A COMPARISON OF SELECTED PERCEPTUAL VARIABLES AND MEASURED STRENGTH DURING THE MENSTRUAL CYCLE

By

WENDEE J. LENTZ

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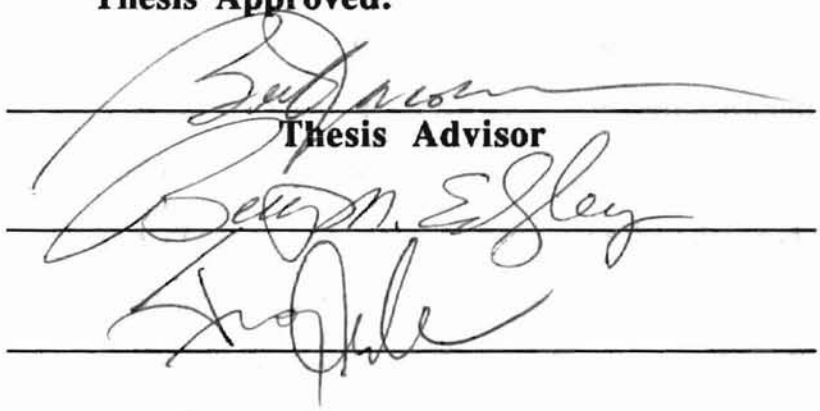

Thesis Advisor

Thomas C. Collins

Dean of the Graduate College

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CHAPTER I

INTRODUCTION

A COMPARISON OF SELECTED PERCEPTUAL VARIABLES AND MEASURED STRENGTH DURING THE MENSTRUAL CYCLE

Primitive societies associated menstruation with ill fortune, disasters, and the supernatural. There were and still are many inquisitions relating to the nature of the cycle. The connection between menstruation and the supernatural questioned the logic of early cultures by wondering how women continue to thrive each month after suffering inexplicable and recurring bleeding, bleeding that did not result in death or stem from bodily injury. The term menstruation comes from the Latin word "monthly" (Norris & Sullivan, 1983). Menstruation is defined as the loss of blood and tissue as the endometrium of the uterus sloughs away at the end of the menstrual cycle. The menstrual cycle refers to the series of hormonal changes that occur in sexually mature, nonpregnant females. Typically, the menstrual cycle is about 28 days and is divided into four separate phases: menses, proliferative, ovulation and secretory. Each phase has an approximate division throughout the 28 day cycle. Days one to six are considered to be days of menstruation or menses, days six to 14 are the proliferative phase, day 14 is considered to be the day of ovulation and days 15 to 28 are classified as the secretory phase (Seeley, Stephens, & Tate, 1991).

According to many female athletes, there are certain phases during the menstrual cycle where they feel performance is elevated and other times when it is decreased. It is an

everyday occurrence that an athlete must emotionally judge her ability to perform, and from that perception the quality of athletic performance is determined.

In relation to the menstrual cycle, there is an abundance of information over a broad scope. Besides the array of research that has accumulated over the years, there has been no principle analysis of the perception of one's physical capacity in comparison to the measured value during four phases of the menstrual cycle.

Purpose of the Study

The purpose of the present study was to compare perception variables relating to physical capacity/strength to measured strength during the four specific phases of the menstrual cycle.

Hypotheses

The following null hypothesis were tested at the .05 level of significance:

Hypothesis 1: There will be no significant difference in any of the ten perception variables among the four phases of the menstrual cycle.

Hypothesis 2: There will be no significant difference in the measured strength among the four phases of the menstrual cycle.

Operational Definitions

1. Menstrual cycle is defined as a 28 day cycle consisting of four separate phases. Cyclic hormonal patterns cause the differences among the four phases.
2. The four specific phases of the menstrual cycle were defined as:

   Phase I -- Menstrual (MEN) - fourth day of menstrual flow; day four of the 28 day cycle.

Phase II -- Postmenstrual (POST) - fourth day after cessation of menstrual flow; day eleven of the 28 day cycle.

Phase III -- Intermenstrual (INTER) - eleventh day after cessation of menstrual flow; day 18 of the 28 day cycle.

Phase IV -- Premenstrual (PRE) - the fourth day before menstrual flow; day 25 of the 28 day cycle.

3. Muscular strength is the maximal force (expressed in newtons or kilograms) that can be generated by a specific muscle or muscle group.
4. Isokinetics is defined as exercise at a fixed speed that occurs through an accommodating resistance.
5. Measured strength is defined as strength that is isokinetically measured through the full range of motion to determine a maximum peak torque value.
6. Torque is defined as rotational force of a limb.
7. Quadriceps isokinetic peak torque performance was measured by using the quadriceps muscles, (vastus lateralis, vastus intermedius, vastus medialis and rectus femoris) against isokinetic resistance to achieve a maximal peak torque value.
8. Perceived strength is defined as self perception of one's own strength during a given phase of the menstrual cycle.
9. Aerobic exercise is defined as the utilization of oxygen during participation in activities such as basketball and volleyball.
10. Anaerobic exercise is defined as the absence of oxygen utilization during participation in activities such as softball and field events of track and field competition.
11. Leg dominance was determined by asking the subject which leg they prefer to use when kicking a ball. Leg used to kick ball with will be deemed "dominant leg".
12. A semantic differentiation scale is a scale defined by a pair of polar terms eliciting the subjects judgment that is in correspondence to the given concept. The response

between the polar terms was based on intensity of reaction and measured on a five point Likert scale.

13. Oral contraceptives are a form of contraception taken by mouth. Oral contraceptives regulate the cyclic hormonal pattern of the menstrual cycle.
14. Implants are a form of contraceptive implanted under the skin in the brachial region of the arm.
15. Subjects were defined as: college female athletes between the ages of 18 to 22 years of age; having regular, complete menstrual cycles within three previous months of testing; a non-participant of contraceptives and from a combination of aerobic and anaerobic sports.

Extent of the Study

Delimitations

1. The subjects were limited to only female athletes with regular monthly menstrual cycles.
2. The subjects were not using oral contraceptives or implants.
3. Isokinetic testing was performed on the dominate leg as determined by asking the subject which leg they prefer to kick a ball with.
4. Testing was performed on specific dates during each of the four phases of the menstrual cycle.
5. A Cybex - Orthotron II was the unit used for measurement of isokinetic testing.
6. Words used in semantic differentiation were chosen and limited by the researcher to include topics pertinent to this study.
7. Testing of the subjects was over a one month period to include one complete menstrual cycle of 28 days.
8. The use of a variety of intercollegiate athletes specifically trained aerobically or

anaerobically for participation in their sport.

9. The study used only athletes that are actively participating in varsity sports at a four year university.
10. The study measured only quadriceps isokinetic peak torque performance.
11. Subjects were self-selected; participation was voluntary.
12. No baseline data was collected at the beginning of the study.
13. There was no randomization of subjects.
14. Only those subjects completing all questionnaires and isokinetic strength testing were included in the research.

Limitations

1. Sport specific strength training being performed by subjects during the time span of the research.
2. Subjects will be in-season or off-season depending on their sport.
3. Some subjects included in the research participated in a variety of sports.
4. Each subjects regular cycle could fluctuate.

Assumptions

1. Subjects gave maximal effort during isokinetic testing.
2. Subjects were consistent on their strength perception questionnaire throughout the testing and were not psychologically or physiologically influenced from prior testing.
3. Subjects answered the medical history questionnaire honestly and to the best of their knowledge.
4. The subjects were representative of the population of female athletes at a four year university.
5. Subjects did not alter their food intake or vitamin consumption.

CHAPTER II

REVIEW OF THE LITERATURE

A Review of Menstrual Cycle, Perception and Strength Literature

When examining problems that female athletes face, one of the most prevailing questions is, "How is sport performance affected during the menstrual cycle?" Are the effects only physiological or are some of them based on psychological states (Erdelyi, 1962)? The preconceived notion that exercise is debilitating to menstruating women is now being turned around to suggest that physical exertion during the various phases of the cycle will decrease menstrual pain (Wells & Plowman, 1983). On the other hand, athletes are still convinced that their athletic performance is impaired during various phases (Quadagno, et. al., 1991). Aganoff and Boyle (1994), reported that physical exercise is advocated as therapeutic treatment during menstruation. They suggest that women who exercise regularly exhibit milder physical symptoms such as muscle pain, breast tenderness and headaches, during the menstrual cycle. In a "Gynecological Survey of Female Athletes", Erdelyi (1962) examined several questions pertaining to menstruation. According to the research, it has been suggested that the sport performance of a female athlete may fluctuate during her menstrual cycle. One angle of the investigation focused on the sport performance of an athlete during the menstrual cycle. It stated that generally, many female athletes are able to achieve their average sport performance throughout the entire menstrual cycle. Forty-two to 48% of the female athletes from a variety of sports studied by Erdelyi

(1962), did not show any change in performance during the menstruation phase of the cycle. However, Erdelyi (1962), found performance changes in some phases of the cycle other than the menstrual phase. He reported the best performance was during the postmenstrual phase, whereas the worst performance was during the premenstrual phase. Performance during the intermenstrual phase was rated "good", second behind postmenstrual performance.

The decreased efficiency in sport performance of a female athlete, Eldelyi (1962) found, was in connection with changes in the premenstrual phase of the cycle. These changes come from physiological and psychological differences. Emotional variances included lack of stamina, quick fatigue, irritability, inattention, depressive mood, and probable increase in reaction time. Hormonal changes in the premenstrual phase included water retention, and an increase in the level of steroidal hormones, such as testosterone, which is linked to premenstrual tension. During menstruation, the psychological factor influencing performance is knowledge itself of the athlete knowing she is menstruating. During the time this psychological burden may awaken the inferiority complex and prevent the athlete from achieving her usual performance (Erdelyi, 1962).

Perception and Self Evaluation

An array of research ranging from perceived exertion (Borg, 1982) to performance (Quadagno, et. al., 1991) has been studied in relationship to the menstrual cycle. Comprehensive studies on menstruation often include physical performance measures such as proprioception and tracking skills, psychological states including short term memory capacity and word matching tasks (Ussher, Wilding, 1991), perceived exertion through direct or indirect measure of physiological systems (Borg, 1982) and onset of the menstrual cycle (Frisch, et. al., 1981). From the related literature there has been little attention given to muscular strength as compared to perceived strength during the menstrual cycle.

A recent study performed by Quadagno et. al. (1991), looked at how the menstrual cycle effected strength and swimming performance. They studied twelve recreational weight lifters who trained 30 minutes or more a day for a minimum of three days per week. The subjects performed bench and leg presses during three phases of the cycle; premenstrual (3 to 4 days prior to menses), menstrual (days 1 and 2 of the menses), and postmenstrual (10 to 12 days after onset of menses). The results of the weight lifters strength performance indicated no significant difference of strength between the three phases of the cycle.

Perception is most commonly conceptualized as perceived exertion when discussing the menstrual cycle. Gunnar Borg, a well known Swedish researcher, devised a perceived exertion scale that included a ratio-scaling method called the Borg Scale for ratings of perceived exertion or Borg's RPE (Rate of Perceived Exertion) Scale (Borg, 1982). This categorical scale was constructed to increase linearly with the exercise intensity for work on a cycle ergometer. Borg's RPE scale was designed to coincide with physical activity relating to physiological variables. Perception, on the other hand, can also come from a psychological basis such as the adjustment made to perform or judge a certain task to be accomplished (Adaptation-Level Theory). Allport (1955), suggests the Adaptation-Level Theory represents a "centering" of given stimuli to reach a meridian. He gives an example of a weight that seems "heavy", but in actuality, it is very "light". When a person picks it up, they must adapt their perception and physiological ability to reach a "true zero of functioning." The position of this functional zero (adaptation-level) is determined through pooling the magnitude of perception versus actuality. A case study of the Adaptation-Level Theory will be presented in the review of literature.

The use of self-reported measures of psychological state is useful in menstrual cycle research because it gives an indication of a subject's self perception (Ussher, Wilding, 1991). The involvement of self-perception is very helpful in measuring different emotional

states of the menstrual cycle. Physiological changes are not always perceived and therefore may have little effect on behavior (Mandler, 1975). It is also often assumed by researchers that performance changes are due to variations in self-perception (Erdelyi, 1962).

In an earlier study, research psychologists Ivey and Bardwick looked at mood changes throughout the menstrual cycle to see whether or not a distinct emotional cycle exists which parallels the pattern of recurring hormonal change (Weideger, 1976). Twenty-six college students, at two points in their menstrual cycle (once during the expected ovulatory period and once again just before menstruation), were asked to relate some past incident-any memory that spontaneously came to mind. The first statement was given near the time of ovulation and the second near the anticipated time of flow. The investigators studied the answers given during the two periods to see whether or not a particular pattern emerged. As stated "...the pattern of responses is overwhelmingly evident--optimistic and life-affirming thoughts spontaneously arise near ovulation, while more morbid memories spring to consciousness near menstruation" (Weideger, 1976). Further analysis of the responses showed that women felt the greatest sense of self-esteem and competitiveness near ovulation. Aggressive feelings peaked in the period just before the onset of flow.

The conclusions drawn from this research indicated ovulation is associated with underlying optimism and the premenstrual period with underlying pessimism. They also concluded that competition arises from the feeling that one can actually accomplish something and this in turn stems from feelings of self-esteem rather than from aggressive needs.

Due to variations in perception, there is continued need to develop better methods to measure perceptual intensities. The use of semantic differential scales yield quantitive data that are verifiable in the sense that researchers can apply the same set of scales to various subjects to yield similar results (Snider, 1969). When a subject judges a concept against a

series of ideas, each judgment represents a selection among a set of given alternatives and serves to localize the concept as a point in the semantic space. More ideas allows for a better representative selection of the concept thus increasing the validity of the study.

In a previous study, Loucks and Horvath (1984), sought to determine the role of stress in the development of amenorrhea. Fifteen subjects with a mean age of 21 years were recruited from collegiate track teams. Data collection included psychological status, body composition, and training mileage. Runners were classified as amenorrheic (n=7) or eumenorrheic (n=8). Before the individuals were allowed to participate they had to meet the following stipulations: (a) no use of oral contraceptives, (b) regularly menstruating before training, (c) run 35 miles or more a week before the study, (d) have less than 22 % body fat, and (e) borne no children. Subjects were tested on separate days for preliminary screening, percent body fat, and psychological data. The subject performed 10 underwater trials and the average of the last three trials was recorded. The formula of Brozek et al. (1963) was used to determine percent body fat. Psychological status was measured by the Profile of Mood States (POMS) by McNair et al. (1971) and the State-Trait Anxiety Inventory (STAI) by Spielberger et al. (1970).

A two-tailed t-test revealed a significant difference between the amenorrheic and the eumenorrheic subjects with regard to miles trained per week. There was no significant body composition difference between the amenorrheic and eumenorrheic groups. With regard to the POMS measure, both groups scored higher on vigor than the norms for undergraduate women. On the POMS, the amenorrheic and eumenorrheic subjects scored lower (i. e., in the desirable direction) on tension, depression, anger, fatigue and confusion than the norms. Regarding tension, the STAI measures were equal to the POMS measures. No significant values were given. Loucks and Horvath concluded that the POMS and STAI may not be sensitive enough to determine fine differences between the groups with regard to psychological traumas. The researchers strongly urged further study in the area

of psychological stress and amenorrhea.

Isokinetic Strength Testing

In the late 1960's the concept of isokinetic exercise was developed by James Perrine (Davies, 1992). This new concept has since proven to be a revolution in the area of exercise training and rehabilitation. Isokinetics is the basis of testing that branches out in several directions to include a variety of objective measures. The concept behind isokinetics involves a dynamic pre-set fixed speed with resistance that is totally accommodating throughout the entire range of motion (ROM). The areas of isokinetic testing include objective screening, quantifying objective information, industrial screening, identifying malingerers, quantify compensations and/or disability cases, develop normative data, and to correlate torque curves with pathologies to determine reliability of testing as a non-invasive diagnostic tool during an objective examination procedure (Davies, 1992).

There are several advantages to isokinetics during research testing. It is the only way to load a dynamically contracting muscle to its maximum capability at all points throughout the ROM. Its safety is commended because an individual will never meet more resistance than he/she can handle since resistance is equal to force applied. There is minimal post exercise soreness with concentric isokinetic contractions, it helps develop force control accuracy and quickness, there is high validity and reliability in equipment performance and is highly reliable in the reproducibility of testing. The only disadvantages of isokinetic testing is the availability and cost of equipment, lack of personnel trained to use or interpret data, delayed onset muscle soreness after the use of eccentric loading, and lag time until the limb actually catches the velocity of the dynamometer.

Review of Literature Summary

The literature presented in this chapter includes areas of menstruation, perception, self evaluation and isokinetic strength testing. There has been extensive research on menstruation. The past ideas that exercise is debilitating to menstruating women are now being changed to suggest that exercise helps to decrease physical symptoms of muscle pain, breast tenderness and headaches (Aganoff & Boyle, 1994).

How an athlete perceives herself during menstruation is based on emotional states such as mood and physical capacity. Due to the variations in perception, there is a continued need for the development of reliable testing methods. Researchers are still searching for an instrument sensitive enough to use when looking at psychological stress, perception and menstruation.

The use of isokinetic testing as been around for almost forty years. Over that period of time a variety of speeds have been tested for the ability to reach an optimum peak torque measurement. Researches have found 60 degrees per second to be the appropriate speed for reaching maximum peak torque because of joint integrity and less compression loading on the specific joint (Cybex, 1982).

CHAPTER III

METHODOLOGY

Introduction

The procedures in this chapter have been divided into two sections; preliminary and operational. Preliminary procedures involve the selection of subjects, informed consent, selection and implementation of measuring devices, and submission and acceptance of a proposal to the Institutional Review Board (IRB). The operational procedures include subject instruction, collection of data, and analysis of data.

Preliminary Procedures

Selection of Subjects

The sample for this study were varsity female athletes (n=18) at a comprehensive Midwestern University. The subjects were defined as aerobic/anaerobic sport athletes and included athletes participating in track and field (n=2), volleyball (n=6), basketball (n=6) and softball (n=4); $\bar{x}$ age= 19.1 years, sample SD age= 1.39, $\bar{x}$ weight=150 lbs., sample SD weight=41.80, athletes in-season=10, athletes off-season=8, all subjects (18) were right leg dominant and no athletes were using iron supplementation. The sample was derived from those female athletes with regular monthly menstrual cycles for the three previous months, and were not using any type of contraception at the present time. For

the data collection, the criterion of no contraception during the investigation period made the recruitment of potential subjects difficult. Wynder (1981) estimated that about 10 to 15 million women in the United States participate in the use of contraception. From the estimated population of seventy-five athletes, twenty-two female athletes met the inclusion criteria and eighteen voluntarily participated in the study; four subjects were not included in the research due to time conflicts or not wanting to participate. Subjects' data is detailed in Table I.

TABLE I

SUBJECT'S DESCRIPTIVE DATA

Subject	Age	Weight (lbs)	Season	Leg Dominance	Iron Supplementation
1	18	232	OFF	RIGHT	NO
2	19	200	OFF	RIGHT	NO
3	20	160	IN	RIGHT	NO
4	21	161	IN	RIGHT	NO
5	18	143	IN	RIGHT	NO
6	18	120	OFF	RIGHT	NO
7	21	125	OFF	RIGHT	NO
8	18	129	IN	RIGHT	NO
9	18	133	OFF	RIGHT	NO
10	18	165	OFF	RIGHT	NO
11	19	135	IN	RIGHT	NO
12	20	145	IN	RIGHT	NO
13	18	162	OFF	RIGHT	NO
14	21	145	OFF	RIGHT	NO
15	18	135	OFF	RIGHT	NO
16	18	142	OFF	RIGHT	NO
17	18	130	IN	RIGHT	NO
18	22	138	IN	RIGHT	NO

To recruit subjects for the present study, a purposive sampling design was utilized. Kerlinger (1973) defined purposive sampling as "a deliberate effort to obtain representative samples by including presumably typical areas or groups in the sample" (p. 129). In recruiting subjects for the research, the researcher tried to obtain an equal number of athletes from a variety of sports. They were identified from a medical history questionnaire completed during their routine preseason/return to school team meeting. After identification and selection from the medical history questionnaire, subjects were contacted by the researcher, and asked to voluntarily participate in the study. All subjects completing the questionnaire were assured confidentiality. To ensure confidentiality, all research testing was performed and recorded by the designated researcher. All records, consisting of medical history forms, physical information, results of strength perception scale and isokinetic testing were personal and kept confidential for each subject. Data charts entailing results of research for each subject were coded by random numbers instead of personal names. All information regarding research data was kept in a locked file cabinet of the researcher.

Information obtained from the medical history questionnaire included frequency and length of menstruation, frequency of menstruation over the past three months and twelve months, participation in the use of contraception and use of iron supplementation. Of the eighteen subjects that voluntarily participated in the study, demographic information obtained included: age, sport, home phone, leg dominance, weight, in/off season, iron supplementation and flow onset.

Perception and isokinetic testing was evaluated once during each of the four phases of the menstrual cycle. The testing took place on the fourth day of each of the phases. Each phase (**I - menstrual, II - post-menstrual, III - inter-menstrual and IV - pre-menstrual**) was seven days in length (28 days total), therefore the fourth day, being the centralized day, was chosen for analysis of the subjects.

Prior to beginning the study, the researcher completed several preliminary steps. The related literature was studied and assimilated. A proposal was then developed and presented to the thesis committee for suggestions and corrections. The outline was revised as suggested by the thesis committee members and submitted to the Institutional Review Board (IRB). The institutional review board (IRB) granted permission to conduct the study and was filed in the Graduate School at the Oklahoma State University. A copy of the permission letter is presented in Appendix A.

Instrumentation

A five point semantic differentiation scale derived of ten sets of descriptive polar terms were used to analyze perceived strength through the four phases of the menstrual cycle. Polar terms were acquired from the Semantic Differential Technique: A Sourcebook and have been tested for validity and reliability (Snider, 1969). Terms chosen were: strong:weak, fatigued:not fatigued, slow:fast, heavy:light, tense:relaxed, passive:active, powerless:powerful, tired:alert, calm:aggressive, bloated:not bloated. The semantic scaling instrument gives representation to the major dimensions along which meaningful reactions or judgments may vary. It is a communicative product of written words that follow a varying order. The words (stimuli) evoke reactions to a measurable event (Snider, 1969). Snider states, "there is an intimate relationship between perceptual and meaningful phenomena." The way a person associates a feeling to a behavior is influenced by an instinct of that feeling.

Reliability testing of the data from the semantic differential instrument included 40 of the 1,000 items; data for the factor analysis were chosen at random. The reliability coefficient was .85. From all of the data collected and researched, several problems displayed convincing face-validity. Two of these experimental checks for face validity

include (a) correlation of attitudes toward various social objects as measured on standard tests with allocation of signs of these social objects within the semantic differential, and (b) the use of experimentally induced changes in meaning of signs (Snider, 1969).

Isokinetic testing was performed on a Cybex-Orthotron II isokinetic testing unit. Maximum peak torque was determined from quadriceps testing of the dominant leg. Calibration was performed by locating the approximate zero position of the speed control knob. If no movement occurred by attempting to pull the adaptor through the range of motion, the speed control was correctly positioned and no calibration was necessary. If any movement were to occur, a 16 step procedure was necessary to re-calibrate the isokinetic testing unit (Cybex, 1982). As suggested by research, calibration of isokinetic equipment should be performed regularly, once a month (Davies, 1992). Other materials suggest every two weeks depending on the use and force applied to the equipment (Cybex, 1982). For the purpose of this research the Orthotron II used in data collection was calibrated weekly due to the continued and constant use of the machine.

Operational Procedures

All subjects were required to arrive at the beginning of the school year with a pre-college physical examination for sports participation. At each of the preseason team meetings, each female athlete was asked to complete a medical history questionnaire. Included in the medical history questionnaire were questions pertaining to menstruation. (Appendix B) Those questions included items that aided the researcher in determining regularity of the menstrual cycle and use of contraception. The questions were screened by the researcher. The researcher is a Certified Athletic Trainer and staff member of the Athletic Department /school of Health Physical Education and Recreation and has access to

all medical records.

Subjects invited to participate in the study were asked to come to the athletic training room at their convenience to receive information pertaining to the study and were requested to sign a consent form approved by the university's Institutional Review Board. (Appendix C) Those subjects giving written consent were monitored for one month to determine exact onset and duration of their menstrual cycle. After onset and duration of the menstrual cycle and leg dominance was determined, the researcher charted each subject's cycle to identify the fourth day of each of the four phases of the menstrual cycle. The fourth day was chosen because it is the central day of each of the four phases (ie. 28 day cycle, four phases - seven days per phase). The subjects were contacted by phone, informed of the four specific test dates and were requested to appear on those dates for testing. The subjects were again contacted by the researcher one day prior to the test date as a reminder.

The researcher constructed data collection charts for each subject including subject identification number, age, sport of the subject, home phone number, leg dominance, date of menstrual onset, iron supplementation, in/off season, list of four specific testing dates, peak torque performance column for each of the three trial sets and maximum trial value and a results table for the strength perception semantic scale. (Appendix D) Identification numbers were assigned by specific sport and alphabetical roster by last name of subject (example VB1-volleyball, subject 1; SB4-softball, subject 4).

Following one month of cycle monitoring, each subject was informed the four specific dates they were to be tested. Each subject followed the same procedure for testing, and the procedure was followed four separate times; one procedure for each phase of the cycle. The testing routine was the same for all subjects; subjects would begin during the menstrual phase, the second testing session would be during the post-menstrual phase, third phase was inter-menstrual and testing ended after the last phase of the cycle--pre-menstrual phase.

The testing procedure was as follows: as the subject arrived in the training room, during the first testing session only, the subject was asked to fill out her demographics chart listing age, iron supplementation, and season (in-season or off-season -- depending on her sport). Next she was weighed on the training room scales and asked "if you were to kick a soccer ball, which leg would you use?" to determine leg dominance. Next, the subject was requested to fill out a questionnaire containing ten sets of perception variables regarding her individual strength during that specific phase of her cycle. (Appendix E) After completing the questionnaire, the subject would warm-up in the gym by running two laps on the indoor track, and perform adequate stretching of the quadriceps and hamstring muscles; all of this was done just prior to isokinetic testing. Following proper warm-up, the subject was seated on the Orthotron II and fit properly to the dynamometer head of the machine. Fitting the subject required adjusting the seat back for proper leg length, inserting and adjusting the torso stabilization handles, attaching the shin pad strap to the above the ankle and finally stabilizing the subject with the velcro torso and thigh stabilization straps. Identical adjustments were made each time the subject was tested.

The testing procedure for the subject allows for a warm-up trial consisting of four repetitions at a speed of 60 degrees per second. Previously, in the 1970's the Cybex corporation suggested 30 degrees per second to be the optimum speed for measuring the maximum peak torque of the knee. However, in 1980, Cybex changed the recommendation to 60 degrees per second. The change in speed was due to joint integrity, meaning 30 degrees per second testing is an unnatural speed, leading to abnormally high joint compressive loading and creating an inhibition of force. Therefore, 60 degrees per second continues to be the optimum speed for testing maximum peak torque of the knee (Cybex, 1982). Warm-ups were performed at quarter speed, half speed and two at full maximum speed. The test in which data was recorded and analyzed, consisted of three sets of five repetition trials. The testing was set at five repetitions because the researcher was

looking at strength not endurance and anything over five repetitions would fatigue the subjects. There was a 60 second rest period between each of the trials and after the warm-up segment of the testing. Again, the Cybex corporation suggests the optimum rest period to be 90 seconds when performing sets of 10 repetitions (Cybex, 1982). Modified to fit this study, containing sets of five repetition, a 60 second rest period between intervals was allowed.

Following each testing period the subjects were verbally assured confidentiality from the strength perception survey and isokinetic testing results. The administrator of the tests also suggested stretching the muscles in the tested leg to prevent next day soreness. Finally, after the testing was completed, the subjects were reminded of their next testing date.

After each subject's testing session, the researcher transferred the data collected to the subject data collection chart. (Appendix D) Results of strength testing included three separate figures of maximum peak torque. The highest figure was recorded as the maximum torque and was used in the stastical analysis process. Results from the strength perception survey were copied directly onto the collection chart in conjunction with the legend stating phase and color. For example, results from the perception questionnaire of phase I was charted with a red pen, phase II was blue, phase III was green and phase IV was recorded with a black pen. The color variation allows for using the same chart to record each subjects results of the four phases.

Statistical Analysis

The data was analyzed on Statview 512 for the Macintosh. A one-way repeated measures analysis of variance (ANOVA) was used to note a difference in perception among

the four phases of the menstrual cycle. (Appendix F) A second repeated measures ANOVA was performed to locate strength differences among the four phases. (Appendix G) Post hoc analyses were performed using the Newman-Keuls Multiple Range Test.

CHAPTER IV

RESULTS

A COMPARISON OF SELECTED PERCEPTUAL VARIABLES AND MEASURED STRENGTH DURING THE MENSTRUAL CYCLE

Introduction

The purpose of this study was to compare perception variables relating to physical capacity/strength to measured strength during the four phases of the menstrual cycle. Data was collected four times throughout a one month cycle; the four phases were divided into menstrual, post-menstrual, inter-menstrual and pre-menstrual periods. During each phase the subjects completed a perception questionnaire and was tested isokinetically for a quadriceps strength evaluation. Data was gathered for each competence during all four phases. A one-way repeated measures analysis of variance (ANOVA) was used to analyze each set of data (perception and strength). A Newman-Keuls Multiple Range Test was used in all post hoc comparisons. The alpha level was set at .05.

Hypotheses Testing and Analysis

Two hypotheses were tested in this research study. The following is an evaluation of the results. Normative data are presented in Tables II through VII.

First Hypothesis

There will be no significant difference in any of the ten perception variables among the four phases of the menstrual cycle. The following data provides a basis for accepting the first hypothesis.

TABLE II

AGGREGATE PERCEPTION DATA

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Between subj.	17	766.40	45.08	1.10	.3749
Within subj.	54	2206.25	40.86		
treatments	3	306.04	102.01	2.74	.0529
residual	51	1900.21	37.26		
Total	71	2972.65			

TABLE III

ONE FACTOR ANOVA-REPEATED MEASURES FOR X1...X18

Phase	Count	Mean	STD. Deviation	STD. Error
One	18	28.500	6.129	1.445
Two	18	33.278	7.103	1.674
Three	18	33.333	5.445	1.283
Four	18	33.167	6.261	1.476

The data from the first hypothesis was analyzed by a one-way repeated measures analysis of variance. The ANOVA was carried out, using the perception data scored on a Likert-type scale, to investigate differences in perception of physical capacity/strength among four phases of the menstrual cycle. There was no significant difference among the phases. There was a consistent trend of increasing means during the first three phases,

resulting in better perception of physical capacity/strength, with only a slight decrease in the mean during phase four. A post hoc comparison was not performed since there was not a significant difference among the four phases.

The ten variables of perception were also broken down individually to note how they independently scored among the four phases of the menstrual cycle. The following table represents the ten variables as they were scored by all 18 subjects among each of the four phases. The data was measured on a Likert-type scale, numbering one to five, meaning the higher the score the stronger the perception toward the right hand column of variables. Each set of polar terms is designed to elicit a specific response from each subject based on their intensity of feeling during the various phases.

TABLE IV

Perception Data Independently Scored Among The Phases

	Phase I Menstrual	Phase II Post-Men.	Phase III Inter-Men.	Phase IV Pre-Menstrual	
weak	60	59	65	60	strong
fatigued	42	55	54	56	not fatigued
slow	57	60	57	61	fast
heavy	50	60	61	60	light
tense	51	62	61	59	relaxed
passive	54	59	63	62	active
powerless	53	60	65	63	powerful
tired	38	54	50	57	alert
calm	54	58	53	60	aggressive
bloated	54	74	76	63	not bloated

Data is based on a Likert-type scale, the higher the number, the stronger the perception toward the right hand column of variables. Data can range from 18 to 90.

Second Hypothesis

There will be no significant difference in the measured strength among the four phases of the menstrual cycle. The following data provides basis for rejecting the second hypothesis.

TABLE V

MEASURED STRENGTH DATA

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Between subj.	17	163769.66	9633.51	18.99	.0001
Within subj.	54	27399.83	507.40		
treatments	3	12736.48	4245.49	14.77	.0001
residual	51	14663.35	287.52		
Total	71	191169.49			

TABLE VI

ONE FACTOR ANOVA-REPEATED MEASURES FOR X1...X18

Group	Count	Mean	STD. Deviation	STD. Error
Phase one	18	128.512	47.661	11.234
Phase two	18	145.321	51.746	12.197
Phase three	18	161.544	53.741	12.667
Phase four	18	159.821	51.563	12.154

Comparison:	Mean Diff.:	Newman-Keuls:
p-one vs p-two	-16.81	11.35*
p-one vs p-three	-33.03	11.35*
p-one vs p-four	-31.31	11.35*
p-two-vs p-three	-16.22	11.35*
p-two vs p-four	-14.50	11.35*
p-three vs p-four	1.72	11.35

*Significant at 95%

Tables V and VI show the results of one factor repeated measure analysis of variance measuring the difference in strength among the four phases of the menstrual cycle. Overall, there was a significant difference among the four phases ($f=18.98$, $df=17,54$, $P<.0001$). Phase one (menstrual) had a mean of 128.512 ft.-lbs. with means increasing over the next two phases, post-menstrual and intermenstrual, to 145.321 ft.-lbs. and 161.544 ft.-lbs. and a final drop in mean strength during the last phase (pre-menstrual) to 159.821 ft.-lbs.

A Newman-Keuls Multiple Range post hoc comparison found significances at $P<.05$ when comparing the phases. There was a significant difference found among phases one versus two (menstrual vs. post-menstrual), one versus three (menstrual vs. inter-menstrual), one versus four (menstrual vs. pre-menstrual), two versus three (post-menstrual vs. inter-menstrual), and two versus four (post-menstrual vs. pre-menstrual); the only comparison that was not found to be significant was the comparison between phases three versus four (inter-menstrual vs. pre-menstrual).

Relationship between perception and strength among the phases

When visually comparing means of the two hypotheses, there is a similar increase among the first three phases with a slight drop during phase four. The following (Table VII) is a comparison of means the note increases among the phases.

Table VII

Means

	Perception Variables	Strength
Phase One	28.500	128.512
Phase Two	33.278	145.321
Phase Three	33.333	161.544
Phase Four	33.167	159.821

Thus, in conclusion, the results indicate the subjects have increasing perception of strength variables and strength among phases one through three (menstrual, post-menstrual and inter-menstrual) with a slight decrease in perception variables and strength during phase four (pre-menstrual). Therefore, as previous research has concluded, subjects assume themselves to be weaker during the pre-menstrual phase and by no significant amount show their strength to decrease in the same pattern.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter includes a brief summary of the research, discussion of the research results, conclusions, and a list of recommendations for further research.

Summary of the Hypotheses

Hypothesis #1: There will be no significant difference in any of the ten perception variables among the four phases of the menstrual cycle. From the results there was no significant difference found among the four phases, therefore hypothesis #1 was accepted.

Hypothesis #2: There will be no significant difference in the measured strength among the four phases of the menstrual cycle. From the measured strength data there was a significant difference among all of the phases except phases III and IV. Hypothesis #2 was rejected even though there was no significant difference between phases III and IV.

Discussion of Research Results

From the perception data collected and analyzed by a one-way repeated measures analysis of variance (ANOVA), no significant difference was found among the four phases of the menstrual cycle. Results of the second hypothesis showed a significant difference in strength during the first three phases of the menstrual cycle and an insignificant decrease in phase four. The first reason to justify this increase in strength is the athletic-related

strength training performed by the athletes during the testing session. Even though the research testing lasted only one month, each subject continued strength training during that time. Each subject, depending on whether they were in-season or off-season, maintained a strength training program. Subjects involved with training in-season were on a maintenance program three times per week to maintain their strength, while subjects involved with off-season, lifted weights daily to develop muscular strength.

Strength training, on the other hand, cannot be the only justification for the increase in strength scores among the phases, because there was a slight drop in strength after phase three. The slight decreased strength in phase four, which is the pre-menstrual phase, could be the result of hormonal changes that take place in the body. The decrease in the level of estrogen may have a direct correlation with the decrease in physical strength. Whereas estrogen levels are low during menstruation, they are at their peak on day 14 of the menstrual cycle; the 14th day of the menstrual cycle is the day of ovulation (Weideger, 1975). The 14th day corresponds to the start of the third phase (inter-menstrual), and by results of the data, phase three is when strength was measured at its highest value. Therefore, the hormonal pattern does have a direct correlation with the values of strength as they increase and decrease throughout the cycle.

Another consideration to the recorded increase in strength over the four phases of the menstrual cycle may involve a learning curve. The principle of learning states that a learner can improve by practice or exercise only when the learner has some way of knowing what has been executed well and receives feedback at once (Hart, 1983).

Whereas there was a change in strength among the phases, there was no change in the perception of strength variables. One reason behind the lack of perception change is the degree of predictability of one's perception through emotion and impulse may be simply a matter of distribution through time of the occurrence (Allport, 1955). Meaning, each subject has her own perception of strength that will vary only slightly from day to day and

no matter what the subject felt (strong or weak), during a certain phase, it will not change over time and the subject will not sway to an extreme from her set perception.

There may appear to be a problem with the small sample size. As stated in research, a well-selected and controlled small sample size is better than a poorly selected and controlled large sample (Baumgartner & Strong, 1994). Population size has a direct effect on sample size. Since the total number of female athletes was only 72, the sample size was limited. With a small sample size there is a high probability that the mean is not normally distributed. According to the Central Limit Theorem, a larger sample size would help to ensure a normally distributed mean (Ott, 1993). It is possible the subjects' perceptions and measured strength are not a fair representation of a normal population. However, since the population was so small it is likely that the perceptions and strength of the whole population were well represented.

The hawthorne effect is a common source of error in research that states that subjects in an experiment may perform in an atypical manner due to the newness or novelty of the treatment and because they realize that they are participating in an experiment (Baumgartner & Strong, 1994). From this idea, researchers suggest that subjects should be unaware of their participation in an experiment and of the hypothesized outcome of the study as much as possible.

During research on the menstrual cycle, all subjects began testing on the fourth day of menstruation, therefore, at that point the subjects new what phase they were in (menstruation). From there, subjects were asked to come back for their second testing session seven days later and at that time the researcher did not mention what phase they were performing in. Overall, the subjects had a probable idea of their time frame as to where they were during their menstrual cycle. But, as stated, the researcher did not make the subjects aware of what specific phase they were testing in. Therefore, the idea of

atypical performance because the subject knew of their participation in a research study, may or may not have had an effect on the outcome of this study.

Conclusions

Based upon the findings of this study, the following conclusions are submitted: There is no difference in the way the subjects perceived their strength or physical capacity throughout the four phases of the menstrual cycle. However, there is a difference in strength among the phases. A difference in strength among the phases was found in phases: one versus two (menstrual vs. post-menstrual), one versus three (menstrual vs. inter-menstrual), one versus four (menstrual vs. pre-menstrual), two versus three (post-menstrual vs. inter-menstrual), and two versus four (post-menstrual vs. pre-menstrual). There was not a significant difference in phase three versus four (inter-menstrual vs. pre-menstrual) therefore concluding the strength of the subjects were nearly the same during these phases of the menstrual cycle.

Rationale behind differentiating strengths among the phases are the continued weight training of the subjects during the one month of strength testing throughout the four phases, hormonal changes in the body, the effect of the learning curve, and possibly the hawthorne effect.

In relation to perception and strength among the four phases the trend showed a continued increase in strength and strength perception among phases one, two and three with a slight decrease in phase four. From this it is concluded that by beginning in the menstruation phase there was a baseline established for perception of strength and measured strength. There results showed increases in the next two phases, which is similar to existing data; after the menstruation phase both strength and perception of strength increased slightly during the post-menstrual and inter-menstrual phases. Lastly,

there was a slight decrease in strength and perception of strength during the pre-menstrual phase and again this follows true to existing data (Erdelyi, 1962).

Recommendations for future research

Based upon the findings of the present study, the following recommendations are suggested for future research: 1) A direct focus on a specific sport whether it be a short term, anaerobic or a longer duration, aerobic event. 2) Begin testing of athletes during random phases instead of starting all athletes on the same phase. By doing this, it would counter the effects of the learning curve. 3) Define factors that cause athletes to perceive themselves weaker or stronger during different times of the menstrual cycle. 4) Perform other types of strength testing (isometric or isotonic) to find strength differences among the phases. 5) Research how stress level of a subject affects perception of athletic ability. 6) Study how much activity can be performed before oligomenorrhea or amenorrhea is reached. 7) Replicate study with a larger sample size. 8) Perform study using pre-test and post-test comparisons and test over a longer period to include three or four cycles. 9) Sample blood-hormone levels to see if there is any physiological change among the phases of the menstrual cycle. 10) When selecting subjects, use a combination of athletes and non-athletes to compare perception of the menstrual cycle. When using athletes, it was suggested, that they are use to exercising through menstrual discomfort, therefore, may have a better perception of themselves due to the findings that athletes usually have a higher self-esteem.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

APPENDIX A.

INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 08-01-95 IRB#: ED-96-009

Proposal Title: A COMPARISON OF PERCEIVED STRENGTH AND MEASURED STRENGTH DURING THE MENSTRUAL CYCLE

Principal Investigator(s): Bert Jacobson, Wendee J. Lentz

Reviewed and Processed as: Expedited

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING.
APPROVAL STATUS PERIOD VALID FOR ONE CALENDAR YEAR AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval are as follows:

COMMENTS:

The application is approved, but the reviewers wanted to share a couple of comments. It's suggested that the PI, in order to fully inform the participants regarding confidentiality, include the paragraph from question #13 of the application in the consent form. Also, what will the PI do with the ID coding list after the study is completed? (See question #12 in the application).

Signature: _____ Date: August 23, 1995
Chair of Institutional Review Board

APPENDIX B

MEDICAL HISTORY QUESTIONNAIRE

APPENDIX B. MEDICAL HISTORY QUESTIONNAIRE

1. How often do you have a period?

2. How many days does you regular monthly period last?

3. How many periods have you had in the last 12 months?

4. When was your last period?

5. Have you had regular periods over the last 3 months?

6. Do you take birth control pills or hormones?

7. Do you have norplant implants as a form of birth control?

8. Do you supplement your diet with iron? If yes, how much?

APPENDIX C

INFORMED CONCENT

APPENDIX C. INFORMED CONCENT

"I, _____, hereby authorize or direct _____, or associates or assistants of her choosing, to perform the following procedure."

EXPERIMENTAL PROCEDURE

Subjects involved in this study will be requested to be present for testing once during each of the four phases of the menstrual cycle. The testing procedure will be as follows: as the subject arrives inthe training room, she will be requested to fill out a perceived strength questionnaire regarding her physical well being during that specific phase of her cycle. Next she will perform a short warm-up consisting of jogging two laps around the indoor track facility, stretching of the muscles in the dominant leg, and be fit properly on the Cybex-Orthotron II isokinetic testing unit. the test will consist of five repetition warm-up trials, and three sets of five repetition maximal exertion trials. After completion of the testing session, the subject will again be reassured of confidentiality and reminded of her next testing date. Total time of the testing session should not require more than 15 minutes. Frequency of testing will include four sessions, one for each phase of the menstrual cycle, totaling one month.

To ensure confidentiality all research testing will be performed and recorded by the designated researcher. All records, consisting of medical history forms, physical information, results of strength perception scale and isokinetic testing will be personal and kept confidential for each subject. Data charts entailing results of research for each subject will be coded by random numbers instead of personal names. All information regarding research data will be kept in a locked file cabinet of the researcher. Once research is completed, all data will be destroyed six months following submission of thesis project.

This is done as part of an investigation entitled "A Comparison of Selected Perceptual Variables and Measured Strength During the Menstrual Cycle."

The purpose of this study is to determine if there are differences between the perception of an athletes' physical capacity/strength versus the actual measured value of strength during four phases of the menstrual cycle.

"I understand that is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any tome without penalty after notifying the project director."

I may contact _____ at telephone number _____.

I may also contact University Research Services, 001 Life Science East, Oklahoma State University, Stillwater, OK 74078; Telephone (405) 744-5700.

I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date:_____ Time:_____ (a.m./p.m.)

Signed:_____
Signature of Subject

"I certify that I have personally explained all elements of this form to the subject before requesting the subject to sign it."

Signed:_____
Project Director or Authorized Representative

APPENDIX D

DATA COLLECTION CHART

APPENDIX D. DATA COLLECTION CHART

Demographic Information

I.D. Number:_____ Age:_____ Sport:_____

Home Phone:_____ Leg dominance:_____

Flow Onset:_____ Iron Supplementation:_____ In/Off Season:_____

Testing Dates

Phase I:_____ Phase II:_____

Phase III:_____ Phase IV:_____

Peak Torque Results

	Phase I	Phase II	Phase III	Phase IV
Trial 1	_____	_____	_____	_____
Trial 2	_____	_____	_____	_____
Trial 3	_____	_____	_____	_____
Max. Torque	_____	_____	_____	_____

Perception Scale Results

	very	somewhat	neither	somewhat	very	
weak	_____	_____	_____	_____	_____	strong
fatigued	_____	_____	_____	_____	_____	not fatigued
slow	_____	_____	_____	_____	_____	fast
heavy	_____	_____	_____	_____	_____	light
tense	_____	_____	_____	_____	_____	relaxed
passive	_____	_____	_____	_____	_____	active
powerless	_____	_____	_____	_____	_____	powerful
tired	_____	_____	_____	_____	_____	alert
calm	_____	_____	_____	_____	_____	aggressive
bloated	_____	_____	_____	_____	_____	not bloated

Total Phase I:_____ Phase II:_____

Phase III:_____ Phase IV:_____

Legend: Phase I -red Phase II - blue Phase III - green Phase IV - black

APPENDIX E

PERCEPTION QUESTIONNAIRE

APPENDIX E. PERCEPTION QUESTIONNAIRE

	very	somewhat	neither	somewhat	very	
weak	_____	_____	_____	_____	_____	strong
fatigued	_____	_____	_____	_____	_____	not fatigued
slow	_____	_____	_____	_____	_____	fast
heavy	_____	_____	_____	_____	_____	light
tense	_____	_____	_____	_____	_____	relaxed
passive	_____	_____	_____	_____	_____	active
powerless	_____	_____	_____	_____	_____	powerful
tired	_____	_____	_____	_____	_____	alert
calm	_____	_____	_____	_____	_____	aggressive
bloated	_____	_____	_____	_____	_____	not bloated

APPENDIX F

AGGREGATE PERCEPTION DATA

APPENDIX F. AGGREGATE PERCEPTION DATA

ATHLETES	PHASE I Menstrual	PHASE II Post-Men.	PHASE III Inter-Men.	PHASE IV Pre-Menstrual
1	38	30	31	29
2	34	32	34	42
3	25	28	36	33
4	20	38	35	40
5	25	35	37	32
6	42	30	46	20
7	20	38	24	37
8	29	17	30	30
9	29	27	27	23
10	30	27	28	31
11	30	39	39	32
12	20	28	28	33
13	26	42	35	40
14	22	42	38	28
15	31	44	27	38
16	32	35	34	29
17	27	27	33	38
18	33	40	38	42

Data is based on a Likert-Type scale, the higher the number, the stronger the perception toward the right hand column of variables. Data can range from 10 to 50.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Between subj.	17	766.40	45.08	1.10	.3749
Within subj.	54	2206.25	40.86		
treatments	3	306.04	102.01	2.74	.0529
residual	51	1900.21	37.26		
Total	71	2972.65			

Phase:	Count:	Mean:	Standard Deviation:	Standard Error:
ONE	18	28.50	6.13	1.45
TWO	18	33.28	7.10	1.67
THREE	18	33.33	5.45	1.28
FOUR	18	33.17	6.26	1.48

APPENDIX G

MEASURED STRENGTH DATA

APPENDIX G. MEASURED STRENGTH DATA (PEAK TORQUE)*

ATHLETES	PHASE I Menstrual	PHASE II Post-Men.	PHASE III Inter-Men.	PHASE IV Pre-Menstrual
1	240.56	216.38	248.62	226.92
2	117.80	166.78	170.50	184.14
3	261.02	307.52	319.30	327.36
4	104.16	137.64	147.56	162.44
5	121.52	153.76	158.10	171.74
6	99.82	122.14	112.84	100.44
7	117.18	112.84	104.78	137.62
8	93.00	97.96	165.54	149.42
9	91.14	98.58	117.80	101.06
10	98.58	105.40	112.84	116.56
11	125.86	190.96	217.62	164.92
12	118.42	120.90	143.84	125.86
13	109.12	148.18	153.76	153.14
14	168.64	143.22	155.62	155.00
15	110.98	153.76	143.22	168.64
16	111.60	104.78	135.78	128.96
17	110.98	116.56	178.56	153.76
18	112.84	118.42	121.52	148.80

*All figures in foot-pounds

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Between subj.	17	163769.66	9633.51	18.99	.0001
Within subj.	54	27399.83	507.40		
treatments	3	12736.48	4245.49	14.77	.0001
residual	51	14663.35	287.52		
Total	71	191169.49			

Phase:	Count:	Mean:	Standard Deviation:	Standard Error:
phase one	18	128.51	47.66	11.23
phase two	18	145.32	51.75	12.20
phase three	18	161.54	53.74	12.67
phase four	18	159.82	51.56	12.15

Comparison:	Mean Diff.:	Newman-Keuls:
p-one vs p-two	-16.81	11.35*
p-one vs p-three	-33.03	11.35*
p-one vs p-four	-31.31	11.35*
p-two-vs p-three	-16.22	11.35*
p-two vs p-four	-14.50	11.35*
p-three vs p-four	1.72	11.35

*Significant at 95%

VITA

Wendee J. Lentz

Candidate for the Degree of

Master of Science

Thesis: A COMPARISON OF SELECTED PERCEPTUAL VARIABLES AND MEASURED STRENGTH DURING THE MENSTRUAL CYCLE

Major Field: Department of Health, Physical Education & Leisure

Area of Specialization: Health Promotion

Biographical:

Personal Data: Born in Girard, Kansas, on August 12, 1971, the daughter of Wendell and Deloris Lentz.

Education: Graduated from Girard High School, Girard, Kansas in May 1989; received Bachelor of Science degree in Biology with a minor in Athletic Training from Pittsburg State University, Pittsburg, Kansas in May 1993. Candidate for the Master of Science degree with a major in Health, Physical Education & Leisure from Oklahoma State University, Stillwater, Oklahoma in May 1996.

Experience: Reared in Girard, Kansas; employed at the local newspaper The Girard Press during high school; employed by Pittsburg State University as a student athletic trainer during undergarduate; employed by Oklahoma State University as a graduate assistant athletic trainer, August 1994 to May 1995; employed by Mt. Carmel Medical Center as the associate athletic trainer for Pittsburg State University while completing requirements for M.S. degree, August 1995 to present.

Professional Memberships: National Athletic Trainers' Association, Oklahoma State Board of Medical Licensure and Supervision and the Kansas Athletic Trainers' Association.