REACTION TIME AND STRENGTH IN PREGNANT
AND NONPREGNANT EMPLOYED WOMEN

by

W. YONDELL BINGHAM MASTEN, B.S., B.S.N., M.S., M.S.N.

A DISSERTATION

IN

INDUSTRIAL ENGINEERING

Submitted to the Graduate Faculty
of Texas Tech University in
Partial Fulfillment of
the Requirements for
the Degree of

DOCTOR OF PHILOSOPHY

Approved

August, 1985

HC
201
TE
1985
No. 56
Copy 2

ACKNOWLEDGMENTS

I am deeply indebted to Dr. James L. Smith for his support and direction of this dissertation and to the other members of my committee, Dr. M. M. Ayoub, Dr. Teddy Langford, Dr. William Kolarik, and Dr. Betty Wagner, for their helpful criticism.

TABLE OF CONTENTS

ACKNOWLEDGMENTS	ii
LIST OF TABLES	v
LIST OF FIGURES	vi
I. INTRODUCTION	1
Purpose and Scope of the Dissertation	2
Research Problem Statement	3
Definition of Terms	3
II. REVIEW OF PREVIOUS RESEARCH	5
Pregnant Working Women	5
Biomechanical Characteristics of Pregnancy	6
Physical Work Capacity in Pregnancy	9
Emotional Impact of Pregnancy	15
Reaction Time in Pregnancy	15
III. METHODS AND PROCEDURES	17
Objectives	17
Target Population	18
Study Sample	19
Variables	20
Design	20
Data Collection	23
Analysis	27
Procedures	29

IV.	RESULTS	35
V.	DISCUSSION	42
	Interpretation	42
VI.	SUMMARY AND CONCLUSION	51
	Summary	51
	Conclusion	55
	REFERENCE LIST	58
	APPENDICES	61
A.	Study Sample Demographic Data, and Personal Data and Consent Form	62
B.	Reaction Time Data for Each Subject for All Five Sessions	69
C.	Hand Grip Strength Data for Each Subject for All Five Sessions	74
D.	Static and Dynamic Arm Strength Data for Each Subject for All Five Sessions	79
E.	Anthropometric Data for Each Subject for All Five Sessions	84
F.	Testing Instructions to Volunteers	89
G.	<u>t</u> Test for Nursing Personnel Subgroups and Test for Equal Variances Tables	94
H.	Graphs of Mean Values of Strength and Reaction Time Data by Group for the Four Testing Sessions	99

LIST OF TABLES

Table	Page
1 Mean Values for Age and Anthropometric Measurements for the Experimental and Control Groups 	19
2 <u>t</u> Test Table for Comparison of Pregnant and Nonpregnant Group Means of Change Over Test- ing Sessions for Each Dependent Variable . . .	36
3 Overall Mean Values of Strength and Reaction Time	37
4 Percentage of Women with Change in Strength by Group	43
5 Group Strength Mean and Average Change in Strength Measurements for the Experimental and Control Groups for the Four Testing Sessions	44
6 Percentage of Women with Change for Reaction Time by Group	46
7 Group Reaction Time Mean and Average Change in Reaction Time for Women in the Experimental and Control Groups for the Four Testing Sessions	46
8 Mean and Standard Deviation Strength Values by Trimester	48
9 Mean and Standard Deviation Reaction Time Values by Trimester	49
10 Percent of Volunteers Reporting Fatigue at Least One Time by Trimester	50

LIST OF FIGURES

Figure		Page
1	Hand Grip Dynamometer and Position for Grip Test	31
2	Position for Static Arm Strength Test with Minigym	32
3	Starting and Ending Positions for Dynamic Arm Strength Test with the Minigym	34

CHAPTER I

INTRODUCTION

In recent years more women of childbearing age have become employed outside the home. Many of the women who become pregnant wish to continue employment during their pregnancies. Historically, in the United States, there has been a tendency toward viewing the pregnant woman as being different than the nonpregnant woman. Attitudes among male employers and supervisors include the perception that pregnant women are an unnecessary burden (Gries, 1981). Reasons given for this perception were based on the belief that pregnant women needed different job assignments during pregnancy, that reassignment of the pregnant women resulted in accusations of favoritism being shown toward the pregnant women, and that pregnant women are more emotional and complained more, irrespective of their job assignment. In addition, male physicians tend to base their advice for work during a normal pregnancy on their own cultural and social beliefs toward what work pregnant women should be able to perform rather than on documented medical experience with working pregnant women (Gries, 1981).

Literature on working pregnant women focused on the effect of exposure to radiation and chemical hazards in the

work place and pregnancy or fetal outcome. Based on a recent computer literature search (MEDLINE AND BIOSIS), there were no available studies addressing reaction time and strength in pregnant employed (or nonemployed) women. Thus, no evidence was available in the literature to indicate that women experiencing normal pregnancies could or could not continue working or seek employment in nonhazardous work areas.

Purpose and Scope of the Dissertation

The purpose of this study was to determine whether or not pregnant and recently delivered, employed women differed from nonpregnant employed women in reaction time and hand and arm strength. Resultant changes in reaction time, strength and/or physical work capacity during pregnancy could have implications for maternal and fetal safety, and for job assignment, tool design and work process design for expectant mothers. Balance (O'Connell, 1979) is affected by changes in weight, body contour, and center of gravity shift. Awkwardness, fatigue and tendency toward loss of balance could become critical, especially when rapid movement or reaction is required for safety or task performance.

The American Medical Association Council on Scientific Affairs (1984) has recommended evaluation of pregnant women in the work force in order to formulate

guidelines for working pregnant women. In addition, the American College of Obstetricians and Gynecologists (Chamberlin, 1984) has called for evaluation of the employed expectant mother.

Research Problem Statement

The problem is whether or not changes in reaction time and hand or arm strength in the pregnant group are significantly different than the changes in the nonpregnant group.

Definition of Terms

For the purposes of this study, the following terms are defined in the manner indicated:

Normal pregnancy is pregnancy which is not classified as being at risk due to maternal age, pre-existing complications, or pregnancy induced complications (such as teenage pregnancy, age past 40, diabetes, cardiac disease, parity greater than four, kidney disease, hyperemesis gravidarum or pregnancy induced hypertension).

Three trimesters of pregnancy divide the 40 weeks of pregnancy. The fourth trimester of pregnancy is the three-month period following childbirth.

The puerperium or postpartum period is the six to twelve weeks following childbirth.

Static strength is "the capacity to produce torque or force by a maximal voluntary isometric muscular

exertion" (Chaffin, 1975, p. 506). The contraction occurs for a short period of time and does not involve body movement. The contracting muscles do not become appreciably longer or shorter.

Dynamic strength is the capacity to produce torque or force by a maximal voluntary muscular exertion which is "accompanied by storage and/or release of energy in moving body parts" (Chaffin, 1975, p. 506).

Reaction time is the time required to make a response after a stimulus is presented. For this study the movement time portion of reaction time was minimized by having the volunteers place their fingers near the response key of the microcomputer keyboard. Furthermore, whole body movement was not required by the reaction time test procedures.

CHAPTER II

REVIEW OF PREVIOUS RESEARCH

Pregnant Working Women

Today, there are increasing numbers of women who are members of the American workforce. The ACOG Newsletter (Chamberlin, 1984) indicates that 52 % of American women work during pregnancy. The need for research regarding the effect of pregnancy on the female worker is apparent. According to the American Medical Association Council on Scientific Affairs (1984, p. 1995) the "impact of pregnancy on a worker's ability to perform her job has only recently become an area considered suitable for scientific inquiry." The need for researchers to examine the emotional and physical impact of pregnancy on women was cited by The Council.

Recent studies of pregnant women in industry tended to focus on three areas of concern. These areas are the capability of the expectant mother to perform her assigned task(s), the effect of teratogenic substances in the work environment on the developing embryo/fetus, and the effect the changes of pregnancy have on the worker. The effect many of the physical changes of pregnancy have on the worker seem to be directly related to the design of the workplace.

Biomechanical Characteristics of Pregnancy

O'Connell (1979) identified unique characteristics of pregnant women in the workplace. The biomechanical or ergonomic changes identified are the progressive shift in the center of gravity, progressive change in body contour, and softening and lengthening of ligaments (which increase the susceptibility to back injuries and affect the gait).

An additional ergonomic consideration mentioned by O'Connell (1979) was the apparent difference in muscle mass between men and women. Since women, in general, tend to have less muscle mass than men, he considered the difference a disadvantage when women were required to move large masses.

Strength

No studies in the literature on strength in pregnant women were identified by the computer literature searches. However, Hogan (1980) reviewed the literature on the state of the art of strength testing. Several studies from various disciplines (e.g., work physiologists, physicians, psychologists and industrial engineers) have found differences in muscle strength between men and women. The most useful categorization of the differences reported by Hogan (1980) was that summarized in 1976 by Laubach in a review of the literature of comparative muscle strength in men and women.

Laubach (1976) found four specific muscular strength base rates for determining strength capacity for job assignment: upper extremity static strength, upper extremity dynamic strength, trunk static strength and lower extremity static strength.

Hogan (1980) identified several studies which agree that women generally have less upper body extremity strength than has been reported in early literature and more lower body extremity strength than that reported in the more recent literature. The comparison of men's and women's upper body extremity static strength indicated that the mean value for women's strength was from 35% to 79% of men's strength. In upper extremity dynamic strength, the mean value for women's strength ranged from 59% to 84% of men's strength. The mean for women's lower extremity static strength was 57% to 86% that of men's. The mean for static trunk strength for women was 37% to 70% that of men's. Thus, Hogan (1980, p. 81) surmised

if the strength findings were averaged across the total body, women's strength would be about two-thirds that of men's. However, because of the magnitude of the differences between upper and lower extremity strength, an index of total body strength is meaningless, especially for predicting the ability to perform tasks involving special levers or muscles.

In addition, Mackay and Bishop (1984) concluded that because Laubach did not standardize the data in the reviewed studies for body size or physical fitness, the data were biased against females and can not be used as

valid indicators of potential strength for a particular woman. Mackay and Bishop (1984) also reported that Wilmore, in a 1975 study, found the differences in upper and lower body extremity strength disappeared when strength was expressed relative to lean body weight. Wilmore (1974) had previously decided that strength differences might be explained better by the use individuals made of their muscles. Thus, since women use their leg muscles in a similar manner as men, leg muscle strength should be similar. However, women do not normally use their arm muscles for as strenuous work as men and should not expect to have as much arm strength as men. Mackay and Bishop (1984) tended to support Wilmore's belief about the strength differences for upper and lower extremity strength in men and women.

In another study reported by Mackay and Bishop (1984), Snook and Cirello, in 1974, compared lifting capabilities in housewives, industrial women, and industrial men. Findings of the study revealed that housewives lacked the ability that industrial men and women possessed to lift loads. The authors attributed this difference to the effect of training among the industrial men and women (i.e., daily use of their muscles) in different activities compared to the activities of housewives.

Grip strength is important in the design of hand tools and in the evaluation of the different types of grips

(i.e., power and precision) used in the workplace (Bazar, 1978; Patterson and Gabbard, 1982). In reviewing studies of grip strength, Bazar reported that the dominant hand grip strength of women compared to men was 52% to 63% that of the men. Grip strength was found to decline with age with the maximum grip strength being at age 25-30 years.

Physical Work Capacity in Pregnancy

The American Medical Association Council on Scientific Affairs (1984) identified the need for objective evaluation of physical work capacity in pregnant women to determine if an alteration actually exists. Oxygen consumption testing was recommended for evaluating physical work capacity. The Council further stressed that results of the evaluation(s) be used for developing recommendations for women experiencing normal and uncomplicated pregnancies.

To stress the point that evaluation of oxygen consumption in pregnant women during exercise was not a new occurrence, Seitchik (1967) cited such an experiment performed by Teruoka in 1932. Since 1932, several studies have been conducted on oxygen consumption and cardiovascular/respiratory system response of pregnant women. Hunt (1979) reviewed several past studies of the effects of physical activity on pregnancy.

In a study of 150 Bulgarian women athletes (Zaharieva, 1972) from 1952 to 1972, the athletes were

followed during pregnancy, delivery, and the puerperium. Zaharieva concluded that even extreme physical activity did not jeopardize childbearing capacity in women so long as nutrition and medical care were adequate.

Hunt (1979) reported the results of a 1960 study of physical work capacity during and after pregnancy conducted by Dahlstrom and Irhman. Fifty rural Swedish women were followed for a year during pregnancy and the puerperium. The results, using a bicycle ergometer to measure physical work capacity, revealed the following:

1. The pulse frequency was about 10 beats per minute faster at rest in pregnancy compared to nonpregnancy and it decreased after delivery.
2. The physical work capacity remained fairly constant throughout pregnancy, was higher at 36 weeks of pregnancy than it was in early pregnancy, was reduced after delivery, returned to early pregnancy levels by two months after delivery and was not decreased by age (the older pregnant women in the study had been physically conditioned in their earlier years by walking and bicycling).

In a separate study conducted by Irhman in 1960 and reported by Hunt (1979), 26 women were examined for the effect of supervised, moderate ten-week physical training period from 20 to 30 weeks of pregnancy. By comparing the

26 physically trained, pregnant women with 50 physically untrained, pregnant women, Irhman concluded that circulatory adjustments in pregnancy and those due to the training effect were similar. Thus, physical training during the 20-30 week period of pregnancy did not appear to influence the circulatory adjustments of pregnancy.

Seitchik (1967) measured oxygen uptake in 133 pregnant, 34 nonpregnant, and 28 postpartum women. Measurements were done at rest, during exercise on a bicycle ergometer at less than maximal effort, and during recovery from exercise. The results indicated that (1) at rest, the mean energy expenditure rate was increased in pregnancy, and increased significantly during progression of pregnancy; and (2) in nonweight-bearing work, the pregnant women appeared to be at least as efficient (in terms of calories required for the exercise) as nonpregnant women. In addition, the pregnant women were apparently more efficient during 24-35 weeks gestation in work performance, at submaximal workloads, than nonpregnant women.

Seitchik (1967) cautioned that when the pregnant woman is required to move her own body mass during task performance, a greater workload is imposed. Performing the identical task during pregnancy rather than in nonpregnancy increased the work due to movement of the increased body mass. Thus, the pregnant woman would expend more energy in performing identical work than when she was not pregnant,

and, in late pregnancy, posture changes and increased abdominal size would result in more fatigue for the same amount of work.

Guzman and Caplan (1970) studied cardiorespiratory response to exercise in eight healthy, pregnant women. Oxygen uptake, heart rate, respiratory frequency, and cardiac output were measured for three submaximal exercise workload levels (150, 250 and 350 KgM per minute) monthly, from the first trimester until delivery and again three months after delivery. Study findings, in bicycle exercise (which minimizes the effect of increase in body weight), indicated that (1) muscular efficiency during mild and moderate workloads was not decreased in pregnancy; (2) metabolic demand was not significantly increased in pregnancy; and (3) the physiologic response to exercise (as indicated by the rate of increase in ventilation and cardiac output for increasing workloads) was the same in pregnancy and nonpregnancy.

Similar conclusions were reached by Knuttgen and Emerson (1974). Their study identified three major respiratory system changes from pregnancy to postpartum in 13 pregnant women who were observed during pregnancy and the puerperium. Functional residual capacity was decreased, respiratory capacity was increased, and vital capacity was increased. Total lung capacity did not change from pregnancy to postpartum. Thus, the conclusion, based on bicycle

ergometer exercise, was that hyperventilation during pregnancy was due to tidal volume changes (at rest and during exercise). Furthermore, increased size of abdominal contents during pregnancy did not impair ventilation during exercise.

Pernoll, et al. (1975 a) performed monthly evaluations of oxygen consumption in pregnant subjects during exercise and rest periods. Twelve pregnant and postpartal women were measured for efficiency (work performed/oxygen consumption) in a steady state under standardized conditions, using a bicycle ergometer. The conclusions of the study tended to contradict the results of Guzman and Caplan, Knuttgen and Emerson, and Seitchik. Pernoll, et al. (1975 a) found (1) a progressive increase in the rate of oxygen consumption at rest and during a standard intensity of weight-bearing exercise during pregnancy; (2) a significant increase in the oxygen debt in pregnancy during a standard amount of exercise; and (3) an increase in cardiac output during exercise in pregnant women. Thus, muscular efficiency for mild muscular exercise did decline during pregnancy. Consequently, based on the progressive increase in oxygen consumption at rest and during exercise, the amount of work that could be performed by women was considered to be altered in pregnancy.

In an additional study of ventilation in pregnant women during rest and exercise, Pernoll, et al. (1975 b)

attempted to explain the relative hyperventilation of pregnancy more accurately. They discovered a greater increase in resting minute ventilation than oxygen consumption or carbon dioxide production in pregnant women during exercise and at rest; a greater increase in carbon dioxide production at rest during pregnancy; and a lower carbon dioxide partial pressure at rest and during exercise in pregnant women. From these results, Pernoll, et al. (1975 b) concluded that (1) the functional changes during pregnancy maintained the carbon dioxide partial pressures at a low level during moderate exercise; (2) the sensitivity of the respiratory center to carbon dioxide increased progressively during pregnancy; and (3) hyperventilation was characteristic of pregnancy at rest and during exercise and was most probably related to an increase in volume of the physiologic dead space. However, Gee, et al. (1967) concluded that the hyperventilation of pregnancy was due to decreased airway resistance due to increased diameter of conducting airways in pregnancy.

From reviewing the studies on effects of physical activities and pregnancy, Hunt (1979, p. 54) concluded that "the physiologic adaptations of pregnancy are sufficient for a woman to maintain her prepregnancy range of physical activity with a possible need to acknowledge increased fatigue levels in the last weeks of gestation as body size becomes cumbersome."

In summary, oxygen consumption increases progressively at rest and during a standard amount of exercise in pregnant women (Pernoll, et al., 1975 b). Recommendations for pregnancy include (Hunt, 1979; Pernoll, et al., 1975) (1) recognizing that the additional weight carried and additional oxygen required during pregnancy reduce the amount of work that can be performed; and (2) acknowledging the occurrence of increased fatigue levels due to body size.

Emotional Impact of Pregnancy

For perceived well-being on the Beck Depression Inventory, Lips (1982) compared the responses of 108 women in the first half of pregnancy with expectant and non-expectant fathers and nonpregnant women. The study results indicated that the pregnant women's responses did not differ from the men and nonpregnant women. Lips is continuing to evaluate the emotional impact of late pregnancy for perceived well-being.

✓ Reaction Time in Pregnancy

Reaction time has been used to evaluate (1) mental workload (Hicks and Wierwille, 1979); (2) effects of environmental conditions on performance (Bell, et al., 1982; Ellis, 1982); (3) the influence of alcohol on steering in a driving simulator (Dott and McKelvey, 1977); and (4) comprehension of verbal and symbolic traffic sign messages (Ellis and Dewar, 1979). To date, no studies have

been reported on reaction time during pregnancy. However, Hunter, et al. (1979) investigated the relationship of reaction time and plasma estrogen concentration during the menstrual cycle. Subjects included 18 young women using oral contraceptives and 18 young women experiencing normal menstrual cycles. The women were tested on simple, complex and choice reaction times once a week for two menstrual cycles. Blood sampling for total estrogen level was conducted at each testing period. Results indicated that (1) oral contraceptives produced a lower overall estrogen level during the menstrual cycle and eliminated the preovulatory and midluteal phase peaks of estrogen that occur in the normal cycles; (2) the relationship between simple and complex reaction times and estrogen concentration for both groups of young women was not statistically significant at the 0.01 level; and (3) the choice reaction time performance for young women experiencing a normal menstrual cycle was increased during the premenstrual-menstrual phase of the cycle (when estrogen is at a low level of concentration). Thus, there is a question of what simple and choice reaction times do during pregnancy when estrogen levels are known to increase. If the choice reaction time is longer when estrogen levels are low, then does choice reaction time decrease or increase as pregnancy progresses and estrogen levels continue to increase?

CHAPTER III

METHODS AND PROCEDURES

Based on the review of literature, several concerns regarding pregnancy and the working woman were identified for exploration. These included simple and choice reaction time, grip strength, and static and dynamic arm strength.

Objectives

The objective of the experiment was to determine whether or not the change in reaction time and hand and arm strength in pregnant and postpartal employed women, over the four testing sessions, were significantly different than the change in the nonpregnant employed women.

Two reaction time tests, one simple and one choice reaction time, were performed by the subjects at each testing session. At each testing session, potential changes in strength were evaluated by measurement of hand grip, and static and dynamic arm strength. In addition, certain standard anthropometric measurements (height, weight, functional arm reach and abdominal depth) were taken during each session.

Research Hypotheses

The research hypotheses evaluated in this study were the following:

1. Changes in simple reaction time in employed women in the first, second, third and fourth trimester of pregnancy are different than changes in simple reaction time for employed, nonpregnant women.
2. Changes in choice reaction time in employed women in the first, second, third and fourth trimester of pregnancy are different than changes in choice reaction time in employed, nonpregnant women.
3. Changes in hand grip strength for employed women in the first, second, third and fourth trimester of pregnancy are different than changes in hand grip strength in employed, nonpregnant women.
4. Changes in static arm strength for employed women in the first, second, third and fourth trimester of pregnancy are different than changes in static arm strength in employed, nonpregnant women.
5. Changes in dynamic arm strength for employed women in the first, second, third and fourth trimester of pregnancy are different than changes in dynamic arm strength in employed, nonpregnant women.

Target Population

The target population was pregnant and nonpregnant employed women, 18 to 40 years of age. The population age was chosen to include employed women and to exclude women at risk for complications of pregnancy due to age.

Study Sample

The experimental group consisted of 31 employed volunteers between the ages of 19 and 34 years who were experiencing a normal first, second, third or fourth pregnancy. The volunteers were classified as being within one of the four trimesters of pregnancy at the beginning of their participation in the study. The mean values for the age, height, weight, functional arm reach and abdominal depth of the experimental group are presented in Table 1. Twenty of the volunteers were nursing and 11 were nonnursing personnel. The nonnursing volunteers were employed in such positions as secretary, designer, small parts assembly-line worker, quality control checker, photographer's assistant, nutritionist, and full-time nursing student (who was classified as nonnursing because her actual patient care activities comprised less than 40 hours per week). Appendix A contains additional demographic data, and the Personal Data and Consent Form.

Table 1. Mean Values for Age and Anthropometric Measurements for the Experimental and Control Groups

Item	Experimental Group (N=31)	Control Group (N=31)
Age	26.64 years	30.32 years
Height	163.71 cm	163.12 cm
Weight	160.48 lb	147.55 lb
Arm Reach	69.02 cm	69.10 cm
Abdominal Depth	26.70 cm	21.84 cm

The 31 nonpregnant employed volunteers in the control group were 22-39 years of age. The mean values for age, height, weight, functional arm reach and abdominal depth of the control group are in Table 1. Fourteen volunteers were nursing personnel and 17 were nonnursing. The nonnursing volunteers were employed in positions such as secretary, small parts assembly-line worker or quality control tester.

Variables

The dependent variables were simple reaction time, choice reaction time, hand grip strength, static arm strength, and dynamic arm strength. The dependent variables were quantitative since reaction time and strength values were recorded for each variable. Three values for each strength test and responses to ten repetitions of stimuli for each reaction time test were recorded and then averaged for each volunteer's testing session.

The independent variable was pregnancy. Since the volunteers could not be assigned randomly to a treatment group (one of the four trimesters of pregnancy or to the nonpregnant group), the independent variable was fixed. The two levels of pregnancy were the four pregnancy trimester groups and the nonpregnant group.

Design

The experiment did not fulfill the requirements of established experimental designs because volunteers could

not be assigned randomly to treatment groups, measurements on the dependent variables were different, and the volunteers were not tested in each of the pregnancy levels. Thus, there were several single-factor experiments with repeated measurements for all volunteers in the separate treatment levels. The repeated measurement feature allowed calculation of the amount of change in test values for each volunteer on each dependent variable for successive testing sessions.

The Number of Observations Taken

Each volunteer was evaluated on each dependent variable at each testing session. Testing sessions were scheduled biweekly, plus or minus two days, for two months. Volunteers who had the same days off each week were evaluated on the same day of the week for each session. Volunteers who had different days off each week (primarily nursing personnel) needed to be evaluated on a different day of the week in successive testing sessions in order for them to be tested on a working day.

An average reaction time score was calculated from 10 simple reaction time responses at each testing session. The total number of errors, in addition to an average reaction time, was recorded for the choice reaction time tests.

Each of the strength tests was performed three times per testing session. For each session, the average score

for each type of strength was calculated from the three values obtained at each session.

Anthropometric measurements were taken at each testing session. The measurements were height, weight, functional arm reach and abdominal depth.

The testing sessions were conducted during the Spring, 1985 semester. Volunteers began the study in January, February, March or April and completed the study in March, April or May.

The Order of Experimentation

A table of random numbers was used to assign the volunteers to a daily testing order for the anthropometric measurements and each of the strength and reaction time tests. Because there was no performance measure of the volunteer in the anthropometric measurements, each of the measurements was completed in succession instead of in random order. The volunteers were evaluated during working hours or at the completion of their shifts, depending on the preference of the employers. For consistency, successive testing sessions were scheduled at the same time of the day for each volunteer.

Method of Randomization Used

Randomization was limited to random assignment of volunteers to testing order and to random occurrence of pregnancy (since the experimenter could not control the

occurrence of pregnancy in volunteers in the experimental group). Thus, the volunteers could not be randomly assigned to treatment levels.

The Hypotheses Tested

The following hypotheses were tested for acceptance or rejection for each dependent variable:

Null Hypothesis

The means of the changes in value for the pregnant and nonpregnant groups are equal.

Alternate Hypothesis

The means of the changes in value for the pregnant and nonpregnant groups are not equal.

Data Collection

Reaction Time

Reaction time (the time required to make a response after a stimulus is presented) was determined by using a microcomputer to present the tests and record the responses. For the purposes of this study, movement time (the time to complete a movement once a response had begun) was held as constant as possible and reduced to as small an amount of time as possible so that the reaction time did not also include prolonged or varying amounts of movement time.

For the simple reaction time test, the volunteers depressed the "shift" key until the stimulus appeared on the screen. With the appearance of the stimulus, the volunteer released the "shift" key. The reaction time response was the time from the appearance of the stimulus until the key was released.

The choice reaction time test required volunteers to position a hand on the keyboard of the microcomputer near the space bar. When an appropriate stimulus appeared on the screen, the volunteer depressed the space bar. Response time was the time from appearance of an appropriate stimulus on the screen to the time the space bar was depressed.

Simple reaction time "is the time to make a specific response when only one particular stimulus can occur, usually when an individual is anticipating the stimulus" (McCormick and Sanders, 1982, p. 198). The volunteers were expecting the stimulus which consisted of four pound signs (####) to appear at random time intervals in the same position on the screen of the microcomputer. The pound signs stimulus appeared ten times. The microcomputer recorded the time in seconds for the volunteers' responses to each of the ten stimulus appearances. The time scores were later averaged for one mean score for each volunteer for each testing session (see Appendix B for average scores for volunteers for each session).

Choice reaction time requires that at least two stimuli and at least two possible responses be presented (McCormick and Sanders, 1982). The two types of stimuli presented to the volunteers were the appearance of a string of random numbers in varying locations on the microcomputer screen. The strings of numbers contained either seven, eight, or nine digits. The two possible responses were (1) to depress the space bar on the keyboard if the string of numbers contained eight digits or (2) to not depress the space bar if the string of numbers contained more than or less than eight digits. The response times were averaged for each testing session to obtain a mean score of all the response times per session. Average reaction time scores and the number of errors (incorrect responses recorded by the computer) for each testing session for each volunteer is presented in Appendix B.

In order to verify that the volunteers possessed the visual capability to perform the reaction time tests, each volunteer was asked to read the Snelling Chart from a distance of 20 feet. Volunteers who normally wore corrective lenses were asked to read the chart with their lenses in place. All of the women, except one, were able to read the chart through the line designating 20/20 vision. One volunteer could read no further than the line indicating 20/30 vision. She indicated that she did own corrective lenses but did not like to wear them.

Hand Grip Strength

Hand grip strength was measured using a standard grip dynamometer. Three measurements were recorded for each hand and the average value for each hand was calculated from the three observed values. Average values for each testing session for each volunteer are presented in Appendix C.

Static Arm Strength

Static arm strength was measured using a portable minigym apparatus. A maximum raw score for each of the three trials, measured in pounds, was obtained from the readings of the load cell attached to the rope of the minigym. Average values for each volunteer at each testing session were calculated from the three raw scores. The average scores are included in Appendix D.

Dynamic Arm Strength

Using the minigym apparatus, each volunteer's dynamic arm strength was measured, in pounds, three times per session. An average dynamic arm strength score for each volunteer at each testing session was calculated from maximum values obtained in each of the three trials per testing session. Appendix D includes the volunteers' average dynamic arm strength scores for each session.

Anthropometric Measurements

The four standard anthropometric measurements taken on each volunteer at each testing session were height,

weight, functional arm reach and abdominal depth. Anthropometric measurement values for each volunteer at each testing session are presented in Appendix E.

Analysis

During the Spring 1985 semester, the volunteers were evaluated on each dependent variable biweekly (plus or minus two days) for two months. The first session was the practice session and the remaining four sessions were actual testing sessions. In order to evaluate the change over testing sessions for each individual, differences in values between successive testing sessions were calculated for use in the statistical analysis.

The t Test was performed on the mean of the differences over the four testing sessions for both the experimental and control groups. The purpose of the analysis was to determine whether or not the change occurring in volunteers in the pregnant group was different than the change occurring in volunteers in the nonpregnant group. Because the volunteers in the sample varied according to age, height, weight, and type of occupation (and therefore type of work performed), two subgroups of the sample were identified for analysis using the t Test. One subgroup consisted of all nursing personnel present in the experimental and control groups. The other subgroup consisted of nurses in each group who were matched as closely as

possible for age, height, weight, and type of nursing tasks performed.

Assumptions

The assumptions for utilization of the t -distribution are the following (Runyon and Haber, 1971):

1. The difference between the means of the two samples has a normal distribution.
2. When the population variance is unknown, the estimate of the standard error of the difference between the means is based on the unbiased estimate of the population variance.
3. The two samples are drawn from populations with equal variances (homogeneity of variance).

Normality of distribution of the difference between means can be assumed when the two samples are selected independently and when the two populations can be assumed to be normally distributed (Fischer, 1973). The two groups were selected by solicitation of interested volunteers at several hospital and service institutions, and at two local industrial sites. The two populations were assumed to be normal. In addition, there were 31 volunteers in each sample which would have the effect of minimizing violation of the assumption of a normal population (Myers, 1979). When the two sample groups are equal in number, violation of the assumption of equal variances does not affect the the validity of the t Test (Huck, et al., 1974).

Procedures

Volunteers were allowed to become familiar with the equipment and testing procedures during the initial session. Each volunteer was allowed to practice with the equipment before she was asked to perform the test. In addition, each volunteer was asked to perform each of the reaction time and strength tests for practice during the first testing session. The volunteers were unaware that the initial session was a practice session. They believed a total of five testing sessions was required for the experiment. The data recorded at the initial session were obtained in the same manner as for the successive four testing sessions. However, the data from the initial session were not utilized in the analysis. Instructions given to the volunteers are presented in Appendix F.

Procedure for Simple Reaction Time

The simple reaction time test consisted of four pound signs appearing on the microcomputer screen at random intervals. The volunteer responded to the stimulus by releasing the "shift" key. Then, in response to instructions on the screen, she depressed the "shift" key again and held it down until the pound signs reappeared on the screen. The pound signs appeared at random time intervals in the same location on the screen for a total of ten times over a time period lasting approximately 60 seconds.

Procedure for Choice Reaction Time

The choice reaction time test consisted of the appearance of strings of random numbers containing seven, eight, or nine digits. The strings of numbers appeared in various locations on the screen at random time intervals. The volunteer's response was to depress the space bar when the string of numbers contained eight digits only. The computer recorded the time for each response (time from appearance of the stimulus to depression of the space bar) and identified the correct and incorrect responses. The stimulus was repeated for a total of ten times over an 60-90 second time period (depending on each volunteer's speed of "requesting" successive stimuli) at each testing session.

Grip Strength

The hand grip strength was measured using a hand grip dynamometer, model number 78010, distributed by the Lafayette Instrument Company, Lafayette, Indiana. Each volunteer was seated with her hands and forearms unsupported and the forearm positioned at a right angle to the upper arm (see Figure 1). Bazar (1978) mentioned that grip strength was found to be weaker when the hand was supported by the body or a table. After a demonstration of the hand grip procedure, each volunteer was asked to exert a maximum squeeze on the dynamometer. Alternating the left

Figure 1. Hand Grip Dynamometer and Position for Grip Test

and right hand, each hand was tested three times, following a rest period. The forces exerted were measured in kilograms by the dynamometer and recorded on paper for each session.

Static Arm Strength

The Mini-Gym, Model 101 (see Figure 2) was used for performance of the static arm strength test. The minigym was bolted to a platform upon which the volunteer was asked to stand with her arms held next to her body and flexed 90 degrees at the elbow. Then, the rope was unwound far enough for the handle to be placed in the volunteer's hands

Figure 2. Position for Static Arm Strength with Minigym

(with her palms facing the ceiling). Each volunteer was asked to take a deep breath and to pull up on the bar (as hard as she felt comfortable in doing so) for 3-4 seconds as she exhaled. She was asked to exhale as she performed the test in order to prevent an increase in intraabdominal pressure (which could potentially have an adverse effect on pregnant volunteers). The upward force exerted on the handle by the volunteer was measured in pounds by the load

cell which was attached between the bar and the rope. In order to hold the rope stationary during the exertion, a one-inch wide strap, attached to the rope beneath the load cell, held the rope in a stationary position (see Figure 2). The load cell was calibrated for each testing session. Volunteers performed the task three times with a rest period between trials.

The procedure for the test was demonstrated for each volunteer at each testing session. Volunteers were allowed a practice period during the initial session order to become familiar with the equipment and the procedure.

Dynamic Arm Strength

The volunteers utilized the minigym for performance of the dynamic arm strength test in a similar manner as Pytel and Kamon (1981). The minigym was set at a constant velocity of 41 inches per second (Plott, 1983) for unwinding the rope. Values were measured by the load cell in pounds.

Each volunteer started the test with the handle in both of her hands (palms up) and with her arms fully extended. She was asked to exhale while flexing her arms completely as fast as she felt comfortable in doing (see Figure 3). She was asked to exhale as she performed the test to prevent increasing intraabdominal pressure. The task was performed three times with a rest period between trials. The procedure was demonstrated for the volunteers

Figure 3. Starting and Ending Positions for Dynamic Arm Strength Test with the Minigym.

at each session and they were allowed to practice with the equipment during the initial session.

Anthropometric Measurements

The same scale was used to measure each volunteer's weight at each session. Height, functional arm reach and abdominal depth were measured, using a standard anthropometric kit manufactured by GPM. Each volunteer was assisted in assuming the correct position for each of the anthropometric measurements.

CHAPTER IV

RESULTS

The t Test was performed to evaluate whether or not the changes across four testing sessions in pregnant employed women were different than the changes in non-pregnant employed women for simple and choice reaction time and upper extremity strength. The assumptions for the t distribution were met because (1) the experimental and control groups were selected independently; (2) the sample was large (greater than 30); (3) there were equal numbers of volunteers in the experimental and control groups; and (4) the test for equal variances indicated equal variances for each dependent variable (see Appendix G).

Statistical analysis indicated no significant difference, in the mean change over the four testing sessions, for the experimental and control groups on any of the dependent variables Table 2 presents the t Test results for the pregnant and nonpregnant groups. In general, the means and standard deviations for the subgroups for the dependent variables were slightly different than for the experimental and control groups. However, the t values for the subgroups were not improved enough to indicate a significant difference between the values for the pregnant and non-pregnant volunteers in the subgroups at the .05 level.

Thus, the null hypotheses were supported. Tables for the t Test results on the subgroups of nursing personnel are presented in Appendix G.

Table 2. t Test Table for Comparison of Pregnant and Nonpregnant Group Means of Change Over Testing Sessions for Each Dependent Variable

VARIABLE	PREGNANT		NONPREGNANT		T	DF	PR > T
	N	MEAN	N	MEAN			
NON-DOMINANT HAND	31	0.229	31	0.108	-0.5912	60	0.5566
DOMINANT HAND	31	0.125	31	-0.104	-0.7092	60	0.4810
STATIC ARM	31	0.495	31	-0.301	-1.3822	60	0.1720
DYNAMIC ARM	31	0.237	31	0.029	-0.8199	60	0.4155
SIMPLE RT	31	-0.004	31	-0.010	-0.7265	60	0.4704
CHOICE RT	31	-0.032	31	0.013	1.3601	60	0.1789
CHOICE RT ERROR	31	-0.022	31	-0.086	-0.4402	60	0.6614

In Table 3, the similarities of overall mean values for each of the strength and reaction time tests are presented by group. Even though the observed means for strength values are similar for both groups, the nonpregnant group means are slightly larger than the means for the pregnant group. For simple reaction time, the mean

Table 3. Overall Mean Values of Strength and Reaction Time

Test	Pregnant			Nonpregnant		
	Mean	Standard Deviation	Standard Error	Mean	Standard Deviation	Standard Error
Non-Dominant Hand (kg)	30.78	6.14	1.102	30.92	5.94	1.066
Dominant Hand (kg)	29.30	5.10	0.917	30.12	5.79	1.039
Static Arm (lb)	38.43	9.76	1.752	41.37	6.91	1.242
Dynamic Arm (lb)	20.24	3.32	0.596	21.46	3.30	0.593
Simple Reaction Time (s)	0.31	0.09	0.016	0.30	0.07	0.013
Choice Reaction Time (s)	1.61	0.45	0.081	1.63	0.33	0.059
Choice Errors	1.31	1.17	0.210	1.52	1.54	0.276

for the nonpregnant group is slightly smaller than the mean for the pregnant group, indicating that the observed simple reaction time was slightly longer for the pregnant group. The opposite is indicated for choice reaction time (the pregnant group mean was slightly smaller than the mean for the nonpregnant group, indicating an observed faster reaction time for the pregnant group). The slightly smaller mean for the pregnant group for choice reaction time errors implies that, as a group, the pregnant volunteers made

slightly fewer errors than the nonpregnant group. The large standard deviations for each group for the strength measurements indicate considerable dispersion of strength values among the volunteers in each group. The relatively small standard error of the means for strength and reaction time indicates that because of the relatively large sample, the dispersion of individual means from the sample mean was relatively small. Graphs of mean values, by subject number, for strength and reaction time are included in Appendix H.

Even though comparison values for strength and reaction time are not available for pregnant women, an observational comparison of the study values was made with known values for women. The average value for simple reaction time is 200 milliseconds (or 0.2 seconds), and for choice reaction time (with two or more stimuli and two possible responses) is 0.35 seconds (McCormick and Sanders, 1982). Hunter, et al. (1979) reported average simple reaction time for the women on birth control pills as being 215.6 or 216.5 milliseconds (.2156 and .2165 seconds), depending on the phase of the menstrual cycle. For the women experiencing normal menstrual cycles, the simple reaction times were 229.6 or 229.5 milliseconds. Standard deviations for the birth control pill group were 37.39 and 33.17 milliseconds (0.03739 and 0.03317 seconds), and 72.73 or 69.18 milliseconds (0.07273 and 0.06918 seconds) for

the normal menstrual cycle group. The current simple reaction time mean values of 0.308 and 0.297 seconds, respectively, for the experimental and control groups are similar to the Hunter, et al. study means, especially when the standard deviations for the current study are compared with the normal menstrual cycle group (who have higher peaks of estrogen levels, though not as high as pregnant women). For the control group in the current study, the standard deviation for simple reaction time was 0.07 seconds, and 0.09 for the experimental group. Differences in comparison of the study simple reaction time values with the average value (McCormick and Sanders, 1982) or with the menstrual cycle study (Hunter, et al., 1979) values could be due to the different type of stimulus (visual using a computer screen versus auditory), or to the type of equipment (computer key board versus a five button pad).

Comparison of the current study strength values was accomplished using published data for nonpregnant women. Grip strength in nonpregnant women 31 years of age or younger (Kamon and Goldfuss, 1978) was reported as 27.6 kilograms with a standard deviation of 6.4 kilograms. The current study results indicated a mean grip value of 30.12 kilograms and standard deviation of 5.79 kilograms for the dominant hand in the nonpregnant group; and a mean and standard deviation of 29.30 kilograms and 5.10 kilograms, respectively, in the pregnant group. Thus, from an obser-

vational viewpoint, the study sample results indicate a slightly larger mean grip value for the dominant hand than the mean indicated by the published value and a slightly lower standard deviation value than the published standard deviation value.

For static arm strength comparison, values for women with a mean age of 20 years were used (Kroemer, 1983). The mean value and standard deviation for static arm strength was reported as 15.46 kilograms and 5.09 kilograms (34.012 pounds and 11.198 pounds), respectively. Static arm strength means and standard deviations for the study sample were 41.37 pounds and 6.91 pounds for the nonpregnant group, and 38.43 pounds and 9.76 pounds for the pregnant group.

The dynamic arm strength for the study sample was compared with maximal acceptable lifts of weight from knuckle to shoulder height (Ayoub, et al., 1982). The mean value reported for women was 31.97 pounds with a standard deviation of 6.55 pounds. The means for the study pregnant and nonpregnant groups were 20.24 pounds and 21.46 pounds, respectively, with standard deviations of 3.32 and 3.30 pounds. Thus, the study groups exhibited smaller strength values for dynamic arm strength than the reported values for actual lifting activities. However, the standard deviation for the study groups were approximately half the value for the reported standard deviation.

In summary, both the pregnant and nonpregnant volunteers in the study indicated slightly greater grip and static arm strength means with smaller standard deviations than the published values for nonpregnant young women. Both of the study groups indicated a 10 to 11 pound lighter mean value for dynamic strength than the published values for maximal acceptable lifts from knuckle to shoulder using actual weights rather than simulated lifting (minigym). Thus, even though the study volunteers were instructed to exert only as much effort on the static and dynamic arm tests as was comfortable to them and were asked to exert the force while exhaling to prevent an increase in intra-abdominal pressure, the study sample can be assumed to have exerted an approximately maximal effort for each strength test.

CHAPTER V

DISCUSSION

Interpretation

Strength

In order to avoid potential injury to the expectant volunteers in the study, strength measurement was limited to muscles and procedures that did not involve the abdomen and back. Thus, strength measurements were confined to the hand and arm muscles. No statistically significant difference in the grip or static and dynamic arm strength of pregnant and nonpregnant volunteers was detected.

Intuitively, significant differences in hand and arm strength in pregnant, as compared to nonpregnant, employed women would not be expected. Wilmore's (1974) belief that strength is based on the manner in which people use their muscles would seem to support a lack of difference. If Wilmore's belief is correct, and if the assumption is correct that pregnant employed women do not use their hands and arms differently when they are pregnant, then there should be no significant difference between pregnant and nonpregnant employed women who use their upper extremity muscles for similar tasks.

From a practical viewpoint, the volunteers in each group were examined to determine whether or not the percent

of women indicating changes (overall increase and decrease) over the four testing sessions were similar. Table 4 presents the number and percentage of women indicating change for the strength measurements. Of the 31 volunteers in each group, at least half indicated an increase in all of the strength tests.

Table 4. Percentage of Women with Change in Strength by Group

Strength	Pregnant			Not Pregnant		
	Increase	Decrease	No Change	Increase	Decrease	No Change
Non-Dominant Hand (n)	51.61 (16)	38.71 (12)	9.68 (3)	58.06 (18)	35.48 (11)	6.45 (2)
Dominant Hand (n)	51.61 (16)	45.16 (14)	3.23 (1)	51.61 (16)	38.71 (12)	9.68 (3)
Static Arm (n)	58.06 (18)	41.94 (13)	0.00 (0)	54.84 (17)	45.16 (14)	0.00 (0)
Dynamic Arm (n)	51.61 (16)	35.48 (11)	12.91 (4)	51.61 (16)	45.16 (14)	3.23 (1)
N	31			31		

The group strength mean, and average increase and decrease for each group across the four testing sessions, is shown in Table 5. The observed average increase and decrease for each group is similar. However, observed

decrease for the pregnant group is smaller than the decrease for the nonpregnant group for each of the strength measures. In addition, the observed average increase in all strength measures, except for non-dominant hand grip, is slightly greater in the pregnant group than in the nonpregnant group. However, the fluctuation observed in the average increases and decreases for the pregnant group seems to be smaller than for the pregnant group. Thus, the pregnant group seems to be showing slightly more consistency than the nonpregnant group.

Table 5. Group Strength Mean and Average Change (Increase and Decrease) in Strength Measurements for the Experimental and Control Groups for the Four Testing Sessions

Strength Measure	Pregnant			Nonpregnant		
	Mean	Average Increase	Average Decrease	Mean	Average Increase	Average Decrease
Non-Dominant Hand (kg)	30.78	2.17	1.49	30.92	2.26	2.78
Dominant Hand (kg)	30.30	3.39	3.00	30.12	2.36	4.25
Static Arm (lb)	38.43	5.74	4.74	41.37	4.00	6.79
Dynamic Arm (lb)	20.24	2.81	2.05	21.46	2.56	2.82

Reaction Time

The two reaction time tests performed during the four testing sessions were simple and choice reaction time. The numbers of errors were recorded for the choice reaction time test. Table 6 indicates the percentage of volunteers in the experimental and control groups who increased, decreased or remained unchanged for the two reaction-time tests and number of errors made on the choice reaction-time test during the four testing sessions.

The majority of the volunteers in both the experimental and control groups indicated a decrease in simple reaction time. Slightly more than half of the volunteers in the experimental group showed a decrease in choice reaction time, while the same percentage of the volunteers in the control group showed an increase in choice reaction time. Most control group volunteers showed either a decrease in choice reaction time errors or remained the same. Equal percentages of volunteers in the experimental group revealed a decrease or no change in reaction time errors. However, almost half of them indicated an increase in errors.

Table 7 shows the group reaction time mean and average change (increase and decrease) for each group for the reaction times. The average increase and decrease in reaction time was small for both groups. The experimental group indicated a slightly larger average increase in both

Table 6. Percentage of Women with Change for Reaction Time by Group

Reaction Time	Pregnant			Nonpregnant		
	Increase	Decrease	No Change	Increase	Decrease	No Change
Simple (n)	38.71 (12)	58.06 (18)	3.23 (1)	35.48 (11)	64.52 (20)	0.00 (0)
Choice (n)	45.16 (14)	54.84 (17)	0.00 (0)	54.84 (17)	45.16 (14)	0.00 (0)
Errors (n)	41.94 (13)	29.03 (9)	29.03 (9)	22.58 (7)	38.71 (12)	38.71 (12)

simple and choice reaction time than the control group. The observed average decrease in simple reaction time was slightly less for the pregnant group than for the nonpregnant group. However, the average decrease in choice

Table 7. Group Reaction Time Mean and Average Change (Increases and Decreases) in Reaction Time for Women in the Experimental and Control Groups for the Four Testing Sessions

Reaction Time	Pregnant			Nonpregnant		
	Mean	Increase	Decrease	Mean	Increase	Decrease
Simple (sec)	0.31	0.0576	0.0561	0.30	0.0331	0.0624
Choice (sec)	1.61	0.2954	0.3856	1.63	0.2588	0.2265
Errors (No.)	1.31	1.538	2.000	1.52	1.714	1.667

reaction time was slightly less for the nonpregnant group than for the pregnant group. The pregnant group indicated a slightly smaller average value for increase in errors and a slightly larger observed average value for decrease in errors than the nonpregnant group.

Thus, for reaction time, both groups showed similar percentages of volunteers increasing and decreasing simple and choice reaction time, with a greater increase in percent of pregnant volunteers indicating an increase in choice reaction time errors. The similarity between the groups would be expected since body movement time was not included in the reaction-time test. For the average increase in reaction time, the pregnant group indicated a slightly larger average than the nonpregnant group. In addition, the average increase in errors was slightly smaller for the pregnant group, even though almost two times more pregnant than nonpregnant volunteers indicated an increase in commission of errors.

Potential Pattern of Fluctuation by Trimester

In an attempt to determine if a pattern for strength fluctuation by trimester could be observed in the data, mean strength values were computed for all volunteers in each trimester. The overall mean and standard deviation values for each of the strength dependent variables are presented in Table 8 according to trimester. Except for the non-dominant hand grip and dynamic arm strength values

Table 8. Mean and Standard Deviation Strength Values by Trimester

Strength	Trimester							
	1		2		3		4	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Non-Dominant Hand (kg)	31.27	7.72	30.69	6.08	29.75	6.23	32.22	5.99
Dominant Hand (kg)	28.00	3.90	30.43	6.22	28.40	5.50	29.00	4.10
Static Arm (lb)	39.73	11.12	40.02	8.88	36.58	10.38	37.64	12.2
Dynamic Arm (lb)	21.13	3.14	20.09	3.40	20.22	3.30	20.82	4.90

in the first trimester, observed mean strength values in the first and third trimesters are slightly lower than values in the second and fourth trimesters. However, the observed increases and decreases in the mean values are small and the relatively large standard deviation values indicate considerable (and expected) subject variability for such small potential change for the trimesters. The overall reaction time mean values and standard deviations for each of the trimesters were observed to be exceptionally similar. The values are presented in Table 9. The lowest simple reaction time mean value occurred in the third and fourth trimesters and the highest one in the second trimester. The maximum observed choice reaction time value of 1.68 seconds occurred in the second

Table 9. Mean and Standard Deviation Reaction Time Values by Trimester

Reaction Time (RT)	Trimester							
	1		2		3		4	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Simple RT (seconds)	0.31	0.05	0.33	0.15	0.29	0.06	0.29	0.03
Choice RT (seconds)	1.47	0.43	1.68	0.51	1.52	0.54	1.68	0.47
Choice RT Errors (No.)	1.30	1.83	0.94	1.13	1.70	1.85	1.48	1.25

trimester, and the minimum observed value of 1.52 seconds occurred in the third trimester. Even though the second trimester had the highest observed choice reaction time mean, it also had the lowest observed error mean. Furthermore, the lowest observed choice reaction time mean and the highest reaction time error mean occurred in the third trimester.

Fatigue

During the testing sessions, some of the volunteers commented that they did not feel very strong on the day of some testing sessions because they were tired, or they indicated that they were having difficulty with the reaction time tests because they were tired. The number of sessions at which the volunteers reported being tired was recorded for each volunteer. For the four testing ses-

sions, 64.52% (20 out of 31) of the volunteers in the experimental group reported being tired for at least one testing session, while 22.53% (7 out of 31) of the control group reported being tired during at least one testing session. Intuitively, it is expected that pregnant women would experience more fatigue than nonpregnant women. Thus, fatigue might be implicated in the slightly larger overall average increase in simple and choice reaction time for the experimental group. Table 10 indicates a pattern of progressive increase in fatigue by trimester through the third trimester, with a slight decline in percentage of volunteers reporting fatigue to 50% in the fourth trimester.

Table 10. Percent of Volunteers Reporting Fatigue at Least One Time by Trimester

	Trimester			
	1	2	3	4
Percent	40.00	43.75	53.85	50.00
(n)	(2)	(7)	(7)	(4)
N	5	16	13	8

CHAPTER VI

SUMMARY AND CONCLUSION

Summary

[No statistically significant difference in reaction time and strength between the two groups was detected.] However, there were some small changes over the four testing sessions for most of the volunteers. The majority of volunteers in both groups indicated a small increase in strength measures over the four testing sessions with the pregnant group having a slightly greater average increase and the nonpregnant group having a slightly larger mean for group strength. [The majority of volunteers in the experimental group indicated a decrease in both simple and choice reaction time.] In the control group, the majority indicated a decrease in simple reaction time and an increase in choice reaction time. No majority of volunteers for either group indicated an increase, decrease or no change in choice reaction time errors. However, a larger percentage of volunteers in the experimental rather than the control group showed an increase in number of errors.

As far as the potential pattern of fluctuation in strength and reaction time by trimesters is concerned, volunteers in the first and third trimesters showed slightly lower mean values, in general, with potential restoration of strength in the second and fourth trimesters. The

fluctuations in strength were of small magnitude. { Simple reaction time was exceptionally similar for all four trimesters } with the lowest value being 0.29 seconds and the highest value being 0.33 seconds. [For choice reaction time, the pattern of fluctuation indicated very similar mean values for the first, second and fourth trimesters with the third trimester showing the lowest overall mean value. Choice reaction time errors were somewhat similar for all four trimesters with the second trimester indicating the lowest mean and the third, the highest mean.

The pattern for fatigue by trimester was a gradual, progressive (expected) increase across trimesters with slightly more than half of the volunteers reporting fatigue at least once during the third trimester. As expected for new mothers, 50% of the volunteers in the fourth trimester reported fatigue during at least one of the testing sessions.

Limitations

There were several limitations to the study. An obvious limitation was the use of volunteers from more than one type of occupation (nursing and nonnursing personnel). An additional limitation related to occupation was the time and length of shift worked by the volunteers. Some of the nursing personnel worked 10-hour shifts or, occasionally, double eight-hour shifts. Several of the nonnursing personnel worked 12-hour shifts. A third limitation was the

testing of some of the volunteers during their shifts and others at the end of the shift. The problem of testing during versus after completion of the shift was unavoidable for the study because of preference by employers.

Since the sample consisted of volunteers who were pregnant or not pregnant by the time the study began, additional limitations were the lack of strict random sampling and random assignment to treatment groups. The use of volunteers for human subject experiments is an unavoidable limitation. In addition, the study of pregnant volunteers imposes its own limitations. Conception must have been completed in order to study pregnant women. Thus, control of assignment of subjects to a pregnancy treatment level is beyond the strict control of the experimenter.

The type of design was another limitation. In order for repeated measurements to be utilized optimally for reducing subject variation, all volunteers should have been present in all treatment levels.

Implications

The results in this study suggest that arm and hand strength may not be adversely affected by pregnancy. In addition, the data were viewed observationally in terms of the mean values, percentage of volunteers with overall increases and decreases for the four testing sessions, and the average amount of increase and decrease by group.

Based on the observations of the data, the volunteers in the sample seem very similar in terms of strength and reaction time. The small fluctuations, in both groups, for the testing sessions could probably be explained as due to normal daily fluctuations. Thus, the expectant mother may be able to continue the same tasks involving the hands and arms that she performed before pregnancy as long as precautions are taken to (1) avoid fatigue due to the added workload of the pregnancy; (2) avoid back strain due to the extra load of pregnancy on the spine and the effect of joint and ligament relaxation (O'Connell, 1979); and (3) avoid rapid or frequent movement of the bulky pregnant body, which could lead to falls due to the shift in center of gravity (O'Connell, 1979).

In addition, [the results suggest that reaction time (excluding body movement time) may not be greatly different during pregnancy than in nonpregnancy.] [The mean reaction time values, percentage of volunteers showing increases and decreases in reaction time and the average change (increase and decrease) for each group were only slightly different.] Logic would seem to indicate, however, that when movement of the pregnant body is included in reaction time, the combined reaction time and movement time would probably increase then because of movement of the added mass due to pregnancy.

The greater percent of women in the experimental group who reported fatigue would seem to indicate that pregnant women may need additional rest during pregnancy, either at home and/or scheduled during the work shift.

Conclusion

A statistically significant difference in reaction time and upper extremity strength between pregnant and nonpregnant employed women was not detected. However, additional study with more control over occupation type, shift length/time of day and an established experimental design may allow stronger detection of indications regarding potential similarities or differences between pregnant and nonpregnant, employed women.

Recommendations

As is true of exploratory and first time research studies, the greatest contribution of this dissertation study may be the identification of new ideas for further study. Recommendations for future study of reaction time and strength in pregnant and nonpregnant employed women are the following:

1. Use of pregnant and nonpregnant women in one type of occupation to reduce potential variation effect due to the different tasks performed in the various occupations.

2. Selection of women who work the same length of shift at the same time of day/night to reduce potential variation due to extended work days and circadian rhythms.
3. Measurement of movement time in addition to reaction time in order to determine the effect of potentially prolonged body movement time on pregnant workers.
4. Testing pregnant women throughout all four trimesters of pregnancy in order to determine patterns of changes in the entire sample throughout pregnancy and the postpartum period, as well as the changes for successive trimesters.
5. Increasing the time interval between testing sessions from two weeks to four weeks. One reason for increasing the testing session interval is to allow potential changes to become more evident. The second reason is that the volunteers in both groups seemed to become disinterested in the testing sessions by the fourth and/or fifth session. In addition, the volunteers voiced displeasure at having to perform the reaction time tests again. Strength testing procedures did not seem to be bothersome to them, but the reaction time did.

6. Measuring fatigue levels for correlation with changes in strength, reaction time and number of errors.
7. Performing the testing procedures in a controlled laboratory setting to reduce variability included in field studies. A high coefficient of variability is expected in field studies (Kamon and Goldfuss, 1978).
8. Evaluation of focus of attention or locus of control for correlation with reaction time and number of errors committed.
9. Consideration of a joint study involving engineering, nursing and human development researchers for evaluation of physical, as well as, psychosocial and emotional development toward parenthood during pregnancy and its effect on decision-making capabilities, motivation and work tasks/responsibilities.

REFERENCE LIST

- American Medical Association Council on Scientific Affairs (1984). The Effects of Pregnancy on Work Performance. Journal of the American Medical Association, 251, 1995-1997.
- Ayoub, M. M., Gitcumb, C. F., Reeder, M.J., Beshir, M. Y., Hafez, H. A., Aghazadeh, F., and Bethea, N. J. (1982). Development of a Female Atlas of Strength. Lubbock: Texas Tech University Institute for Ergonomics.
- Bazar, A. R. (1978). Grip Strength of Cerebral Palsied, Human Factors, 20, 741-744.
- Bell, P. A., Loomis, R. J., Cervone, J. C. (1982). Effects of Heat, Social Facilitation, Sex Differences, and Task Difficulty on Reaction Time. Human Factors, 24, 19-24.
- Chaffin, D. B. (1975). Ergonomics Guide for the Assessment of Human Static Strength. American Industrial Hygiene Association Journal, 36, 505-511.
- Chamberlin, G. (1984). Effects of Work on Pregnant Women. ACOG Newsletter, 28,(7), 9.
- Dott, A. B., and McKelvey, R. K. (1977). Influence of Ethyl Alcohol in Moderate Levels on the Ability to Steer a Fixed-Base Shadowgraph Driving Simulator. Human Factors, 19, 295-300.
- Ellis, H. D. (1982). The Effects of Cold on the Performance of Serial Choice Reaction Time and Various Discrete Tasks. Human Factors, 24, 589-598.
- Ellis, J. G., and DeWar, R. E. (1979). Rapid Comprehension of Verbal and Symbolic Traffic Sign Messages. Human Factors, 21, 161-168.
- Fischer, F. (1973). Fundamental Statistical Concepts. New York: Canfield Press.
- Gee, J. B. L., Packer, B. S., Millen, J. E., and Robin, E. D. (1967). Pulmonary Mechanics During Pregnancy. Journal of Clinical Investigation, 46, 945-952.

- Gries, M. (1981). Overcoming Male Myths and Taboos. Occupational Health and Safety, 50, 58-64.
- Guzman, C. A., and Caplan, R. (1970). Cardiorespiratory Response to Exercise During Pregnancy. American Journal of Obstetrics and Gynecology, 108, 600-605.
- Hicks, T. G., Wierwille W. W. (1979). Comparison of Five Mental Workload Assessment Procedures in a Moving-Base Driving Simulator. Human Factors, 21, 129-143.
- Hogan, J. C. (1980). The State of the Art of Strength Testing. In: Women, Work, and Health: Challenges to Corporate Policy, D. C. Walsh and R. H. Egdahl (eds.). New York: Springer-Verlag, 75-98.
- Huck, S. W., Cormier, W. H., and Bounds, W. G. (1974). Reading Statistics and Research. New York: Harper and Row, Publishers.
- Hunt, V. R. (1979). Work and the Health of Women. Boca Raton: CRC Press, Incorporated.
- Hunter, S., Schraer, R., Landers, D. M., Buskirk, E. R., and Harris, D. V. (1979). The Effects of Total Oestrogen Concentration and Menstrual-Cycle Phase on Reaction Time Performance. Ergonomics, 22, 263-268.
- Kamon, E., and Goldfuss, A. J. (1978). In-plant Evaluation of the Muscle Strength of Workers. American Industrial Hygiene Association Journal, 39, 801-807.
- Knuttgen, H. G., and Emerson, K. (1974). Physiological Response to Pregnancy at Rest and During Exercise. Journal of Applied Physiology, 36, 549-553.
- Kroemer, K. H. E. (1983). An Isoinertial Technique to Assess Individual Lifting Capability. Human Factors, 25, 493-506.
- Laubach, L. L. (1976). Comparative Muscular Strength of Men and Women: A Review of the Literature. Aviation, Space, and Environmental Medicine, 47, 534-542.
- Lips, H. M. (1982). Somatic and Emotional Aspects of the Normal Pregnancy Experience: The First 5 Months. American Journal of Obstetrics and Gynecology, 142, 524-529.
- Mackay, C. J., and Bishop, C. M. (1984). Occupational Health of Women at Work: Some Human-Factors Considerations. Ergonomics, 27, 489-498.

- McCormick, E. J., and Sanders, M. S. (1982). Human Factors in Engineering and Design (5th ed). New York: McGraw-Hill.
- Myers, J. L. (1979). Fundamentals of Experimental Design (3rd ed.). Boston: Allyn and Bacon, Incorporated.
- O'Connell, R. L. (1979). Female and Fetal Responses to Toxic Exposures. National Safety News, 119, 77-80.
- Patterson, P. E., and Gabbard, C. (1982). Hydraulic Transducer for Assessing Grip Strength. Human Factors, 24, 245-247.
- Pernoll, M. L., Metcalfe, J., Schlenker, T. L., Welch, J. E., and Matsumoto, J. A. (1975 a). Oxygen Consumption At Rest and During Exercise in Pregnancy. Respiration Physiology, 25, 285-293.
- Pernoll, M. L., Metcalfe, J., Kovach, P. A., Wachtel, R., and Dunham, M. J. (1975 b). Ventilation During Rest and Exercise in Pregnancy and Postpartum. Respiration Physiology, 25, 295-310.
- Plott, C. C. (1983). Alternative Strength Testing Methods for Employee Screening. A Master's Thesis in Industrial Engineering. Lubbock: Texas Tech University.
- Pytel, J. L., and Kamon, E. (1981). Dynamic Strength Testing as a Predictor for Maximal and Acceptable Lifting. Ergonomics, 24, 663-672.
- Runyon, R., and Haber, A. (1971). Fundamentals of Behavioral Statistics (2nd ed.). Reading: Addison-Wesley Publishing Company.
- Seitchik, J. (1967). Body Composition and Energy Expenditure During Rest and Work During Pregnancy. American Journal of Obstetrics and Gynecology, 97, 701-713.
- Wilmore, J. H. (1974). Alterations in Strength, Body Composition and Anthropometric Measurements Consequent to a 10-week Training Program. Medicine and Science in Sports, 6, 133-138.
- Zaharieva, E. (1972). Olympic Participation by Women. Journal of the American Medical Association, 221, 992-995.

APPENDICES

- A. STUDY SAMPLE DEMOGRAPHIC DATA AND PERSONAL DATA AND CONSENT FORM
- B. REACTION TIME DATA FOR EACH SUBJECT FOR ALL FIVE SESSIONS
- C. HAND GRIP STRENGTH DATA FOR EACH SUBJECT FOR ALL FIVE SESSIONS
- D. STATIC AND DYNAMIC ARM STRENGTH DATA FOR EACH SUBJECT FOR ALL FIVE SESSIONS
- E. ANTHROPOMETRIC DATA FOR EACH SUBJECT FOR ALL FIVE SESSIONS
- F. TESTING INSTRUCTIONS TO VOLUNTEERS
- G. t TEST FOR NURSING PERSONNEL SUBGROUPS AND TEST FOR EQUAL VARIANCES TABLES
- H. GRAPHS OF MEAN VALUES OF STRENGTH AND REACTION TIME DATA BY GROUP FOR THE FOUR TESTING SESSIONS

APPENDIX A: STUDY SAMPLE DEMOGRAPHIC DATA AND PERSONAL DATA AND CONSENT FORM

Table A-1. Demographic Data for the Control Group

Subject No.	Ethnic Group	Occupation	Job Title
40	Black	Nonnursing	Calculator Tester
41	White	Nonnursing	Assembler
42	White	Nursing	Registered Nurse
43	White	Nursing	Registered Nurse
45	White	Nonnursing	Repair Tech
46	White	Nursing	Registered Nurse
47	Spanish	Nonnursing	Tester
48	White	Nursing	Licensed Vocational Nurse
49	Black	Nonnursing	Supervisor
50	White	Nursing	Registered Nurse
51	White	Nursing	Registered Nurse
52	White	Nursing	Quality Control
53	White	Nursing	Registered Nurse
54	White	Nursing	Registered Nurse
55	Black	Nonnursing	Dispatcher (ordering)
56	White	Nursing	Registered Nurse
57	Black	Nonnursing	Computer Operator
58	White	Nursing	Registered Nurse
59	White	Nursing	Registered Nurse
60	Spanish	Nonnursing	Secretary
61	Spanish	Nonnursing	Quality Control
62	Spanish	Nonnursing	Quality Control
63	White	Nonnursing	Secretary
64	Spanish	Nonnursing	Calculator Tester
65	White	Nonnursing	Accounting Clerk
66	White	Nursing	Registered Nurse
67	White	Nonnursing	Calculator Tester
68	Black	Nonnursing	Calculator Tester
69	Spanish	Nonnursing	Calculator Tester
70	Spanish	Nursing	Licensed Vocational Nurse
71	White	Nursing	Registered Nurse

Table A-2. Demographic and Trimester Data for the Experimental Group

Subject Number	Trimester No. per Testing Session					Ethnic Group	Occupation	Job Title
	1	2	3	4	5			
1	4	4	4	4	4	Black	Nonnursing	Q.C.
2	2	2	2	2	2	Black	Nonnursing	Assembler
3	2	2	2	3	3	White	Nursing	Staff R.N.
4	4	4	4	4	4	White	Nursing	Staff L.V.N.
5	2	2	2	3	3	White	Nonnursing	R.D.
6	3	3	3	3	3	White	Nonnursing	Mgmt & Design
7	3	3	4	4	4	White	Nursing	Staff R.N.
8	2	2	2	2	2	Black	Nonnursing	Secretary
9	2	2	2	2	2	White	Nursing	Staff R.N.
10	3	3	3	3	3	White	Nursing	Staff R.N.
11	1	1	2	2	2	White	Nursing	Staff R.N.
12	3	4	4	4	4	Spanish	Nursing	Staff L.V.N.
13	2	2	2	3	3	White	Nonnursing	Repair Tech
14	3	3	3	3	3	White	Nonnursing	Secretary
15	1	1	2	2	2	White	Nonnursing	Student
16	3	3	3	3	3	White	Nursing	Staff L.V.N.
17	3	3	3	3	3	White	Nursing	Staff R.N.
18	3	4	4	4	4	White	Nursing	Staff R.N.
19	2	2	2	2	2	White	Nursing	Staff R.N.
20	3	3	3	3	3	White	Nonnursing	P.Assist.
21	2	2	2	2	2	Black	Nonnursing	Q.C.
22	1	2	2	2	2	White	Nursing	Staff R.N.
23	3	4	4	4	4	Spanish	Nursing	O.R.T.
24	4	4	4	4	4	White	Nursing	N.T.
25	2	2	2	2	2	White	Nursing	L.V.N.
26	2	2	2	2	3	White	Nursing	Staff R.N.
27	1	1	1	4	4	White	Nursing	R.N. Super.
28	3	3	3	3	3	White	Nursing	R.N. Super.
29	1	1	1	1	2	Spanish	Nonnursing	Tester
30	1	1	2	2	2	White	Nursing	Staff R.N.
31	2	2	2	3	3	White	Nursing	Staff L.V.N.

Key for Nursing:

R.N. = registered nurse
 L.V.N. = licensed vocational nurse
 N.T. = nursing technician
 O.R.T. = operating room technician
 Super. = Supervisor

Key for Nonnursing:

R.D. = registered dietitian
 Student = full-time nursing (patient care <40 hrs)
 Q.C. = quality control (monitor)
 P. Assist. = photographer's assistant
 Assembler = PC board assembly
 Tester = test calculators

PERSONAL DATA AND CONSENT FORM

NAME _____ DATE _____

Name and phone number of individual to be contacted in case of emergency _____.

Name and phone number of physician and physician's hospital _____.

NUMBER OF PREGNANCIES _____ NUMBER OF MISCARRIAGES _____.

NUMBER OF CHILDREN YOU HAVE GIVEN BIRTH TO _____.

ARE YOU PREGNANT? _____ YES _____ NO. IF YOU ARE PREGNANT, WHAT IS YOUR DUE DATE? _____.

IF YOU ARE NOT PREGNANT, DO YOU USE BIRTH CONTROL PILLS FOR CONTRACEPTION? _____ YES _____ NO.

WHAT IS YOUR ETHNIC BACKGROUND? _____ Asian _____ Black
_____ European _____ Hispanic
_____ Oriental _____ White

What type of work (outside the home) do you perform? _____.

What are the main activities involved in your job? _____.

How much time do you spend standing? _____.
sitting? _____.

Which activities do you consider the most physically demanding? _____.

How much time to you spend performing those activities?
_____.

What type of work do you perform at home? _____

_____.

What are the main activities you perform at home? _____

_____.

How much time do you spend standing? _____,

sitting? _____.

Which activities do you consider the most physically
demanding? _____.

How much time do you spend performing those activities?

_____.

What types of activities do you participate in for
recreation? _____.

For how long do you perform those activities on the aver-
age? _____.

How often each week/day do you perform the recreational
activities? _____.

About how much time each day do you rest? Sitting _____,

Lying down _____.

Have you had or do you now have any problem with your blood
pressure? If so, explain _____

_____.

Have you had your normal amount of sleep in the past 24
hours? _____

Have you had your normal amount of food in the past 24
hours? _____.

Have you had a hernia? If yes, please explain _____

_____.

Have you had any vaginal bleeding during this pregnancy?

If yes, please explain _____

_____.

What kinds of prescribed or nonprescribed medicine have you had in the last 24 hours?

_____ Antibiotic	_____ Aspirin	_____ Alcohol
_____ Cold medicine	_____ Tylenol	_____ Hay Fever
_____ Vitamins	_____ Iron	_____ medicine
_____ Other:		

_____.

PLEASE READ CAREFULLY

I have truthfully answered the questions to the best of my knowledge, pertaining to my personal data. I hereby give my consent for my participation in the project. I understand that the person responsible for this project is Dr. J. L. Smith (806)742-3543. He or his authorized representative (806)742-3543 has explained that these studies are part of a project that has the objective of assessing differences in reaction time, and grip and arm strength in employed pregnant and nonpregnant women.

Dr. J. L. Smith or his representative has agreed to answer any inquiries I may have concerning the procedures and has informed me that I may contact the Texas Tech University Review Board for Protection of Human Subjects by writing them in care of Research Services, Texas Tech University, Lubbock, Texas 79409, or calling (806)742-3884.

He or his authorized representative has (1) explained the procedure to be followed and identified those which are experimental and (2) described the attendant discomforts and risks: (1) Briefly these procedures are (a) a test of simple and choice reaction time by correctly releasing or depressing one key on a microcomputer keyboard; (b) performing three handgrip strength tests on each hand, with a rest period in between each of the three tries; (c) attempting to pull upward on a bar handle attached to an anchored rope for three different tries with a rest period between tries; (d) moving the arms from a completely extended position to a completely flexed position while holding a bar handle attached to a rope that is capable of being unwound from around a cylinder with a three-try repetition of the arm flexion procedure; and (e) the measurement of height, weight, arm reach, and abdominal depth.

(2) The risks have been explained to me as follows:

Possible arm muscle soreness.

If this research project causes any physical injury to you, treatment is not necessarily available at Texas Tech University or at the Student Health Center, or any program of insurance applicable to the institution and its personnel. Financial compensation must be provided through your own insurance program. Further information about these matters may be obtained from Dr. John Darling, Vice

President for Academic Affairs and Research, Administration Building, Texas Tech University, Lubbock, Texas 79409.

I understand that I will not derive any therapeutic treatment from participation in this study. I understand that I may discontinue my participation in the study at any time I choose without prejudice.

I understand that all data will be kept confidential and that my name will not be used in any reports, written or unwritten.

SIGNATURE OF SUBJECT _____ DATE _____

SIGNATURE OF PROJECT DIRECTOR or his authorized representative _____

Signature of Witness to Oral Presentation _____

APPENDIX B: REACTION TIME DATA FOR EACH SUBJECT FOR ALL FIVE SESSIONS

Table B-1. Reaction Time Data by Group for the Initial Testing Session

Pregnant				Nonpregnant			
Subject	Simple (sec)	Choice (sec)	Error (No.)	Subject	Simple (sec)	Choice (sec)	Error (No.)
1	0.4666	1.6215	0	40	0.4155	1.8480	2
2	0.9033	2.3560	0	41	0.3178	1.3755	1
3	0.2550	1.4480	0	42	0.3138	1.8520	0
4	0.4012	1.8360	1	43	0.1986	1.2060	0
5	0.9930	1.9540	0	45	0.3680	1.8620	0
6	0.3953	2.3040	0	46	0.2842	2.3715	6
7	0.3006	2.1270	1	47	0.2977	1.4628	4
8	0.4290	2.6205	3	48	0.4326	2.1580	3
9	0.1818	1.0980	5	49	0.2787	2.8800	1
10	0.2680	2.1690	1	50	0.2670	1.5810	3
11	0.3714	2.0550	1	51	0.1686	1.9280	2
12	0.2806	1.6950	1	52	0.2520	2.3130	1
13	0.2340	1.5740	0	53	0.2820	2.5500	0
14	0.3645	0.8865	5	54	0.2666	2.0655	1
15	0.2232	1.5555	1	55	0.3678	2.2580	4
16	0.2503	2.0895	2	56	0.2376	1.8516	6
17	0.3247	2.4648	4	57	0.2604	1.5675	7
18	0.3193	1.3340	0	58	0.2203	1.1760	1
19	0.2790	0.9330	1	59	0.2546	1.9140	0
20	0.2977	1.7700	0	60	0.2811	2.0220	3
21	0.5680	2.3130	1	61	0.3606	1.6700	0
22	0.2406	2.4880	0	62	0.2613	2.5555	8
23	0.2112	1.5060	1	63	0.2593	1.4010	1
24	0.2652	1.8150	1	64	0.3306	2.0640	2
25	0.6546	1.9160	0	65	0.2622	1.8937	2
26	0.2268	1.5460	0	66	0.2028	2.0040	0
27	0.2613	2.0220	0	67	0.9877	2.6860	3
28	0.3517	1.9380	1	68	0.7524	2.4480	2
29	0.4680	1.6000	3	69	0.4410	2.2010	5
30	0.2742	2.1700	0	70	0.3480	1.9950	1
31	0.2616	1.5880	0	71	0.4313	1.7250	1

Table B-2. Reaction Time Data by Group for the Second Testing Session

Pregnant				Nonpregnant			
Subject	Simple (sec)	Choice (sec)	Error (No.)	Subject	Simple (sec)	Choice (sec)	Error (No.)
1	0.2740	1.6110	5	40	0.3042	1.7625	1
2	0.5550	2.1700	0	41	0.2514	1.3420	0
3	0.2820	1.3480	0	42	0.2805	1.1580	0
4	0.2952	1.4990	3	43	0.2688	1.1310	1
5	0.3900	1.7560	2	45	0.3102	1.3650	1
6	0.3862	1.5320	1	46	0.2292	1.9125	2
7	0.3570	1.2860	0	47	0.3728	1.4070	1
8	0.2970	2.4340	2	48	0.4326	1.7110	3
9	0.2328	1.2825	1	49	0.3153	2.1840	0
10	0.2490	2.3480	0	50	0.2466	1.2720	0
11	0.3426	1.9600	0	51	0.2316	1.0500	0
12	0.3606	2.3360	0	52	0.2334	1.9541	1
13	0.2604	1.5870	1	53	0.2391	2.0910	1
14	0.3427	0.4305	5	54	0.2820	0.9640	0
15	0.2587	1.4480	0	55	0.3343	1.7580	5
16	0.2326	1.7580	0	56	0.2394	1.6260	2
17	0.2952	2.5080	0	57	0.2418	0.9285	5
18	0.3078	1.3140	0	58	0.2370	1.3060	2
19	0.2196	1.6520	0	59	0.2298	1.8980	0
20	0.3366	1.5555	3	60	0.2832	1.1808	4
21	0.3876	2.1260	0	61	0.2394	1.7040	0
22	0.2574	1.4240	0	62	0.2436	1.7605	6
23	0.2760	2.7600	4	63	0.2106	1.3980	0
24	0.3585	1.5930	2	64	0.2820	2.2480	0
25	0.4030	1.6455	1	65	0.3713	1.6260	3
26	0.2562	1.2500	0	66	0.2724	1.3140	1
27	0.2424	1.4860	0	67	0.8460	1.8870	3
28	0.3042	0.8508	4	68	0.3926	2.5500	3
29	0.4092	1.5516	2	69	0.3876	2.3717	4
30	0.3742	2.2665	3	70	0.3360	1.6900	0
31	0.2208	1.6530	1	71	0.3906	1.8525	1

Table B-3. Reaction Time Data by Group for the Third Testing Session

Pregnant				Nonpregnant			
Subject	Simple (sec)	Choice (sec)	Error (No.)	Subject	Simple (sec)	Choice (sec)	Error (No.)
1	0.2640	1.4850	3	40	0.3552	1.8150	1
2	0.4680	1.8540	1	41	0.2865	1.3860	0
3	0.2682	1.1420	0	42	0.3393	1.5000	4
4	0.2598	1.7080	2	43	0.2316	1.1920	0
5	0.3022	1.9060	0	45	0.3222	2.0200	0
6	0.2946	1.0380	0	46	0.2244	2.4060	0
7	0.2508	1.2915	1	47	0.4526	1.8204	2
8	0.3226	2.5335	1	48	0.3414	1.5660	3
9	0.2748	0.9000	2	49	0.2838	1.6180	0
10	0.2346	2.1300	5	50	0.2124	1.1600	0
11	0.3315	1.7920	0	51	0.2244	1.1040	0
12	0.2664	2.3760	2	52	0.2240	1.3880	0
13	0.2906	1.5780	0	53	0.2482	1.3740	2
14	0.2688	1.0200	6	54	0.2304	1.4220	1
15	0.1992	1.5480	1	55	0.3773	1.4830	3
16	0.2632	1.1130	1	56	0.2430	1.5240	0
17	0.3640	2.0220	0	57	0.3617	2.4810	2
18	0.2904	1.2024	2	58	0.2333	2.0520	2
19	0.2686	0.8900	0	59	0.2280	1.4980	0
20	0.3042	1.7580	2	60	0.3307	1.3020	5
21	0.6372	2.5740	3	61	0.2334	2.9220	0
22	0.2904	1.1840	0	62	0.2636	0.7980	6
23	0.2933	1.7292	2	63	0.2502	1.5050	0
24	0.2826	2.0520	1	64	0.3000	1.7240	6
25	0.4125	1.4100	0	65	0.3258	1.4064	2
26	0.2256	0.9940	0	66	0.2832	1.3860	1
27	0.2670	1.3780	0	67	0.4326	2.3004	4
28	0.2280	1.0635	4	68	0.2800	2.5720	4
29	0.2970	1.1160	3	69	0.7173	2.4100	0
30	0.3080	2.2228	0	70	0.3378	1.6800	0
31	0.2286	1.8040	0	71	0.3102	1.8520	1

Table B-4. Reaction Time Data by Group for the Fourth Testing Session

Pregnant				Nonpregnant			
Subject	Simple (sec)	Choice (sec)	Error (No.)	Subject	Simple (sec)	Choice (sec)	Error (No.)
1	0.2610	1.0680	1	40	0.3474	1.2640	0
2	0.4026	1.9860	1	41	0.2893	1.2280	0
3	0.2784	1.8600	0	42	0.2424	1.2510	2
4	0.2916	1.4835	1	43	0.2244	0.8800	0
5	0.3108	1.4540	0	45	0.2778	2.1860	0
6	0.3264	1.2080	0	46	0.2184	1.4940	0
7	0.2850	1.9980	2	47	0.4580	1.7560	0
8	0.3180	2.3660	2	48	0.3438	0.8870	3
9	0.2196	0.9552	2	49	0.3257	1.8240	1
10	0.2745	2.0580	2	50	0.2274	1.3110	1
11	0.3555	2.0400	1	51	0.2370	1.4115	1
12	0.3606	2.0680	0	52	0.2686	1.6890	1
13	0.2352	1.7070	1	53	0.2262	1.7430	1
14	0.2760	0.5496	4	54	0.2496	1.0200	0
15	0.2304	1.8860	2	55	0.3420	1.5000	4
16	0.2572	1.6580	1	56	0.2166	1.9800	2
17	0.3114	2.0340	1	57	0.2730	1.0884	4
18	0.2546	1.0620	1	58	0.2028	1.3755	0
19	0.2616	0.9940	0	59	0.2310	1.0410	0
20	0.2595	1.6440	0	60	0.2904	1.3164	2
21	1.1106	2.5420	0	61	0.2686	1.5840	1
22	0.3066	1.3440	0	62	0.2040	1.5900	3
23	0.2646	2.1135	2	63	0.3026	1.6460	0
24	0.2934	2.1100	0	64	0.3727	1.3230	7
25	0.5497	1.4730	2	65	0.2580	1.3875	1
26	0.2034	0.9100	0	66	0.3097	1.3800	1
27	0.2628	1.1380	0	67	0.5160	2.1100	2
28	0.2280	1.0635	4	68	0.3220	2.5420	2
29	0.3106	0.7560	5	69	.04462	2.0355	7
30	0.3080	2.2320	3	70	0.3120	1.4560	0
31	0.2766	1.4740	2	71	0.3133	2.2545	3

Table B-5. Reaction Time Data by Group for the Fifth Testing Session

Pregnant				Nonpregnant			
Subject	Simple (sec)	Choice (sec)	Error (No.)	Subject	Simple (sec)	Choice (sec)	Error (No.)
1	0.2208	1.7925	1	40	0.2920	1.6215	0
2	0.3780	2.3920	1	41	0.2712	1.4560	0
3	0.2958	1.6380	1	42	0.2328	1.2460	0
4	0.3120	2.0520	1	43	0.2232	1.0480	0
5	0.3072	2.2380	0	45	0.2604	1.3980	0
6	0.2682	0.9180	0	46	0.2286	1.7940	0
7	0.3093	1.3740	0	47	0.3234	2.2400	0
8	0.3384	2.1630	3	48	0.3504	1.8411	4
9	0.2418	1.1208	4	49	0.3246	1.5680	0
10	0.2466	1.8984	2	50	0.1974	1.3120	0
11	0.3300	2.5350	1	51	0.2866	1.2600	1
12	0.2887	1.0960	1	52	0.3007	2.0960	0
13	0.2232	1.6500	2	53	0.2388	2.0580	1
14	0.2793	0.3615	5	54	0.2316	1.4320	0
15	0.1872	1.7740	0	55	0.2955	1.4210	5
16	0.2838	1.9660	0	56	0.2930	1.6740	1
17	0.3327	2.1645	1	57	0.2364	1.3388	6
18	0.3222	0.7680	0	58	0.2407	1.7784	2
19	0.2466	0.7700	0	59	0.2182	1.5240	0
20	0.3333	1.3104	0	60	0.2556	1.5120	1
21	0.5916	2.3660	4	61	0.2376	1.4320	0
22	0.2406	1.3820	0	62	0.2442	2.2050	1
23	0.2760	1.9140	2	63	0.2772	1.3020	1
24	0.2857	1.5820	1	64	0.3570	1.6275	4
25	0.4554	1.2480	2	65	0.3156	1.6440	2
26	0.2082	1.2920	0	66	0.2751	1.3350	1
27	0.3073	1.6000	0	67	0.2958	2.4840	1
28	0.2200	1.3965	1	68	0.3174	2.4000	4
29	0.3945	1.4985	4	69	0.3108	2.2842	7
30	0.3382	2.2260	1	70	0.3460	1.4940	0
31	0.3353	0.9240	2	71	0.3513	1.8060	0

APPENDIX C: HAND GRIP STRENGTH DATA FOR EACH SUBJECT FOR ALL FIVE SESSIONS

Table C-1. Non-dominant and Dominant Hand Grip Data (Measured in Kilograms) by Group for the Practice Testing Session

Pregnant			Nonpregnant		
Sub- ject	Non-dominant Hand Grip	Dominant Hand	Sub- ject	Non-dominant Hand Grip	Dominant Hand
1	34.3	21.3	40	42.3	41.6
2	24.6	21.3	41	28.0	28.6
3	34.3	31.3	42	27.0	29.6
4	29.0	28.6	43	34.3	31.0
5	32.3	34.3	45	23.0	22.0
6	36.3	29.3	46	34.6	35.0
7	36.3	32.0	47	26.3	25.0
8	32.0	35.6	48	24.6	30.0
9	20.6	21.6	49	42.6	36.6
10	24.0	26.3	50	25.0	24.6
11	22.6	22.3	51	34.3	37.6
12	25.0	24.3	52	26.0	30.0
13	30.3	26.3	53	20.6	20.6
14	25.0	23.3	54	24.3	28.6
15	23.3	26.3	55	33.0	36.0
16	30.0	25.0	56	26.6	31.3
17	29.6	28.3	57	40.6	37.6
18	38.0	40.0	58	25.3	33.6
19	40.6	36.3	59	41.6	36.0
20	27.0	26.3	60	34.3	32.3
21	37.3	30.6	61	35.6	35.6
22	30.0	30.6	62	25.0	26.6
23	31.0	36.0	63	34.0	31.0
24	27.6	23.3	64	39.3	35.0
25	20.6	19.6	65	29.3	31.0
26	37.3	36.0	66	32.3	29.6
27	36.6	29.0	67	21.6	20.6
28	30.3	36.6	68	33.0	37.0
29	31.0	31.6	69	35.0	32.3
30	33.0	27.3	70	29.6	28.3
31	30.3	35.0	71	24.3	20.6

Table C-2. Non-dominant and Dominant Hand Grip Data (Measured in Kilograms) by Group for the Second Testing Session

Pregnant			Nonpregnant		
Sub- ject	Non-dominant Hand Grip	Dominant Hand	Sub- ject	Non-dominant Hand Grip	Dominant Hand
1	36.3	27.3	40	42.6	37.3
2	25.0	24.0	41	33.6	27.6
3	31.0	31.3	42	27.6	31.6
4	29.0	26.0	43	31.0	28.0
5	31.3	39.0	45	19.6	20.0
6	41.3	28.3	46	34.3	32.3
7	32.0	36.6	47	22.3	25.6
8	34.6	40.0	48	30.6	33.0
9	32.0	29.0	49	44.0	46.3
10	22.3	29.3	50	25.3	33.3
11	18.3	22.0	51	34.6	37.3
12	23.6	27.6	52	28.6	33.0
13	31.3	25.6	53	21.6	21.6
14	25.3	21.0	54	25.6	22.6
15	25.0	24.6	55	31.3	31.6
16	32.3	25.0	56	33.0	31.0
17	25.3	26.3	57	41.6	35.0
18	40.0	33.3	58	30.6	28.6
19	35.0	34.3	59	40.0	34.3
20	25.6	24.6	60	31.0	27.3
21	34.3	38.0	61	37.0	34.3
22	32.0	33.3	62	23.3	23.0
23	37.0	34.3	63	34.0	32.0
24	25.3	24.6	64	35.3	34.3
25	20.3	19.3	65	29.6	24.3
26	37.6	35.6	66	31.3	31.3
27	39.3	33.0	67	20.3	20.6
28	28.6	29.0	68	32.6	36.0
29	28.0	25.0	69	29.6	29.3
30	33.6	26.3	70	31.0	24.3
31	30.3	35.6	71	25.3	22.6

Table C-3. Non-dominant and Dominant Hand Grip Data
(Measured in Kilograms) by Group for the
Third Testing Session

Pregnant			Nonpregnant		
Sub- ject	Non-dominant Hand Grip	Dominant Hand	Sub- ject	Non-dominant Hand Grip	Dominant Hand
1	36.0	19.0	40	44.0	43.3
2	24.3	23.0	41	35.3	31.0
3	33.3	33.6	42	34.0	30.3
4	28.6	25.0	43	29.3	26.0
5	27.0	35.0	45	24.0	23.3
6	42.3	30.6	46	37.0	32.3
7	30.6	33.3	47	28.0	25.0
8	37.6	34.3	48	25.6	29.3
9	28.0	33.0	49	42.6	41.0
10	22.6	22.6	50	25.3	32.0
11	21.6	21.0	51	30.6	38.0
12	25.3	26.6	52	26.0	36.6
13	34.6	31.0	53	20.6	19.6
14	30.0	24.6	54	25.6	22.6
15	26.6	28.0	55	31.0	33.3
16	30.0	22.6	56	35.0	27.6
17	18.6	18.6	57	40.6	37.0
18	40.6	33.3	58	34.3	29.6
19	36.6	38.0	59	37.0	32.3
20	26.3	27.6	60	33.0	29.0
21	37.0	36.3	61	29.0	32.3
22	32.0	29.0	62	21.0	19.3
23	37.6	35.3	63	33.3	30.0
24	25.3	26.0	64	38.6	33.3
25	20.3	20.3	65	27.0	24.0
26	35.6	35.3	66	28.0	27.0
27	37.3	30.0	67	20.0	20.6
28	30.0	32.3	68	30.6	34.3
29	24.6	27.6	69	32.0	31.6
30	35.6	26.0	70	30.6	25.6
31	33.6	36.6	71	25.3	26.0

Table C-4. Non-dominant and Dominant Hand Grip Data (Measured in Kilograms) by Group for the Fourth Testing Session

Pregnant			Nonpregnant		
Sub-ject	Non-dominant Hand Grip	Dominant Hand	Sub-ject	Non-dominant Hand Grip	Dominant Hand
1	37.0	23.0	40	39.0	43.6
2	26.3	26.3	41	34.0	33.3
3	34.3	31.6	42	31.0	30.6
4	27.3	26.6	43	32.3	34.6
5	27.3	42.0	45	22.6	21.6
6	38.3	28.0	46	36.0	34.3
7	33.3	28.6	47	27.0	25.0
8	38.0	36.6	48	26.3	30.3
9	30.0	29.6	49	40.0	42.6
10	25.6	22.3	50	23.3	24.6
11	23.3	24.3	51	30.0	37.0
12	27.0	29.3	52	29.0	36.6
13	35.0	31.3	53	23.3	22.6
14	26.0	24.3	54	25.6	25.3
15	24.0	24.3	55	29.3	33.6
16	32.0	28.0	56	36.3	37.0
17	23.0	18.3	57	40.6	38.3
18	41.0	32.3	58	32.6	31.3
19	37.0	35.3	59	41.0	38.6
20	22.3	27.0	60	32.0	24.3
21	36.3	37.3	61	32.0	37.0
22	28.6	24.0	62	20.3	23.3
23	37.3	32.3	63	32.0	32.0
24	24.0	27.0	64	40.3	36.0
25	21.3	20.0	65	26.0	27.6
26	42.6	34.0	66	30.6	25.6
27	39.3	35.0	67	21.0	18.3
28	31.0	29.3	68	35.0	36.6
29	26.6	28.3	69	30.3	25.3
30	33.6	29.6	70	29.6	27.6
31	34.3	36.0	71	25.3	24.0

Table C-5. Non-dominant and Dominant Hand Grip Data
(Measured in Kilograms) by Group for the
Fifth Testing Session

Pregnant			Nonpregnant		
Sub-ject	Non-dominant Hand Grip	Dominant Hand	Sub-ject	Non-dominant Hand Grip	Dominant Hand
1	40.0	24.0	40	42.6	38.6
2	22.3	25.0	41	35.0	32.6
3	34.0	26.0	42	31.3	30.3
4	28.3	29.3	43	32.6	29.6
5	26.0	36.6	45	22.6	21.3
6	43.0	32.0	46	38.3	34.0
7	31.6	30.6	47	27.3	28.6
8	39.0	42.6	48	27.3	28.3
9	32.3	33.6	49	43.3	46.6
10	23.6	27.0	50	22.0	21.6
11	18.3	18.6	51	33.0	36.6
12	26.0	29.6	52	30.3	35.0
13	33.3	33.3	53	21.6	21.6
14	25.6	24.0	54	27.6	26.3
15	26.6	27.3	55	25.3	31.6
16	30.6	24.6	56	31.3	33.3
17	21.6	20.6	57	39.6	36.0
18	39.3	34.0	58	33.6	30.0
19	38.3	39.0	59	42.3	36.3
20	25.6	28.3	60	34.6	32.0
21	36.0	36.0	61	32.3	31.3
22	31.0	28.3	62	23.6	26.6
23	36.6	34.3	63	35.6	31.6
24	25.3	29.6	64	37.3	29.3
25	20.0	21.3	65	28.6	28.6
26	42.6	34.6	66	33.3	25.3
27	40.3	28.0	67	21.0	20.3
28	28.0	33.3	68	28.3	32.0
29	27.6	28.3	69	31.3	19.6
30	36.6	26.0	70	32.0	25.3
31	32.6	34.6	71	23.3	22.6

APPENDIX D: STATIC AND DYNAMIC ARM STRENGTH DATA FOR EACH
SUBJECT FOR ALL FIVE SESSIONS

Table D-1. Static and Dynamic Arm Strength Data (Measured
in Pounds) by Group for the Initial Testing
Session

Pregnant			Nonpregnant		
Subject	Static	Dynamic	Subject	Static	Dynamic
1	32.0	21.0	40	52.0	23.0
2	27.0	13.6	41	47.0	21.6
3	48.3	20.0	42	35.0	21.0
4	29.0	19.6	43	35.6	16.6
5	66.3	23.0	45	51.6	19.6
6	48.6	22.0	46	35.6	16.3
7	28.3	18.3	47	50.3	19.0
8	43.6	18.3	48	31.6	15.6
9	36.6	20.3	49	50.3	21.0
10	26.0	17.6	50	39.0	19.0
11	23.0	18.6	51	38.0	16.3
12	17.6	18.0	52	45.6	20.6
13	42.0	17.3	53	30.3	22.0
14	29.0	25.3	54	30.0	16.3
15	29.0	17.0	55	59.6	22.3
16	35.3	16.6	56	50.6	18.3
17	28.3	19.0	57	47.0	24.0
18	30.0	35.3	58	36.0	18.0
19	38.0	18.0	59	35.0	21.0
20	31.3	19.3	60	46.6	22.0
21	40.0	16.0	61	41.6	24.3
22	39.0	18.3	62	42.3	24.3
23	28.6	12.6	63	41.0	17.6
24	29.3	16.6	64	36.0	16.0
25	39.6	22.3	65	45.3	25.0
26	35.6	22.6	66	31.3	17.3
27	43.6	28.3	67	38.6	18.3
28	36.3	19.0	68	37.6	16.0
29	36.6	17.6	69	41.0	17.0
30	29.6	19.3	70	38.3	20.6
31	33.0	14.3	71	34.0	18.6

Table D-2. Static and Dynamic Arm Strength Data (Measured in Pounds) by Group for the Second Testing Session

Pregnant			Nonpregnant		
Subject	Static	Dynamic	Subject	Static	Dynamic
1	26.3	20.3	40	47.6	21.3
2	26.6	15.3	41	46.6	22.0
3	46.6	19.3	42	29.6	17.3
4	29.6	19.3	43	42.6	25.0
5	71.0	22.3	45	48.3	22.3
6	50.0	22.6	46	40.0	19.3
7	31.3	20.0	47	48.3	22.0
8	43.3	21.3	48	32.0	16.0
9	31.3	17.3	49	49.0	32.6
10	27.0	15.6	50	48.0	23.3
11	27.0	20.3	51	45.3	23.6
12	26.3	16.0	52	46.0	20.6
13	48.3	24.6	53	22.0	19.3
14	26.0	20.3	54	32.3	20.3
15	33.0	19.3	55	57.6	20.3
16	27.0	17.6	56	46.6	20.3
17	29.6	17.0	57	47.0	22.0
18	46.6	25.3	58	41.6	21.3
19	38.6	18.0	59	45.3	24.0
20	36.3	19.3	60	42.3	24.3
21	37.0	16.3	61	38.6	18.6
22	47.0	22.0	62	36.3	19.0
23	45.3	16.3	63	38.3	15.0
24	26.0	16.6	64	41.3	18.0
25	40.3	19.6	65	48.6	22.0
26	41.6	27.0	66	34.0	23.0
27	53.6	20.0	67	38.3	17.3
28	35.6	24.3	68	40.0	19.3
29	33.6	19.6	69	42.6	19.6
30	35.0	22.3	70	41.3	22.0
31	37.3	17.6	71	31.0	20.3

Table D-3. Static and Dynamic Arm Strength Data (Measured in Pounds) by Group for the Third Testing Session

Pregnant			Nonpregnant		
Subject	Static	Dynamic	Subject	Static	Dynamic
1	24.3	19.6	40	58.3	25.0
2	23.3	15.3	41	53.6	25.6
3	49.0	20.3	42	35.0	21.0
4	30.0	17.6	43	39.3	22.6
5	61.6	26.6	45	51.0	24.6
6	52.0	23.6	46	53.0	25.0
7	49.3	18.6	47	46.3	23.0
8	44.3	22.6	48	35.0	17.3
9	39.0	22.6	49	51.3	37.3
10	23.6	15.6	50	43.0	21.0
11	29.0	16.0	51	46.6	23.6
12	25.6	18.0	52	45.3	19.3
13	43.6	26.3	53	23.6	20.6
14	28.6	19.0	54	33.3	21.6
15	33.3	20.0	55	48.3	22.6
16	29.0	19.6	56	46.6	22.6
17	24.6	17.0	57	43.3	24.0
18	62.0	31.0	58	47.6	23.3
19	47.0	19.0	59	45.6	28.0
20	45.0	20.6	60	52.3	24.0
21	43.6	16.3	61	36.6	16.6
22	46.6	21.6	62	36.6	17.3
23	43.3	16.0	63	39.6	18.3
24	33.6	21.0	64	40.6	22.0
25	34.3	16.0	65	51.0	21.3
26	43.0	24.0	66	32.3	18.3
27	40.0	22.3	67	36.0	17.6
28	36.0	24.3	68	30.0	17.3
29	34.6	19.3	69	49.6	19.0
30	39.6	18.6	70	31.3	22.3
31	43.3	17.3	71	29.0	18.3

Table D-4. Static and Dynamic Arm Strength Data (Measured in Pounds) by Group for the Fourth Testing Session

Pregnant			Nonpregnant		
Subject	Static	Dynamic	Subject	Static	Dynamic
1	18.3	18.0	40	43.0	21.6
2	34.6	15.0	41	50.0	26.6
3	44.3	19.3	42	40.0	22.0
4	39.0	17.6	43	41.6	24.0
5	59.6	26.0	45	45.6	20.0
6	52.0	24.3	46	45.3	22.3
7	48.6	22.0	47	41.6	22.3
8	41.6	20.6	48	38.3	19.3
9	35.6	18.0	49	54.6	31.0
10	28.0	16.6	50	45.6	26.0
11	26.0	19.0	51	43.6	22.3
12	37.3	18.3	52	42.0	22.3
13	43.3	22.3	53	24.6	17.6
14	24.6	20.6	54	35.0	23.3
15	32.6	16.0	55	47.3	23.3
16	34.3	20.6	56	47.3	23.6
17	23.0	17.6	57	44.6	27.6
18	49.6	31.6	58	46.6	20.6
19	43.3	22.6	59	48.0	24.3
20	38.3	19.0	60	43.0	21.0
21	42.6	18.0	61	33.3	17.0
22	48.3	21.0	62	34.6	16.6
23	47.3	18.6	63	41.0	17.3
24	31.6	18.0	64	43.0	20.3
25	32.3	17.3	65	46.0	21.3
26	44.3	29.0	66	33.6	22.0
27	57.0	28.3	67	33.3	19.0
28	37.0	20.3	68	28.0	20.3
29	29.0	16.6	69	33.0	18.3
30	39.3	22.0	70	37.6	24.3
31	41.0	18.0	71	33.3	18.3

Table D-5. Static and Dynamic Arm Strength Data (Measured in Pounds) by Group for the Fifth Testing Session

Pregnant			Nonpregnant		
Subject	Static	Dynamic	Subject	Static	Dynamic
1	17.0	13.6	40	45.3	22.0
2	33.6	16.0	41	51.0	25.6
3	45.6	19.3	42	33.3	19.6
4	33.0	21.3	43	34.6	20.6
5	59.3	19.6	45	45.6	23.6
6	51.3	25.0	46	45.6	25.6
7	48.6	19.0	47	44.0	19.6
8	44.6	23.3	48	43.6	16.0
9	36.0	21.3	49	54.0	34.6
10	29.3	18.6	50	37.3	19.0
11	26.6	20.3	51	46.0	19.0
12	33.6	18.6	52	51.6	25.3
13	46.6	24.6	53	22.3	18.3
14	25.0	19.0	54	32.6	18.3
15	32.6	16.0	55	44.6	24.3
16	34.6	19.6	56	47.3	23.6
17	21.3	18.0	57	52.6	20.6
18	62.3	33.6	58	52.0	18.3
19	47.6	23.6	59	44.3	26.6
20	33.3	18.0	60	44.0	24.6
21	34.3	15.6	61	41.0	16.6
22	45.6	21.6	62	34.0	17.3
23	48.0	19.3	63	39.3	15.3
24	32.6	18.0	64	44.3	20.3
25	31.6	20.0	65	37.6	19.3
26	43.0	30.6	66	31.3	16.3
27	54.3	23.0	67	34.0	20.3
28	39.6	23.0	68	23.6	18.3
29	26.0	16.6	69	29.3	20.6
30	40.0	20.6	70	38.3	25.6
31	42.3	17.6	71	37.3	18.0

APPENDIX E: ANTHROPOMETRIC DATA FOR EACH SUBJECT FOR ALL FIVE SESSIONS

Table E-1. Anthropometric Data by Group for the Initial Testing Session

Sub- ject No.	Pregnant				Sub- ject No.	Nonpregnant			
	Height (cm)	Weight (lb)	A. R. (cm)	A.B. (cm)		Height (cm)	Weight (lb)	A.R. (cm)	A.D. (cm)
1	168.8	268.00	66.8	33.3	40	172.6	223.75	80.5	30.5
2	164.0	168.50	66.2	27.0	41	158.8	129.75	68.4	19.3
3	170.9	154.00	69.8	25.0	42	155.0	124.00	68.5	17.5
4	166.5	141.00	67.0	23.9	43	169.5	117.00	72.9	17.0
5	160.5	168.25	66.1	24.3	45	158.0	117.50	68.6	20.3
6	183.9	194.25	76.8	30.0	46	172.8	202.50	72.2	26.2
7	162.5	154.25	68.3	27.4	47	160.4	136.25	70.8	22.5
8	168.7	214.75	70.7	29.8	48	162.6	111.00	68.6	18.5
9	171.2	127.95	75.3	22.5	49	167.8	233.25	47.6	27.9
10	162.7	139.51	70.5	27.2	50	158.5	118.00	63.7	18.0
11	156.3	123.00	70.4	22.2	51	177.6	184.00	67.1	25.0
12	152.0	144.50	63.1	26.8	52	168.0	143.50	71.1	20.5
13	157.2	153.25	68.4	26.0	53	160.4	110.75	68.4	19.5
14	156.1	151.75	68.5	27.4	54	163.6	127.50	67.8	20.9
15	158.4	109.50	66.3	19.3	55	168.4	217.00	72.5	27.5
16	156.2	141.75	65.8	29.3	56	177.0	136.00	73.7	19.5
17	160.5	134.75	69.8	24.4	57	155.5	141.50	71.5	23.0
18	164.0	208.00	66.3	33.2	58	168.0	190.50	70.4	27.5
19	163.7	182.00	71.7	24.2	59	159.5	144.50	68.4	23.4
20	165.0	160.75	70.8	30.7	60	165.3	129.25	69.4	18.5
21	163.5	156.00	67.4	26.2	61	163.8	135.00	68.8	19.0
22	173.0	150.00	72.2	23.0	62	151.5	125.00	61.2	20.5
23	162.4	178.00	70.2	30.3	63	170.5	153.50	70.1	22.0
24	160.0	135.75	66.6	21.5	64	157.2	153.00	66.7	24.0
25	159.5	121.00	67.6	18.4	65	159.0	117.00	64.3	19.3
26	170.3	161.50	71.2	24.8	66	162.2	114.00	66.5	18.0
27	179.0	163.75	71.2	21.5	67	153.7	120.00	60.1	23.7
28	168.1	175.00	67.5	27.7	68	158.1	136.00	68.6	21.8
29	153.3	114.00	64.8	21.4	69	154.2	214.00	67.5	32.0
30	163.5	128.00	70.6	21.6	70	164.1	144.50	68.4	21.4
31	158.2	162.25	67.2	26.0	71	163.1	138.50	69.8	22.5

Key: A.R = Arm Reach
A.D. = Abdominal Depth

Table E-2. Anthropometric Data by Group for the Second Testing Session

Sub- ject	Pregnant				Sub- ject	Nonpregnant			
No.	Height (cm)	Weight (lb)	A. R. (cm)	A.D. (cm)	No.	Height (cm)	Weight (lb)	A.R. (cm)	A.D. (cm)
1	168.8	278.00	66.8	33.3	40	172.6	225.50	80.5	29.7
2	164.0	171.25	66.2	28.2	41	158.8	124.50	68.4	18.4
3	170.9	156.75	69.8	25.5	42	155.0	125.75	68.5	18.5
4	166.5	143.00	67.0	21.6	43	169.5	117.00	72.9	17.0
5	160.5	172.00	66.1	26.3	45	158.0	114.00	68.6	21.0
6	183.9	198.25	76.8	31.0	46	172.8	198.00	72.2	27.3
7	162.5	158.50	68.3	28.5	47	160.4	136.75	70.8	24.4
8	168.7	216.50	70.7	30.5	48	162.6	110.00	68.6	19.3
9	171.2	161.50	75.3	24.0	49	167.8	231.50	47.6	27.5
10	162.7	140.50	70.5	28.1	50	158.5	118.00	63.7	17.8
11	156.3	122.25	70.4	22.7	51	177.6	182.50	67.1	24.0
12	152.0	131.00	63.1	26.3	52	168.0	144.00	71.1	21.0
13	157.2	156.25	68.4	26.6	53	160.4	112.50	68.4	20.0
14	156.1	155.50	68.5	28.8	54	163.6	126.75	67.8	21.6
15	158.4	110.50	66.3	19.8	55	168.4	208.00	72.5	28.0
16	156.2	141.25	65.8	30.3	56	177.0	138.00	73.7	19.5
17	160.5	136.50	69.8	25.5	57	155.5	140.25	71.5	23.0
18	164.0	191.50	66.3	27.8	58	168.0	188.75	70.4	27.0
19	163.7	183.50	71.7	26.3	59	159.5	144.50	68.4	23.8
20	165.0	166.50	70.8	31.0	60	165.3	127.00	69.4	19.2
21	163.5	160.75	67.4	27.7	61	163.8	132.00	68.8	20.0
22	173.0	153.75	72.2	23.8	62	151.5	128.00	61.2	22.0
23	162.4	169.00	70.2	25.8	63	170.5	154.75	70.1	23.8
24	160.0	136.00	66.6	21.3	64	157.2	153.25	66.7	24.4
25	159.5	123.00	67.6	21.5	65	159.0	117.50	64.3	19.2
26	170.3	161.00	71.2	26.4	66	162.2	115.00	66.5	18.0
27	179.0	162.25	71.2	22.5	67	153.7	121.00	60.1	23.2
28	168.1	175.00	67.5	28.5	68	158.1	139.75	68.6	22.7
29	153.3	116.25	64.8	22.0	69	154.2	210.75	67.5	31.8
30	163.5	132.25	70.6	22.5	70	164.1	142.75	68.4	21.3
31	158.2	165.50	67.2	27.0	71	163.1	137.75	69.8	22.0

Table E-3. Anthropometric Data by Group for the Third Testing Session

Sub- ject No.	Pregnant				Sub- ject No.	Nonpregnant			
	Height (cm)	Weight (lb)	A. R. (cm)	A.D. (cm)		Height (cm)	Weight (lb)	A.R. (cm)	A.D. (cm)
1	168.8	274.00	66.8	33.2	40	172.6	225.00	80.5	29.2
2	164.0	169.50	66.2	28.5	41	158.8	124.75	68.4	18.8
3	170.9	156.00	69.8	26.5	42	155.0	125.00	68.5	18.6
4	166.5	139.75	67.0	23.4	43	169.5	118.00	72.9	17.4
5	160.5	174.75	66.1	27.8	45	158.0	116.50	68.6	22.0
6	183.9	203.00	76.8	31.8	46	172.8	201.25	72.2	27.0
7	162.5	133.25	68.3	21.1	47	160.4	132.25	70.8	23.7
8	168.7	218.00	70.7	31.5	48	162.6	110.00	68.6	18.4
9	171.2	163.00	75.3	24.5	49	167.8	231.00	47.6	28.0
10	162.7	143.50	70.5	31.0	50	158.5	118.00	63.7	17.5
11	156.3	122.50	70.4	23.1	51	177.6	182.25	67.1	24.0
12	152.0	131.00	63.1	25.2	52	168.0	146.00	71.1	22.0
13	157.2	161.50	68.4	27.7	53	160.4	115.00	68.4	21.0
14	156.1	157.00	68.5	29.8	54	163.6	126.00	67.8	20.4
15	158.4	113.00	66.3	20.5	55	168.4	209.50	72.5	28.7
16	156.2	143.25	65.8	31.0	56	177.0	138.00	73.7	18.0
17	160.5	141.00	69.8	26.5	57	155.5	140.00	71.5	25.3
18	164.0	193.75	66.3	27.7	58	168.0	188.50	70.4	26.0
19	163.7	186.00	71.7	26.8	59	159.5	145.25	68.4	23.4
20	165.0	167.25	70.8	32.1	60	165.3	123.25	69.4	19.7
21	163.5	167.75	67.4	29.0	61	163.8	130.00	68.8	20.3
22	173.0	151.50	72.2	24.4	62	151.5	129.00	61.2	21.5
23	162.4	166.00	70.2	25.0	63	170.5	154.00	70.1	23.6
24	160.0	137.00	66.6	21.3	64	157.2	153.00	66.7	25.0
25	159.5	125.00	67.6	22.5	65	159.0	117.00	64.3	18.9
26	170.3	163.00	71.2	27.3	66	162.2	112.00	66.5	18.3
27	179.0	165.50	71.2	21.5	67	153.7	120.75	60.1	23.0
28	168.1	179.00	67.5	29.8	68	158.1	136.50	68.6	24.2
29	153.3	116.75	64.8	22.9	69	154.2	212.50	67.5	32.0
30	163.5	133.25	70.6	23.8	70	164.1	143.75	68.4	21.8
31	158.2	165.00	67.2	28.2	71	163.1	137.00	69.8	21.5

Key: A.R. = Arm Reach
A.D. = Abdominal Depth

Table E-4. Anthropometric Data by Group for the Fourth Testing Session

Sub- ject No.	Pregnant				Sub- ject No.	Nonpregnant			
	Height (cm)	Weight (lb)	A. R. (cm)	A.D. (cm)		Height (cm)	Weight (lb)	A.R. (cm)	A.D. (cm)
1	168.8	279.25	66.8	33.0	40	172.6	224.00	80.5	31.8
2	164.0	172.50	66.2	28.8	41	158.8	127.00	68.4	19.3
3	170.9	162.00	69.8	27.0	42	155.0	126.25	68.5	18.6
4	166.5	138.25	67.0	22.3	43	169.5	118.00	72.9	18.0
5	160.5	178.25	66.1	28.3	45	158.0	115.25	68.6	21.0
6	183.9	207.00	76.8	32.8	46	172.8	201.75	72.2	28.3
7	162.5	132.00	68.3	20.8	47	160.4	137.00	70.8	23.5
8	168.7	218.50	70.7	32.5	48	162.6	107.00	68.6	18.0
9	171.2	165.50	75.3	26.4	49	167.8	231.00	47.6	30.5
10	162.7	145.00	70.5	31.2	50	158.5	118.00	63.7	18.0
11	156.3	123.25	70.4	23.5	51	177.6	183.00	67.1	24.5
12	152.0	133.50	63.1	23.7	52	168.0	145.50	71.1	21.2
13	157.2	163.50	68.4	29.7	53	160.4	114.25	68.4	19.8
14	156.1	159.50	68.5	31.5	54	163.6	126.75	67.8	20.6
15	158.4	115.20	66.3	21.0	55	168.4	212.50	72.5	29.0
16	156.2	146.50	65.8	31.0	56	177.0	141.00	73.7	19.0
17	160.5	141.00	69.8	28.8	57	155.5	144.00	71.5	23.3
18	164.0	192.50	66.3	27.6	58	168.0	188.50	70.4	27.3
19	163.7	186.50	71.7	29.1	59	159.5	145.00	68.4	22.8
20	165.0	171.00	70.8	32.5	60	165.3	129.75	69.4	20.0
21	163.5	163.50	67.4	30.0	61	163.8	130.00	68.8	20.3
22	173.0	155.00	72.2	25.8	62	151.5	129.00	61.2	23.0
23	162.4	165.00	70.2	25.0	63	170.5	152.50	70.1	23.2
24	160.0	137.00	66.6	21.2	64	157.2	156.50	66.7	25.1
25	159.5	125.50	67.6	22.5	65	159.0	117.00	64.3	19.1
26	170.3	165.50	71.2	27.9	66	162.2	113.00	66.5	18.0
27	179.0	164.50	71.2	21.5	67	153.7	120.75	60.1	23.7
28	168.1	181.00	67.5	30.6	68	158.1	138.75	68.6	24.8
29	153.3	114.50	64.8	23.3	69	154.2	212.00	67.5	33.7
30	163.5	136.00	70.6	24.7	70	164.1	140.75	68.4	20.3
31	158.2	167.00	67.2	29.5	71	163.1	137.50	69.8	21.8

Key: A.R. = Arm Reach
A.D. = Abdominal Depth

Table E-5. Anthropometric Data by Group for the Fifth Testing Session

Sub- ject No.	Pregnant				Sub- ject No.	Nonpregnant			
	Height (cm)	Weight (lb)	A. R. (cm)	A.D. (cm)		Height (cm)	Weight (lb)	A.R. (cm)	A.D. (cm)
1	168.8	277.00	66.8	32.0	40	172.6	224.50	80.5	30.3
2	164.0	176.75	66.2	29.4	41	158.8	125.50	68.4	19.4
3	170.9	161.00	69.8	27.5	42	155.0	124.50	68.5	18.0
4	166.5	136.25	67.0	22.0	43	169.5	117.00	72.9	18.8
5	160.5	180.25	66.1	29.3	45	158.0	113.50	68.6	21.4
6	183.9	209.25	76.8	34.0	46	172.8	196.00	72.2	27.3
7	162.5	131.50	68.3	20.8	47	160.4	135.00	70.8	21.8
8	168.7	221.75	70.7	33.5	48	162.6	109.00	68.6	18.3
9	171.2	168.25	75.3	27.5	49	167.8	229.25	47.6	29.4
10	162.7	146.75	70.5	31.5	50	158.5	120.00	63.7	18.0
11	156.3	125.00	70.4	24.1	51	177.6	182.25	67.1	24.0
12	152.0	133.25	63.1	23.6	52	168.0	143.75	71.1	21.8
13	157.2	165.00	68.4	30.3	53	160.4	114.00	68.4	19.5
14	156.1	162.75	68.5	32.0	54	163.6	126.50	67.8	20.8
15	158.4	116.00	66.3	22.3	55	168.4	208.50	72.5	28.9
16	156.2	143.00	65.8	31.5	56	177.0	144.00	73.7	21.0
17	160.5	142.50	69.8	29.3	57	155.5	143.25	71.5	25.8
18	164.0	193.50	66.3	27.8	58	168.0	192.00	70.4	27.5
19	163.7	189.75	71.7	30.3	59	159.5	147.00	68.4	24.0
20	165.0	174.00	70.8	33.5	60	165.3	123.50	69.4	18.8
21	163.5	165.00	67.4	30.5	61	163.8	129.00	68.8	20.7
22	173.0	158.50	72.2	27.4	62	151.5	129.00	61.2	23.2
23	162.4	165.00	70.2	24.5	63	170.5	151.25	70.1	22.6
24	160.0	136.50	66.6	21.0	64	157.2	156.00	66.7	23.4
25	159.5	128.50	67.6	23.3	65	159.0	118.25	64.3	18.3
26	170.3	167.00	71.2	28.5	66	162.2	113.00	66.5	18.0
27	179.0	164.50	71.2	21.4	67	153.7	119.50	60.1	22.3
28	168.1	185.50	67.5	32.0	68	158.1	139.00	68.6	23.5
29	153.3	117.25	64.8	23.8	69	154.2	217.50	67.5	32.3
30	163.5	137.25	70.6	25.8	70	164.1	142.25	68.4	21.3
31	158.2	169.00	67.2	31.0	71	163.1	137.25	69.8	20.4

Key: A.R. = Arm Reach
A.D. = Abdominal Depth

APPENDIX F: TESTING INSTRUCTIONS TO VOLUNTEERS

SIMPLE REACTION TIME TEST INSTRUCTIONS

Each volunteer was asked to perform the simple reaction time test using a microcomputer to present the stimulus and record the time for response. The instructions are the following:

1. You are being asked to respond to the appearance of a signal that will appear on the computer screen in the form of four pound signs. The signs will appear in the same spot on the screen at random time intervals.
2. Please depress either "shift" key on the keyboard.
3. Keep the key depressed until four pound signs appear on upper portion of the screen on the left side.
4. As soon as the pound signs appear, release the "shift" key.
5. When you release the "shift" key, a message will appear at the top of the screen. The message says,

"PLEASE DEPRESS THE SHIFT KEY TO START THE TIMER."

This message is the signal for you to depress the "shift" key again until the pound signs reappear. When the pound signs reappear, release the "shift" key.
6. This process will be repeated until you have responded to the appearance of the pound signs a total of ten times.

CHOICE REACTION TIME TEST INSTRUCTIONS

Each volunteer was asked to perform the choice reaction time test using a microcomputer to present the stimulus and record the time for response. The instructions are the following:

1. You are being asked to observe the strings of random numbers that will appear in different locations on the computer screen. There will be seven, eight or nine numbers in the strings.
2. When the test begins, the following message will appear on the top of the screen:

PRESS AND RELEASE THE SPACE BAR TO START THE TIMER.
PRESS AND RELEASE THE SPACE WHEN A STRING OF EIGHT (8) CHARACTERS APPEARS.
3. Please press and release the space bar.
4. Observe the string of numbers that appears at a different spot each time on the screen.
5. If the string contains eight numbers, depress and release the space bar.
6. If the string contains seven or nine numbers, wait until the string disappears and the same message as appeared at the beginning of the test reappears at the top of the screen.
7. When the message reappears, press and release the space bar again to get another string of numbers. Observe how many numbers are in the string and press and release the space bar again only if the string contains eight numbers.
8. You will repeat the process until the computer does not present any more strings of numbers (a total of ten strings of numbers will have appeared on the screen).

HAND GRIP TEST INSTRUCTIONS

1. Please sit on this chair, hold your upper arms next to your body and bend your elbow 90 degrees. (After verifying that the elbow was flexed 90 degrees, I placed the dynamometer in the volunteer's hand.)
2. Now squeeze the dynamometer as hard as you can for 3-4 seconds.
3. After a rest period, the volunteer was asked to repeat the test for a total of three times for each hand.

STATIC ARM STRENGTH INSTRUCTIONS

After demonstrating the procedure and showing the volunteer where to stand on the board that was attached to the minigym, the following instructions were repeated:

1. Please place your upper arms next to your body and bend your elbows 90 degrees with the palms of your hands facing the ceiling.
2. I will place this bar attached to the minigym in your hands and I will ask you to pull up on the bar as you breathe out. The bar will not move.
3. Any time you are ready, take a breath and pull up on the bar as hard as you feel comfortable for 3-4 seconds while you breathe out.

The process was repeated twice with a rest period between each trial.

DYNAMIC ARM STRENGTH TEST INSTRUCTIONS

After demonstration of the procedure and showing the volunteer where to stand on the minigym board, the following instructions were repeated:

1. Please completely extend your arms with the palms of your hands facing forward.
2. I will place the bar attached to the minigym rope in your hands and ask you to completely flex your arms as fast as you feel comfortable while you breathe out.
3. Any time you are ready, take in a breath and flex your arms as you breathe out.

The procedure was performed three times with a rest period between trials.

APPENDIX G: t TEST FOR NURSING PERSONNEL SUBGROUPS
AND TEST FOR EQUAL VARIANCES TABLES

Table G-1. t Test Table for Comparison of Pregnant and Nonpregnant Nursing Personnel Means of Change Over Testing Sessions for Each Dependent Variable

VARIABLE	PREGNANT		NONPREGNANT		T	DF	PR > T
	N	MEAN	N	MEAN			
NON-DOMINANT HAND	20	0.200	14	0.183	-0.0665	32	0.9474
DOMINANT HAND	20	-0.150	14	-0.333	-0.4082	32	0.6859
STATIC ARM	20	1.211	14	0.310	-1.215	32	0.2331
DYNAMIC ARM	20	0.594	14	-0.238	-2.3296	32	0.0263
SIMPLE RT	20	0.0002	14	-0.004	-0.8202	32	0.4182
CHOICE RT	20	-0.055	14	0.015	1.4283	32	0.1629
CHOICE RT ERROR	20	0.017	14	-0.071	-0.6110	32	0.5455

Table G-2. t Test Table for Comparison of Matched Pregnant and Nonpregnant Nursing Personnel Means of Change Across Testing Sessions for Each Dependent Variable

VARIABLE	PREGNANT		NONPREGNANT		T	DF	PR > T
	N	MEAN	N	MEAN			
NON-DOMINANT HAND	6	0.019	6	0.407	0.8188	10	0.4320
DOMINANT HAND	6	-0.741	6	-0.111	1.0527	10	0.3173
STATIC ARM	6	0.648	6	-0.130	-0.5625	10	0.5862
DYNAMIC ARM	6	0.500	6	0.259	-0.4178	10	0.6849
SIMPLE RT	6	0.0023	6	0.0016	-0.1044	10	0.9189
CHOICE RT	6	-0.047	6	-0.025	0.4932	10	0.6325
CHOICE RT ERROR	6	-0.0474	6	-0.025	0.4932	10	0.6325

Table G-3. Results of Test for Equal Variances for Pregnant and Nonpregnant Group t Tests

VARIABLE	VARIANCES	F' VALUE	DF	PROB > F'
NON-DOMINANT HAND	are equal	1.79	30 and 30	0.1152
DOMINANT HAND	are equal	1.13	30 and 30	0.7393
STATIC ARM	are equal	1.06	30 and 30	0.8671
DYNAMIC ARM	are equal	1.15	30 and 30	0.6993
SIMPLE RT	are equal	2.18	30 and 30	0.0360
CHOICE RT	are equal	1.90	30 and 30	0.0836
CHOICE RT ERROR	are equal	1.31	30 and 30	0.4676

Table G-4. Results of Test for Equal Variances for Pregnant and Nonpregnant Nursing Personnel Subgroup t Tests

VARIABLE	VARIANCES	F' VALUE	DF	PROB > F'
NON-DOMINANT HAND	are equal	1.52	13 and 19	0.3968
DOMINANT HAND	are equal	1.18	13 and 19	0.7288
STATIC ARM	are equal	1.01	19 and 13	1.0000
DYNAMIC ARM	are equal	2.29	13 and 19	0.0985
SIMPLE RT	are equal	1.70	19 and 13	0.3301
CHOICE RT	are equal	4.88	19 and 13	0.0055
CHOICE RT ERROR	are equal	3.35	19 and 13	0.0302

Table G-5. Results of Test for Equal Variances for Pregnant and Nonpregnant Matched Nursing Personnel Subgroup t Tests

VARIABLE	VARIANCES	F' VALUE	DF	PROB > F'
NON-DOMINANT HAND	are equal	2.44	5 and 5	0.3499
DOMINANT HAND	are equal	1.03	5 and 5	0.9740
STATIC ARM	are equal	17.52	5 and 5	0.0069
DYNAMIC ARM	are equal	4.95	5 and 5	0.1037
SIMPLE RT	are equal	3.06	5 and 5	0.2446
CHOICE RT	are equal	2.61	5 and 5	0.3150
CHOICE RT ERROR	are equal	4.00	5 and 5	0.1544

APPENDIX H: GRAPHS OF MEAN VALUES OF STRENGTH AND REACTION
TIME DATA BY GROUP FOR THE FOUR TESTING
SESSIONS

- H-1 AVERAGE NON-DOMINANT HAND GRIP STRENGTH
- H-2 AVERAGE DOMINANT HAND GRIP STRENGTH
- H-3 AVERAGE STATIC ARM STRENGTH
- H-4 AVERAGE DYNAMIC ARM STRENGTH
- H-5 AVERAGE SIMPLE REACTION TIME
- H-6 AVERAGE CHOICE REACTION TIME
- H-7 AVERAGE CHOICE REACTION TIME ERRORS

Kilograms

Figure H-1. Average Non-dominant Hand Grip Strength Over Four Testing Sessions by Subject Number

Figure H-2. Average Dominant Hand Grip Strength Over Four Testing Sessions by Subject Number

Figure H-3. Average Static Arm Strength Over Four Testing Sessions by Subject Number

Figure H-4. Average Dynamic Arm Strength Over Four Testing Sessions by Subject Number

Figure H-5. Average Simple Reaction Time Over Four Testing Sessions by Subject Number

Figure H-6. Average Choice Reaction Time Over Four Testing Sessions by Subject Number

Figure H-7. Average Choice Reaction Time Errors Over Four Testing Sessions by Subject Number