baselines." Res. Quart. 39: 533-542, 1968.

11. Harris, D. "Secondary amenorrhea linked to stress." Physician Sportsmed. 6 (10): 24, 1978.

12. Jacobi, M. Question of Rest for Women during Menstruation. New York: G.P. Putnam's Sons, 1877.

13. Jokl, E. Heart and Sport. Springfield: Charles C. Thomas, 1966.

14. Jurkowski, J. and others. "Effects of menstrual cycle on blood lactate, O_2 delivery and performance during exercise." J. Appl. Physiol. 51: 1493-1499, 1981.

15. Malina, R. and others. "Age at menarche and selected menstrual characteristics in athletes at different competitive levels in different sports." Med. Sci. Sports. 10 (3): 218-222, 1978.

16. Phillips, M. "Effect of the menstrual cycle on pulse rate and blood pressure before and after exercise." Res. Quart. 39 (2): 327-333, 1968.

17. Pinkerton, E. "Women's Running." Runners World. 14 (8): 36, 1979.

18. Richardson, H. "Effect of the menstrual cycle on maximal O_2 uptake" (Master's Thesis, University of Wisconsin - LaCrosse, LaCrosse, WI, 1979).

19. Schoene, R.B. and others. "Respiratory drives and exercise in menstrual cycles of athletic and nonathletic women." J. Appl. Physiol. 50: 1300-1305, 1981.

20. Scott, G. and W. Tuttle. "Periodic fluctuation in physical efficiency during the menstrual cycle." Res. Quart. 1: 137-144, 1932.

21. Shangold, M. "Sports and menstrual function." Phys. Sportsmed. 8 (8): 66-68, 1980.

22. _____. "Evaluating menstrual irregularity in athletes." Phys. Sportsmed. 10 (2): 21, 1982.

23. _____. "Woman runner: herbody, her mind, her spirit." Phys. Sportsmed. 10 (2): 24, 1982.

24. Sheehan, G. "Medical Advice." Runners World. 14 (5): 25, 1979.

25. Speroff, L. and D. Redwine. "Exercise and menstrual function." Phys. Sportsmed. 8 (5): 42-52, 1980.

26. Stephenson, L.A, M.A. Kolka and J.E. Wilkerson. "Metabolic and thermoregulatory responses of females to varying intensities throughout the menstrual cycle." (Abstract). Med. Sci. Sports. 11 (1): 101, 1979.

27. Tuesdall, D. and G. Croxford. "Periodic variations in blood pressure, pulse and the physical efficiency test." Amer. J. Physiol. 79: 128-18, 1926.

28. Ullyot, J. Women's Running. Mountain View: World Publications, 1978.
Cited by Elaine Pinkerton, "Women's Running." Runners World. 14 (8): 36, 1979.

29. Webb, J., D. Millan and C. Stolz. "Gynecological survey of American female athletes competing at the Montreal Olympic Games." J. Sports Med. Phys. Fit. 19 (4): 405-413, 1979.

30. Weber, J. and D. Lamb. Statistics and Research in Physical Education. St. Louis: C.V. Mosby Co., 1970.

31. Wilmore, J. and others. "Menstrual Changes in athletes: a round table." Phys. Sportsmed. 9 (11): 98-112, 1981.

APPENDIX A

Body Weight and Blood Pressure Readings
Before and After Exercise for
Test One and Test Two

	TEST ONE			TEST TWO		
Subject	Weight (lb)	Blood Pressure Before Exercise	Blood Pressure After Exercise	Weight	Blood Pressure Before Exercise	Blood Pressure After Exercise
GS	118.75	120/66	164/60	117.25	122/64	142/60
SF	127.00	124/84	144/42	125.50	118/78	116/68
CM	123.25	114/80	140/46	121.00	104/72	122/58
LS	127.00	108/68	160/52	125.25	112/72	154/60
JC	130.25	114/52	136/48	129.75	116/58	172/42
MF	142.50	118/68	152/00	143.25	122/64	180/12
LG	133.00	122/62	192/52	132.75	132/56	208/24
LH	107.00	118/72	160/48	106.75	124/72	180/46
KF	123.50	122/80	146/80	123.00	130/68	174/72
KL	142.00	118/80	182/80	140.50	128/90	172/22

APPENDIX B

Scores for First Day of Menstruation On
Resting and Exercising Heart Rates
(BPM) for Five Minutes

Subject	Resting Heart Rate	Minute One	Minute Two	Minute Three	Minute Four	Minute Five
GS	47	125	125	143	130	158
SF	69.5	150	150	167	176	214
CM	60	143	150	167	167	167
LS	54	158	176	176	188	188
JC	54.5	136	136	143	150	158
MF	83	176	167	176	188	188
LG	88	150	158	158	167	167
LH	120	158	167	176	188	188
KF	88	150	167	167	167	188
KL	104	167	176	176	188	200

APPENDIX C

Scores for the First Day of Menstruation on
Recovery Heart Rate (BPM)
for Five Minutes

Subject	Minute One	Minute Two	Minute Three	Minute Four	Minute Five
GS	63	47	48	48	54.5
SF	158	125	111	100	100
CM	94	61	60	65	71
LS	150	79	83	91	86
JC	111	75	68	60	57
MF	167	150	125	120	103
LG	158	68	65	68	83
LH	176	125	130	125	125
KF	176	130	130	115	130
KL	176	125	115	115	111

APPENDIX D

Scores for Seven Days Later on Resting
and Exercising Heart Rates (BPM)
for Five Minutes

Subject	Heart Rate	Minute One	Minute Two	Minute Three	Minute Four	Minute Five
GS	60	125	130	136	150	150
SF	88	167	188	200	200	200
CM	83	136	136	150	150	167
LS	107	150	167	167	176	176
JC	70	130	130	143	150	158
MF	71	167	158	176	188	188
LG	100	158	167	176	176	188
LH	86	143	158	167	176	176
KF	88	136	158	167	167	188
KL	100	167	176	176	188	188

APPENDIX E

Scores for Seven Days Later on
Recovery Heart Rate (BPM)
for Five Minutes

Subject	Minute One	Minute Two	Minute Three	Minute Four	Minute Five
GS	75	48	52	56	47
SF	158	115	100	94	94
CM	107	71	83	63	63
LS	150	107	88	94	94
JC	115	60	66	56	53
MF	150	120	111	111	107
LG	136	86	91	83	88
LH	150	107	115	97	100
KF	167	125	115	125	111
KL	167	115	107	100	107

VITA

The writer was born in Oak Park, Illinois on August 7, 1959. She attended Mundelein High School in Mundelein, Illinois. At Mundelein, she participated on several inter-scholastic teams, the pompon squad, National Honor Society and Latin Club. She was appointed an Illinois State Scholar as well as receiving the Higher Women Engineering Award.

After graduation in 1977, the writer attended Drake University and later transferred to North Central College in Naperville, Illinois to pursue studies in Latin and Physical Education. Upon completing a Bachelor of Arts degree in March, 1981, the writer coached the Mundelein High School girls' track and field team.

In August, 1981, she attended Eastern Illinois University to pursue a Master's degree in Physical Education. While at Eastern, the writer assisted the women's cross country and track and field teams. Upon completing her degree in August, 1982, the writer will be coaching girls' track and field and volleyball, as well as teaching Physical Education at Metamora High School, Metamora, Illinois.