FUNCTIONAL CHANGES IN VAGINAL MUSCULATURE ASSOCIATED WITH PREGNANCY

by

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A thesis submitted to the faculty of the
University of Utah in partial fulfillment of the requirements
for the degree of

Master of Science

College of Nursing

University of Utah

June 1972

This Thesis for the

Master of Science Degree

by

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ACKNOWLEDGMENTS

For the gracious assistance and encouragement of my supervisory committee, Miss Joyce Cameron, chairman, Mrs. Nancy Davidson, and Dr. Marie Holley, I wish to express my gratitude and appreciation.

Gratitude is expressed also to the women who so willingly participated in this study.

My appreciation always to my parents for their constant interest and support in all my endeavors. To my religious community, the Congregation of the Sisters of St. Joseph of Carondelet, I am sincerely grateful for making this educational opportunity possible.

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ABSTRACT

The purpose of this study was, by use of Kegel's perineometer, to identify functional changes in vaginal musculature associated with pregnancy.

Pregnant women registered in the prenatal clinic of a 277 bed university medical center and under the care of private obstetricians were studied.

The sample consisted of five primigravid women who were less than 14 weeks pregnant at the beginning of the study. Measurements of the vaginal musculature were obtained once during each trimester of pregnancy in an attempt to identify the occurrence of functional change.

The raw data suggested support of the hypothesis that, functional change occurs in vaginal musculature throughout the course of pregnancy. However, statistical analysis of the data failed to support the hypothesis.

Statistical correlations among variables brought to light some fascinating and unexpected data concerning the influence of age, height, and weight upon the vaginal muscle measures.

Failure of statistical analysis to support the hypothesis may be attributable to the small number of study subjects (5).

CHAPTER I

INTRODUCTION

Childbearing is universally described as a normal physiological function of the female. Numerous changes occur within the woman throughout pregnancy which prepare her for the experience of labor and delivery. Most remarkable of all these changes are those which occur physiologically and anatomically.

This study is concerned with one aspect of physical and physiological change, that of vaginal musculature. These changes enable support of the increasing weight of the reproductive organs, and prepare the vaginal musculature for the stretching and accomodation of the fetus which occurs during the birth process.

General references to thickening of mucosa, loosening of connective tissue, and hypertrophy of muscle cells are commonly found in obstetric and physiology texts. Reference to evidence of changes of a functional nature are not readily found.

Anatomy of the vagina and the perineum pertaining to the changes mentioned above is as follows:

VAGINA: The muscular coat is not sharply defined, although two layers of smooth muscle, an outer longitudinal and an inner circular, may usually be distinguished. At the lower extremity of the vagina there is a thin band of striated muscle, the CONSTRICTOR or SPHINCTER VAGINAE; the LEVATOR ANI, however, is the principal muscle that closes the vagina. Outside of the muscular layer is connective tissue that joins the vagina to the surrounding parts. It contains many elastic fibers and an abundance of veins (Hellman & Pritchard, 1971, p. 28).

PERINEUM: The perineum consists of the muscles and fascia of the urogenital and pelvic diaphragms. The urogenital diaphragm, lying across the pubic arch above the superficial perineal (Colles') fascia, consists of the deep transverse perineal muscles and the constrictor of the urethra. The pelvic diaphragm is made up of two muscles, the coccygeus and levator ani, the latter consisting of three portions--- iliococcygeus, pubococcygeus, and puborectalis. These muscles form a sling for the pelvic structures; between them pass the urethra, vagina, and rectum. The puborectalis and pubococcygeus constrict the vagina and rectum and form an efficient functional rectal sphincter. The median raphe of the levator ani between the anus and the vagina is reinforced by the central tendon of the perineum, on which the bulbocavernosi, the superficial transverse perineal muscles, and the external sphincter ani converge. These structures contribute to the PERINEAL BODY and form the main support of the perineal floor (Hellman & Pritchard, 1971, p. 30).

In 1948 Kegel began publishing results of his studies regarding physiology of vaginal perineal musculature. He concerned himself with the problem of urinary incontinence in women and devised a tool for measuring muscle function within the vagina. His tool, the perineometer, was used in a number of studies involving various aspects of physiology of vaginal musculature.(Kegel, 1948, 1956).

Jones (1950, 1955) studied not only urinary incontinence but also injuries specific to vaginal musculature related to surgery and childbirth. In his studies he correlated electomyography and roetgenography with the use of the perineometer demonstrating its validity as a tool for measuring vaginal muscle function.

Bushnell (1950) studied obstetrical patients using the perineometer and reported prenatal as well as postpartal vaginal muscle function.

Allen (1971) correlated the function of vaginal musculature with vaginal perineal exercise regimes in postpartal women.

However, no studies were found related to "spontaneous" changes in the function of vaginal musculature associated with pregnancy. The above mentioned studies were based upon active exercise regimes involving vaginal musculature. Their pertinence and relevance to this study arises from the fact that they concentrated on functional change in vaginal musculature and that the tool of measurement was Kegel's perineometer.

The purpose of this present study was to investigate the status of vaginal musculature and to identify functional changes occurring from the first through the third trimester of pregnancy by use of Kegel's perineometer.

The underlying assumption is that a muscle increases in function in proportion to the demand made upon it.

It seems logical therefore, that with the increasing weight of the reproductive organs, fetus and associated structures such as the placenta and amniotic fluid, measurable supportive and preparative demands are made upon the vaginal musculature throughout the course of pregnancy.

It was hypothesized that:

Measurable functional changes do occur in vaginal musculature throughout the course of pregnancy.

CHAPTER II

METHOD

The study subjects were women registered with the prenatal clinic of a 277 bed university medical center and with private obstetricians. Subjects were selected who were primigravid and in the first trimester of pregnancy.

The study was explained to attending physicians and their approval elicited before patients were invited to participate.

Women in the first trimester of their first pregnancy were contacted to ascertain their willingness to participate in the study. An explanation of the research project and its purpose was given. Included in the explanation was a demonstration of the perineometer as the tool of measurement, and assurance that it was safe to use during pregnancy.

Kegel's perineometer is a pneumatic resistance chamber, cylindrical in shape, 8 centimeters long, and anatomically commensurate with the vaginal canal. Rubber tubing connects the chamber to a manometer which records pressure variance from 0 to 100 millimeters of mercury. Visual guidance helps to establish awareness of function and coordination, and renders further exercise possible. The tubing is long enough to permit the patient to hold the manometer for observation (Figure 1).

Using the perineometer, a series of measurements was performed on the subject once during each trimester of her pregnancy to establish the extent of change in the function of the vaginal musculature.

Women were included in the study who were less than 14 weeks pregnant. The estimated week of pregnancy was recorded at the time of the first data collection.

The second trimester data were obtained between the 20th and 22nd weeks and the third trimester data were obtained between the 35th and 37th weeks of gestation.

The measurement series at each trimester consisted of five measurements, two static and three contractile.

These measurements were obtained by placement of the perineometer into the vaginal canal by the subject. Just prior to placement, in the interest of asepsis, the perineometer was inserted into the thumb portion of a size 8 1/2 sterile glove. A water soluble agent (Lubafax or KY Jelly) was used as a lubricant to facilitate placement of the perineometer.

Measurement Procedure

The first four measurements were taken with the woman in a modified lithotomy position on the examining table.

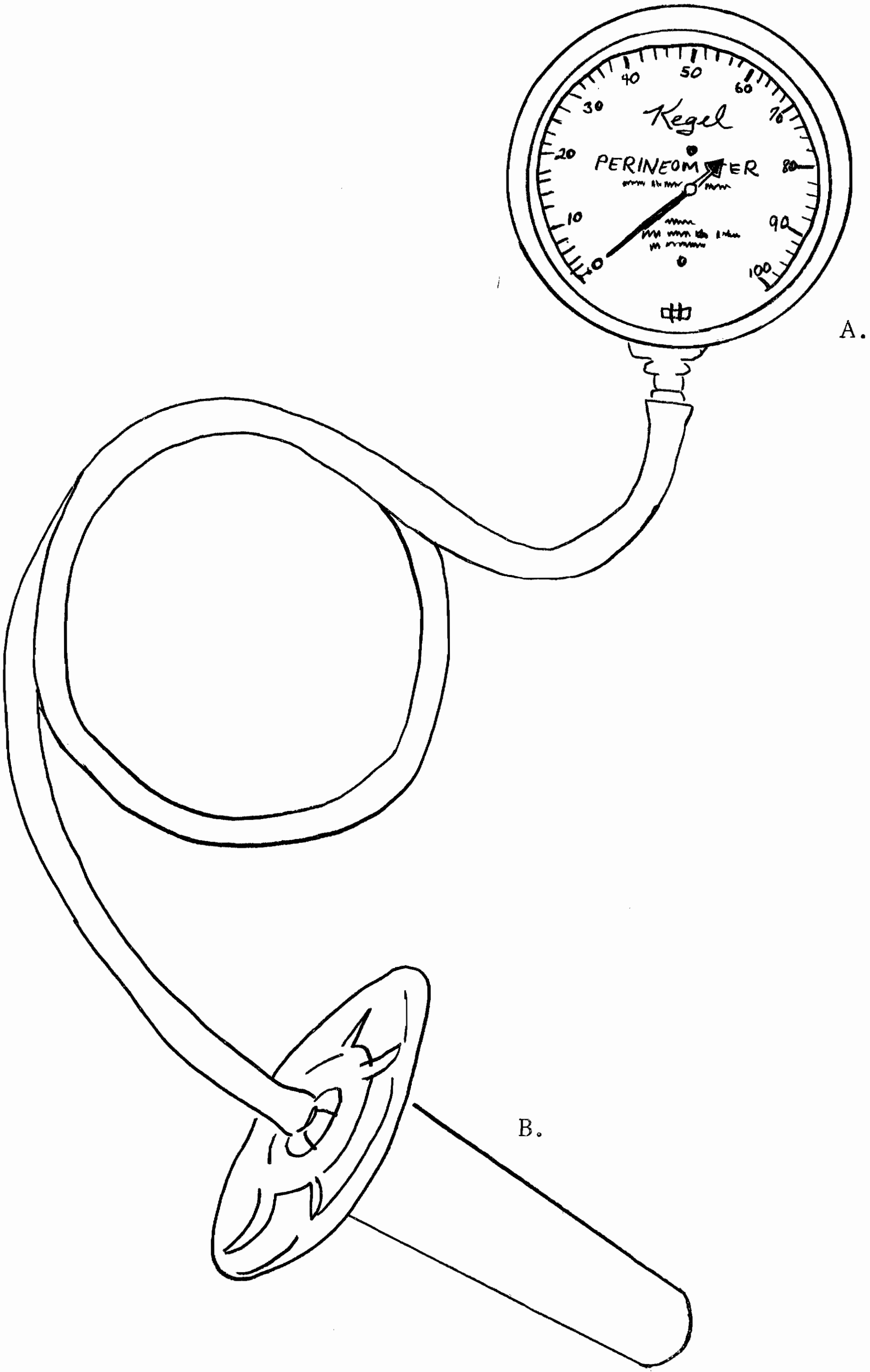

Figure 1. Kegel perineometer. A. Manometer. B. Pneumatic resistance chamber.

First Measurement: The perineometer was placed in the vaginal canal and the reading indicated on the manometer was recorded. This first measurement was a static one, simply a recording of the pressure within the vaginal canal.

Second Measurement: With the perineometer in the vaginal canal the subject was then requested to forcefully contract the vaginal musculature. The highest point indicated on the manometer during the contractile effort was recorded as the measurement of the contractile force.

The subject was then requested to relax the vaginal musculature.

The third and fourth measurements replicated the second exactly with a brief rest period in between each measurement.

These three measurements constituted the contractile measurements of the series.

Fifth Measurement: The upright, standing position was used for this measurement. With verbal direction and by physically assisting the subject from the examining table it was not necessary to remove and replace the perineometer for the measurement. Therefore the perineometer was placed for the first measurement and not removed until the series of measurements was completed. A static measurement, a recording of the pressure within the vaginal canal, was obtained with the subject in this standing position.

This completed the measurement process and the perineometer was then removed.

A single data sheet was kept on each subject and information recorded thereon provided the data for analysis.

Information other than the serial measurement recordings included: subject number, parity, age, last menstrual period, estimated date of confinement, weight, height, body build, exercises, and presence or absence of vaginitis (Data collection form, Appendix A).

The exercise question referred to whether the woman was doing exercises specifically affecting vaginal perineal musculature such as "perineal tightening". There was no intent of encouraging or discouraging such exercises so long as the investigator knew what was being done, so as to determine whether there was a potential for influencing the results of the measurement process. Kegel's research had indicated that change due to exercise is unlikely unless an exercise regime of 120 to 150 contractile efforts daily for 4 to 6 weeks is used.

Information concerning the presence or absence of vaginitis was obtained because of the potential effect a severe vaginitis might have for causing sufficient discomfort and/or muscle function change to influence the measurement process.

CHAPTER III

RESULTS

The study involved five primigravid women. A sixth woman began the study but was found not to be pregnant so was dropped from the study. First trimester data for all women in the study was obtained at about the 13th week (Table I). Second and third trimester data was obtained as previously stated, i.e., between the 20th and 22nd week and 35th and 37th week respectively (Tables II and III).

Analysis of the data was achieved with the assistance of the University of Utah Computer Center using the Univac 1108 and the U.U.C.C. library programs, CORREL for correlational analysis, and RMD1WA, a repeated measures program.

The presence and degree of vaginitis, and, the incidence of performing exercises specific for vaginal perineal musculature became insignificant. That is, none of the five women at any one of the data collections demonstrated evidence and/or symptoms of vaginitis, and none were performing exercises specifically related to vaginal perineal musculature.

TABLE I

DATA COLLECTION I

BASE LINE READINGS

SUBJECTS	VAGINAL MUSCLE MEASURES I	II	III	IV	V
A	7	15	14	16	14
B	0	12	14	14	0
C	0	10	8	7	3
D	0	4	2	5	0
E	12	24	24	26	15

TABLE II

DATA COLLECTION II

SUBJECTS	VAGINAL MUSCLE MEASURES I	II	III	IV	V
A	10	16	16	15	14
B	14	30	30	34	20
C	7	22	24	20	14
D	0	6	8	10	0
E	8	26	24	24	16

TABLE III

DATA COLLECTION III

SUBJECTS	VAGINAL MUSCLE MEASURES I	II	III	IV	V
A	15	22	24	22	25
B	15	26	34	32	22
C	0	20	16	18	10
D	15	20	22	22	20
E	4	22	22	20	12

The five measurements obtained once during each trimester did <u>suggest</u> trends of change as raw data. That is, four of the five subjects (80%) showed increased manometer readings on all five measurements with a final computation of readings significantly above their base line readings. Each subject served as her own control, that is, the first data collection (Table I) determined base line manometer readings for her and the subsequent readings (data collection II and III) were compared with it. The range of increase above base line readings was six (6) to twenty two (22) millimeters of mercury (Table IV).

TABLE IV

A $\pm$ COMPARISON OF BASE LINE READINGS (FIRST DATA COLLECTION) WITH THE THIRD DATA COLLECTION

SUBJECTS	VAGINAL MUSCLE MEASURES				
	I	II	III	IV	V
A	+8	+7	+10	+6	+11
B	+15	+14	+10	+18	+22
C	=	+10	+8	+11	+7
D	+15	+16	+20	+17	+20
E	-8	-2	-2	-6	-3

One subject (20%) consistently showed either a repeat of base line readings or a decrease with a final computation below her base line readings (Table IV).

No attempt was made to assess the influence of pelvic engorgment (a known variable) upon the measurement data obtained.

Changes in variables occuring from one trimester to the others yielded F-ratios of less than 1.0 and were not statistically significant at the .05 level. Thus, the hypothesis that, measureable functional changes do occur in vaginal masculature throughout the course of pregnancy, was not supported by the data.

However, several correlations among variables did reach statistical levels of significance (P >. 05) and may be of import to antepartal care.

Table V includes the relationships of age with the five vaginal muscle measures obtained during each trimester of pregnancy. The difference between the first and third trimester correlations for measures I and V is significant at greater than the . 001 level. Measure III is significant at greater than the . 05 level. Measures II and IV are not statistically significant. The correlations of the first and second trimesters are positive. The third trimester correlations are consistently negative in direction. The older women have relatively high manometer readings in the first trimester, readings drop slightly in second trimester, and dropped significantly in the third trimester in relation to the first.

Table VI includes the relationships of height with the five vaginal muscle measures obtained during each trimester of pregnancy. The size of correlations are high in all trimesters, and the difference between first trimester correlations and third trimester correlations is significant at greater than the . 001 level. The first and second trimester correlations are positive. The third trimester correlations are consistently negative in direction. The taller women have relatively high manometer readings

TABLE V

CORRELATION OF AGE AND VAGINAL MUSCLE MEASURES

	VAGINAL MUSCLE MEASURES														
	First Trimester					Second Trimester					Third Trimester				
	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Subject's Age	.26	.47	.39	.25	.36	.29	.52	.54	.24	.54	-.89	-.21	-.54	-.52	-.73

TABLE VI

CORRELATION OF HEIGHT AND VAGINAL MUSCLE MEASURES

	VAGINAL MUSCLE MEASURES														
	First Trimester					Second Trimester					Third Trimester				
	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Subject's Height	.68	.79	.71	.66	.62	.12	.49	.43	.22	.42	-.84	-.19	-.46	-.55	-.79

in the first trimester, readings drop slightly in second trimester, and dropped significantly in the third trimester in relation to the first.

Table VII includes the relationships of weight with the five vaginal muscle measures obtained during each trimester of pregnancy. The size of the correlations are high and consistently in a negative direction suggesting that the greater the body weight the lower the tension in the vaginal musculature, i.e., the lower the manometer readings. Correlations between measure III and body weight during each trimester are, -.95, -.89, and -.94, and are significant at greater than the .01, .05, and .05 levels respectively. Since measure III represents a contractile measurement it suggests that measurable contractile force within the vaginal musculature is inversely related to body weight in each trimester.

In summary, these significant correlations among variables demonstrate a strong influence of age, height, and weight upon measures of functional change in vaginal musculature. Heavier women tended to have lower manometer readings in all three trimesters. Older and taller women had higher manometer readings in the first and second trimesters and lower manometer readings during the third trimester.

TABLE VII

CORRELATIONS OF WEIGHT AND VAGINAL MUSCLE MEASURES

	VAGINAL MUSCLE MEASURES				
SUBJECTS WEIGHT	I	II	III	IV	V
First Trimester	-.83	-.83	-.95**	-.87	-.82
Second Trimester	-.93	-.70	-.89*	-.82	-.90*
Third Trimester	-.85	-.82	-.94*	-.88*	-.86

* P .05

** P .01

CHAPTER IV

SUMMARY AND RECOMMENDATIONS

The purpose of this study was an attempt to identify functional changes in vaginal musculature associated with pregnancy. Statistical analysis of data did not suggest support of the hypothesis. However, four of the five subjects (80%) did demonstrate functional change in vaginal musculature.

Statistical correlations among variables brought to light some fascinating and unexpected data.

It is not too surprising that heavier women would have consistently lower manometer readings when one realizes that muscle tone generally is poor whenever there is an excess of fatty tissue. Why, however, this particular finding would occur is puzzling in view of the fact that pelvic tissue rarely becomes "fatter" even with increased body weight generally. It is possible that the lax abdomen often found in heavier women resulted in more stress being applied to this area with less force against the pelvic musculature. Decreased force might in turn not demand compensatory increase of muscle tone as pregnancy progressed.

The phenomenon of taller and older women having relatively higher manometer readings in the first trimester, which drop significantly in the third trimester, is difficult to explain. Again, the degree of stress which the reproductive organs and fetus place on the pelvic musculature may be different at different points in pregnancy because of these variables. Further study is indicated in order to clarify these relationships.

Failure of statistical analysis to support the hypothesis is perhaps attributable to the small number of study subjects (5). However, functional change and the striking statistical significance of correlation among variables provides evidence for further investigation and a replication of the study.

It is therefore recommended:

(1) That the study be replicated with a larger population and with particular attention to variations in age, height, and weight.

(2) That a way be devised to obtain study subjects earlier in the first trimester of their pregnancy.

(3) That in addition to the perineometer, a tool be devised to measure the influence of pelvic engorgment.

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REFERENCES

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APPENDIX A

APPENDIX A

DATA COLLECTION FORM

Subject #________ Parity: Primigravida

Age: __________ Height:__________

LMP:__________ EDC: ______________

Body Build:____

Data Collection #1 _____ Weeks Gestation

Measurement	#1_____mm Hg	Wt:__________ lbs.
	#2_____mm Hg	Exercises: _______
	#3_____mm Hg	Vaginitis: Mild _____
	#4_____mm Hg	Moderate: ______
	#5_____mm Hg	Severe: ______

Data Collection #2 _____ Weeks Gestation

Measurement	#1_____mm Hg	Wt:_______ lbs.
	#2_____mm Hg	Exercises:_________
	#3_____mm Hg	Vaginitis: Mild_______
	#4_____mm Hg	Moderate: ______
	#5_____mm Hg	Severe:_______

Data Collection #3

Measurement	#1_____mm Hg	Wt:__________ lbs.
	#2_____mm Hg	Exercises:______
	#3_____mm Hg	Vaginitis: Mild____
	#4_____mm Hg	Moderate:____
	#5_____mm Hg	Severe: _______

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