Effects of Tactile Pressure to the Maternal Abdomen on Fetal Movement at 32 to 39 Weeks Gestation

by

Lynn Danell Wheeler, B.S.N.

A Thesis

Presented to

The Oregon Health Sciences University

Department of Family Nursing

in partial fulfillment of the

requirements for the degree of

Master of Science in Nursing

March, 1987

APPROVED:

[redacted]

Carol L. Howe, D.N.Sc., C.N.M., Associate Professor,

Advisor

[redacted]

Thomas W. Lloyd, M.S., C.N.M., Assistant Professor

First reader

[redacted]

Sheila Kodadek, R.N., Ph.D., Associate Professor

Second reader

[redacted]

Carol A. Lindeman, R.N., Ph.D., Dean, School of Nursing

This study was supported in part by traineeships NU00250-09 and NU00250-10 from the Division of Nursing, U. S. Department of Health and Human Services.

ACKNOWLEDGMENTS

A project such as this is never accomplished by one individual. Carol Howe, C.N.M., D.N.Sc., and committee members Tom Lloyd, C.N.M., and Sheila Kodadek, R.N., Ph.D. have provided their scarce and valuable time and energy in this project. In addition, Barbara J. Stewart, Ph.D. offered many helpful comments on the design and data analysis.

Prepared Childbirth Association generously opened their classes to me for recruitment. I would like to give a special thanks to those women who participated in the study for their time and efforts.

Throughout my graduate education I have been fortunate to have the guidance and support of two very special people, Merla J. Olsen and Lester J. Newman. I am privileged to call them my mentors and my friends. Many other friends assisted me in ways too numerous to mention. Those friends who deserve special mention include Phil Young, Roberta Hellman, Charles Osborne, and Tiz Gasperina.

Without my parent's constant and articulate beliefs in my abilities, I would not have reached for and attained this goal. My brother Ken provided computer, statistical, and emotional support, frequently all at the same time. The rest of my family provided unwavering encouragement in many different forms. This thesis is dedicated with love and admiration to my grandmother, Edna Augusta Christensen Thonstad.

TABLE OF CONTENTS

CHAPTER

LIST OF TABLES AND FIGURES

CHAPTER I

Introduction

The evaluation of fetal activity through the use of maternal reporting of fetal movement (FM) is assuming an increasingly important part in the assessment of fetal health. Although FM are not used exclusively to ascertain fetal health status, they are an important screening tool.

Fetal activity, including FM and fetal heart rate (FHR), is influenced by the behavioral state of the fetus (Dierker, Pillay, Sorokin, & Rosen, 1982a; Nijhuis, Prechtl, Martin, & Bots, 1985). In an active behavioral state, there are frequent FM and FHR accelerations. In a quiet behavioral state, FM is limited and tends to be of short duration, FHR accelerations are shortened or absent, and there is a lack of long term FHR variability (Dierker et al., 1982a). These quiet periods grow longer as the fetus matures and may last as long as 75 minutes at term (Dierker et al., 1982a; Nijhuis et al., 1985).

It is well documented that FM is associated with an increase in FHR in healthy fetuses. This relationship is used to assess fetal status by analyzing FHR patterns through the use of the non-stress test (NST) or the contraction stress test (CST) (Evertson, Gauthier, Schifrin, & Paul, 1979; Lauersen & Hochberg, 1982; O'Leary & Andrinopoulos, 1981).

The NST is often the first diagnostic test performed to determine fetal status (Evertson & Paul, 1978; Vintzileos, Campbell, Ingardia, &

Nochimson, 1983). Criteria for a normal, or reactive NST vary and may include: (a) two to five FHR accelerations of 15 beats per minute (bpm) for at least 15 seconds associated with FM, and (b) a baseline FHR within the range of 120 to 160 bpm, and (c) a certain amount of variability, or short term FHR changes (Sadovsky, Navot, & Yaffe, 1981; Vintzileos et al., 1983). The criteria for a normal NST usually occur within a 10-40 minute period (Evertson & Paul, 1978; Pritchard, MacDonald, & Gant, 1985; Sadovsky et al., 1981; Vintzileos et al., 1983).

If the healthy fetus is in a quiet behavioral state while undergoing a NST, a falsely nonreactive result could be obtained (Dierker, Pillay, Sorokin, & Rosen, 1982b; Evertson & Paul, 1978; Richardson, Campbell, Carmichael, & Patrick, 1981; Timor-Tritsch, Dierker, Hertz, Deagan, & Rosen, 1978). External physical stimulation of the maternal abdomen is frequently used by antepartum testing personnel to increase FM in a quiet fetus in order to decrease the false non-reactive rate when obtaining a NST. Since the NST is simpler, easier to perform, and less interventive than the CST, it is desirable to study methods which facilitate obtaining a valid and reliable NST.

Problem Statement

This study will attempt to document whether applying tactile pressure to the maternal abdomen is effective in increasing FM. Measurement will be limited specifically to FM. However, if applying tactile pressure to the maternal abdomen is effective in increasing

FM, this could reduce the number of equivocal or falsely nonreactive NSTs. It could also improve the success rate and/or decrease the time required to perform an NST. If applying tactile pressure to the maternal abdomen is found to be ineffective in increasing FM, then clinicians can avoid wasting time and effort in carrying out this strategy. In addition, knowing the effect of applying tactile pressure to the maternal abdomen on FM could be useful when FM is not desirable, such as before amniocentesis.

This study is a modification of two studies on the effects of external physical stimulation on FM (Richardson et al., 1981; Visser, Zeelenberg, DeVries, & Dawes, 1983). These studies are described in the review of literature. Unlike the studies performed by Richardson et al. (1981), and Visser et al. (1983), this study did not attempt to evaluate parameters other than FM and attempted to utilize a larger sample size.

There is no evidence that gentle physical stimulation of the maternal abdomen will result in any harm. Forces far exceeding those used in this study are applied for such standard obstetrical practices as Leopold's maneuvers and external version. Both the mother and the fetus may derive some benefit from the mother resting on her side and through psychosocial interction with the fetus, which in this case is an increased awareness of FM (Carter-Jessop, 1981).

This study is predominately practice-oriented. A beginning conceptual framework will be delineated which includes fetal behavioral states, external physical stimulation, and FM. It is hoped that this study will promote a more thorough understanding of the effects of external physical stimulation on the fetus in the third trimester.

Review of the Literature

Introduction

This review of the literature will examine the physiology of FM, the measurement of FM, variables affecting FM, and the use of FM as an indicator of fetal health status. Two studies examining the effects of external physical stimulation on FM will be analyzed in the section on variables affecting FM.

Physiology of Fetal Movement

Development

The first "fetal" movements occur at 6-8 weeks from the last menstrual period (Ianniruberto & Tajani, 1981; Shawker, Schuette, Whitehouse, & Rifka, 1980). At 10 weeks extension movements of the lower and upper limbs begin, usually in a jerky fashion. The developmental progression of muscular activity occurs in a cephalocaudal fashion (Coleman, 1981). At 16 to 19 weeks there is coordination of limb movements with "exploration-type" movements of uterine and placental surfaces (Ianniruberto & Tajani, 1981). FM become more forceful from approximately 20 to 36 weeks gestation, and subsequently more noticeable to the mother, due to a combination of increased fetal neuromuscular coordination and an increase in fetal muscle mass and strength (Sorokin & Dierker, 1982). Comparetti (1981) postulated that FM had functional effects for the fetus in developing extrauterine competencies such as breathing and suckling.

FM and FHR Changes

The association of FM with FHR accelerations occurs primarily after 30 weeks gestation and may be due to development of fetal cardioregulatory mechanisms (Sorokin, Bottoms, Dierker, & Rosen, 1982). Between 20 and 30 weeks FM is commonly associated with FHR decelerations (Sorokin et al., 1982).

The control of FM is directed through the central nervous system, (Sorokin et al., 1982). Terao et al. (1984) studied FHR in anencephalic fetuses in the third trimester and concluded that the midbrain (hypothalamus), as well as the medulla oblongata were "involved with the occurrence of [FHR] accelerations" (p. 206). Rayburn (1982), specified that "...cortical nerves are stimulated from motor neurons to the adjacent cardiovascular neurons" (p.244) and that this explained the resulting FHR accelerations with FM. Timor-Tritsch, Dierker, Zador, Hertz, and Rosen (1979) identified that cortical nerve cells innervating motor neurons and those cells innervating cardiovascular neurons were anatomically in close proximity and that "... the cortical control of muscular activity and the associated increase in heart rate and blood pressure were explained on the basis of diagonal irradiation from the motor to the adjacent 'cardiovascular' neurons" (p. 279). FHR is also influenced by the autonomic nervous system, autonomic reflexes (baroreceptor and chemoreceptor reflexes), and biochemical factors, such as placental functioning and hypoxia (Terao et al., 1984). Other physiologic causes of FHR accelerations include fetal response to acoustic stimuli, partial compression of the umbilical cord, and peripheral nerve stimulation (Sorokin et al., 1982).

Summary

To summarize, FM follows an orderly progression of complexity in development, however the specific physiology of FM has not yet been elucidated. The nature of the relationship between FM and FHR changes is also tenuous. The relationship between FM and FHR accelerations is not well established until 30 weeks, at which time there is a presumed neuro-cardiovascular coordination associated with FM. FM and FHR accelerations can be influenced by placental functioning, and by certain applied stimuli.

The Measurement of Fetal Movement

Classifying Fetal Movement

Many studies have attempted to categorize FM. It is important to classify FM in order to be consistent in the measurement of FM. Categories encountered in the literature include the following: (1) types of FM, (2) patterns of FM, and (3) percentage time of FM (Birnholz, Stephens, & Faria, 1978; Devoe et al., 1986; Ehrström, 1977; Haller, Wille, Henner, Ruttgers, & Kubli, 1976; Patrick, Fetherston, Vick, & Voegelin, 1978).

"Type" classifications include subjective categories, i.e., strong and sudden (Ehrström, 1977; Reinold, 1973), and objective categories (observed by ultrasound) such as twitching, startle, and so forth (Birnholz, 1978). "Pattern classification" collapses objective categories, for example stretching or rolling (Patrick et al., 1978). "Percentage time" of FM is comprised of a timed period of FM per type or pattern of FM (Haller et al., 1976; Rosen, Hertz, Dierker, Zador, & Timor-Tritsch, 1979; Timor-Tritsch, Zador, & Hertz, 1976). Unfortunately terms used are often ambiguous, making it difficult to discern what is meant.

Techniques

FM may be measured by subjective (maternal and observer perception) and objective techniques. Objective techniques consist of passive and active methods.

> "Passive techniques do not introduce energy but rely on the fetal movement to produce the energy that may be converted into a signal. This signal may then be processed, recorded, and stored. Thus objective passive techniques involve the use of strain gauges or tocodynamometers. Active techniques, on the other hand, introduce energy (e.g., ultrasound) into the patient. Examples of active techniques of recording fetal movements are real-time B-mode sonography and continuous Doppler ultrasound, which is used to detect and record respiratory movements." (Timor-Tritsch, Dierker, Hertz, & Rosen, 1979, pp. 584-585).

Subjective techniques have the advantage of being inexpensive, universally available and non-inivasive. Objective techniques, (particularly ultrasound), have the capability of measuring fetal physical parameters and documenting other aspects of fetal health status.

Another consideration when measuring FM is whether the counting will take place for a fixed length of time or for a fixed number of FM. Sadovsky and Yaffe (1973) established a daily fetal movement record (DFMR) which required that FM be recorded for three one hour periods during the day, i.e., morning, noon, and evening. Pearson (1977) introduced a system of counting in which the mother counted FM starting at nine a.m. and recorded the amount of time required to count ten FM.

The rigidness of these two methods was discussed by Grant and Hepburn (1984), who proposed an approach to counting FM based on an individualized rate of FM. The hourly FM rate is calculated based on a two hour period for five consecutive days. The time taken to obtain this hourly norm of FM is then recorded once daily. Since the rate of FM is highly individualized, with a wide range of variability falling into what is considered "healthy" (Sadovsky, 1981), this seems the most logical approach, albeit more time consuming initally.

Reliability

Numerous studies have compared maternal perception of FM and the measurement of FM through the use of electromagnetic recording (Sadovsky, Mahler, Polishuk, & Malkin, 1973; Wood, Walters, & Trigg, 1977) and ultrasound (Hertogs, Roberts, Cooper, Griffin, & Campbell, 1979; Leader & Baillie, 1979; Manning, Platt, & Sipos, 1979; Neldam &

Jessen, 1980). FM in these studies was variably defined and measured.

Electromagnetic recording.

The correlation between maternal perception of FM and electromagnetic recording is close to 90% (Granat, Lavie, Adar, & Sharf, 1979; Sadovsky et al., 1973; Wood et al., 1977). Electromagnetic devices measure changes in body movement. A detector is placed on the maternal abdomen and is attached to a coil, which produces change in the frequency of an oscillator with movements. Those studies using electromagnetic recording devices used sample sizes ranging from 11 to 82, of varying gestational ages and parity. Characteristics of women involved in these studies were not well described.

Ultrasound.

A review of studies comparing maternal perception of FM with ultrasound revealed mean correlations ranging from 21% to 90%, with a bimodal distribution clustering around 40% and 85% (Maršál, 1983). These results must be viewed with suspicion, however, since for the most part measuring times were less than an hour, and in one large study, maternal correlation of FM was assessed by retrospective analysis of cardiotocographic tracings (Neldam and Jessen, 1980). Retrospective analysis of cardiotocographic tracings is not a reliable means of measuring FM (Schmidt, Cseh, Hara, & Kubli, 1984). When removing the study by Neldam and Jessen (1980), approximately 75% of the mothers felt over 70% of FM compared with ultrasound. Rayburn

(1980) found 100% accuracy between ultrasound and maternal perceptionin combined trunk and limb FM and 56% accuracy in isolated limb movements (described as weak or "flutter" movements).

Factors influencing maternal perception of fetal movement.

The reasons why mothers do not perceive 100% of actual FM is not known. Mathews (1975) speculated that the lack of maternal reliability was due to: (1) a pregnant woman's subjectivity, (2) the vigor, frequency, and timing of FM, (3) the amniotic fluid volume, (4) thickness of the abdominal wall, (5) state of attentiveness of the woman, (6) the woman's willingness to establish a kinesthetic relationship with her developing child, (7) deception, and (8) the responsibility of monitoring one's own fetus' activity being too much to bear. There is a paucity of data on the etiology underlying the discrepancy between objective measurements of FM (such as strength of FM and duration of FM) and maternal perception in the current literature.

Other factors which may influence maternal perception of FM include parity, maternal weight, fetal weight less than 2500 grams, time of day, activities which distract the mother from her attentiveness of FM, maternal fatigue, level of maternal body awareness, excess adipose tissue, polyhydramnios, an anterior placenta providing a shielding effect from FM, duration of FM, and maternal posture (Birger, Homburg, & Insler, 1980; Birkenfeld, Laufer, & Sadovsky, 1980; Leader & Baillie, 1979; Minors & Waterhouse, 1979; Rayburn, 1980; Sorokin, Pillay, Dierker, Hertz, & Rosen, 1981;

Valentin, Löfgren, Maršál, & Gullberg, 1984; Wladimiroff, & Roodenburg, 1982; Wood et al., 1977). The etiology underlying these alterations of maternal perception of FM was lacking.

Conversely, Hertogs et al., (1979), found that maternal sensitivity to FM did not depend on gestational age (in the last trimester), maternal age, parity, obesity, duration of FM, or the presence of an anterior placenta. The lack of association between increasing parity and maternal perceptions of FM was also noted by Birger et al. (1980). Leader and Ballie (1979) and Leader, Baillie, and VanSchalkwyk (1981) found no relationship between accuracy of maternal assessment of FM and parity, maternal ponderal index, standard of education or gestational age in their sample of 20 healthy women at 32 to 39 weeks gestation. Rayburn (1980) found that maternal obesity, parity, gestational age (28-43 weeks) or Braxton-Hicks uterine contractions did not influence maternal sensation of FM.

Factors influencing objective measurement of fetal movement.

Sheldon (1978) argued that the discrepancy between maternal perception of FM and ultrasound measurement may not be due to a lack of maternal reliability, but rather to ultrasound technician error. FM traced in late pregnancy by ultrasound may be difficult to evaluate simply due to the relationship between fetal size and size of the real-time ultrasound image (Sadovsky & Polishuk, 1977). Ultrasound measurements along fetal axes may miss isolated limb movements.

The problem of differentiating when one FM ends and another begins is not approached equally among ultrasonographic researchers. Some researchers require a six second interval, while others require a ten second interval without FM before another FM may be counted (Timor-Tritsch, Dierker, Hertz, & Rosen 1979).

A reliability issue infrequently addressed is the effect of ultrasound on FM. David, Weaver, and Pearson (1975) noted up to a 90% increase in FM after exposure to ultrasound, however other authors failed to confirm any effect of ultrasound on FM (Dawes, Visser, Goodman, & Levine, 1981; Hertz, Timor-Tritsch, Dierker, Chik, & Rosen, 1979). Wood et al. (1977) noted that ultrasound "...may produce different information as a result of energy influences on the fetal nervous system" (p. 567) but failed to elucidate what different information might be produced.

When comparing maternal perception and ultrasound for internal consistency, ultrasound may be measuring more than FM, i.e. fetal respiratory movement is detectable by ultrasound but not by maternal perception. If fetal respiratory movements were included in the FM counts and compared to maternal perceptions there is a potential for a significant discrepancy.

<u>Validity</u>

Sadovsky et al. (1973), considered the use of electromagnetic recording devices to be a sensitive tool for measuring FM, although no data is given to support this assumption. Schmidt et al. (1984) found a low correlation between actual FM as measured by ultrasound and cardiotocographic tracings and concluded that retrospective analysis of cardiotocographic tracings was not a valid indication of actual FM. Sheldon (1978) hypothesized that discrepancies in ultrasonic measurements of FM were due to a lack of definition of what constituted a FM.

Wood et al. (1977) suggest that:

> False positive counts may be recorded by patient or observer for psychological reasons, such as the subconscious desire to normalize measurements. Maternal abdominal, diaphragmatic or spinal movement may be falsely interpreted as fetal movement by either the patient or the observer and in the case of the observer alone, the hand on the abdomen may move involuntarily which, again, might be interpreted as fetal movement (p. 566).

It seems likely that ultrasound and maternal perception of FM are, indeed, measuring FM, with rare exceptions. Cardiotocographic recording, especially when analyzed retrospectively exhibits a low degree of validity.

<u>Potential Hazards in Measuring FM by Objective Methods</u>

There is as yet no definitive proof that ultrasound is or is not safe during pregnancy. Most studies do not provide documentation of power transfer in situ or amount of time exposure. Stark, Orleans, Haverkamp, and Murphy (1984) studied the short- and long-term risks after exposure to diagnostic ultrasound in 425 children at birth, seven, and twelve years of age with 381 matched control children and found no biologically significant differences between exposed and unexposed children. Unfortunately, no dose or time exposures were available, although the authors believe that the exposures were greater during the period studied than what is currently used. For now, it seems prudent to utilize subjective methods as much as possible in measuring FM until more research is available on the effects of ultrasound on the fetus.

Variables Affecting Fetal Movement

Variables which may affect FM can be classified as internal and external. Internal variables are those factors intrinsically associated with the pregnancy and fetus which affect FM. These internal variables include such factors as presence of uterine contractions, placental status, fetal abnormalities (congenital anomalies, intrauterine growth retardation), multiple gestation, fetal presentation, and fetal behavioral state. External variables are those factors which are extrauterine, such as circadian rhythm, maternal drug levels, maternal glucose levels, maternal activity, maternal emotional state (encompassing maternal hormonal levels), sound, light, vibration, and tactile stimulation of the maternal abdomen.

Various antecedent events affecting FM have been studied by numerous authors, but not for the purpose of increasing FM. Many of the studies were done with hospitalized women with multiple high risk factors, making it difficult to generalize to a more normal population. Samples of 20 or less were common. Control groups were nonexistent in most of the studies reviewed. There was rarely an explanation of what consistuted a FM, making it difficult to compare the effects of a specific strategy among different studies.

Several authors had doubts as to whether an increase in FM could be affected by external variables such as maternal posture, fundal pressure, and so forth. If the fetus was in a true quiet behavioral state (Richardson et al., 1981; Timor-Tritsch, Dierker, Hertz, Deagan, & Rosen, 1978). Only Schmidt, Boos, Gnirs, Auer, and Schulze (1985) presented fetal behavioral state in analyzing results after application of an external stimulation. Schmidt et al. (1985) concluded that behavioral states must be identified by ultrasound before, during, and after the application of a stimulus. Without such identification, research results would be impossible to interpret. Therefore, although this portion is categorized as variables affecting FM, a more accurate heading might be "variables possibly affecting FM". The reader should keep in mind that behavioral state was not controlled for in the following studies.

Internal Variables Affecting Fetal Movement

Gestational age.

Authors disagree on the effects of gestational age on FM. Patrick, Campbell, Carmichael, Natale, & Richardson (1982) showed a peak in the percentage of gross FM at 38-39 weeks while Roberts, Little, Mooney, Cooper, and Campbell (1979) demonstrated a shorter duration of FM with earlier gestation. However Roberts, Griffin, Cooper, and Campbell (1980) could demonstrate no effect of gestation on FM.

Intrauterine growth retardation (IUGR).

Several authors found a reduction in both the number and duration of general movements in IUGR fetuses (Bekedam, Visser, DeVries, & Prechtl, 1985; Mathews, 1975; Vliet, Martin, Nijhuis, & Prechtl, 1985b). The speculative rationale for this is provided by Vliet, Martin, Nijhuis, and Prechtl, (1985a): "In any case a reduction in periods of vigorous physical activity would seem to be a useful adaptation to intrauterine undernutrition." (p 195). Similar findings were reported by Mor-Yosef, Sadovsky, Brzezinski, Levinsky, and Ohel (1983) with the exception of asymmetrical IUGR babies whose FM were significantly higher at 37 to 38 weeks. Mor-Yosef et al. (1983) noted that a gradual trend of increasing daily fetal movement with gestational age was shown in fetuses with IUGR.

Multiple gestation.

Ohel, Samueloff, Navot and Sadovsky (1985) found less FM in twin pregnancies at 28-40 weeks gestation compared to singleton pregnancies. Paradoxically, Samueloff, Evron, and Sadovsky (1983) found more FM in fetuses of multiple gestation compared to singleton fetuses at 16-40 weeks gestation, and also noted a general decline in FM with increasing gestational age.

Fetal presentation, uterine contractions.

No effect on FM was found with breech versus vertex presentation (Luterkort & Maršál, 1985). Sadovsky, Rabinowitz, Freeman, and Yarkoni (1984) found that uterine contractions did not affect FM.

Polyhydramnios, anencephaly.

Sadovsky and Perlman (1978) found that polyhydramnios was associated with decreased FM. Visser, Laurini, DeVries, Bekedam, and Prechtl (1985) studied eight fetuses with anencephaly and found that movements were generally forceful and jerky in character and of large amplitude, following a "burst-pause" pattern, rather than being spread out.

Fetal behavioral states.

Fetal behavioral states influence fetal activity in healthy fetuses (Comparetti, 1981; DeVries, Visser, & Prechtl, 1985; Nijhuis et al., 1982; Vliet et al., 1985a; Vliet et al., 1985b; Vliet, Martin, Nijhuis, & Prechtl, 1985c). The parameters of fetal behavioral states include FM, fetal eye movements, and FHR patterns, including FHR accelerations and FHR variability (Nijhuis et al., 1982; Vliet et al., 1985c).

In an active behavioral state, there are frequent FM, with concomitant rises in FHR and continuous eye movements (Dierker et al., 1982a; Nijhuis et al., 1982). During quiet periods FM is limited and tends to be of short duration, consequently, FHR accelerations are shortened or absent and there is a lack of long term FHR variability, as well as no eye movements (Dierker et al., 1982a).

External Variables Affecting Fetal Movement

Glucose.

Most authors found no change in FM with increased maternal blood glucose levels, either from eating meals or from intravenous glucose administration (Bocking et al., 1982; Druzin & Foodim, 1986; Lewis, Trudinger, & Mangez, 1978; Minors & Waterhouse, 1979; Patrick et al., 1982; Wladimiroff & Roodenburg, 1982). Gelman, Spellacy, Wood, Birk, and Buhi (1980) did find a significant increase in FM one hour after intravenous glucose administration. However, the study used only 21 women, of which 9 constituted a control group, leaving only 12 women to receive glucose. Significant group differences in blood glucose levels were evident at 30 minutes, at 60 minutes statistically significant differences in FM were found between the two groups. It is not clear that differences in numbers of FM between the two groups was associated with maternal glucose levels.

Maternal position.

Minors and Waterhouse (1979) found sequentially increased FM counts when women were standing, sitting, and recumbant respectively, except for later in the day in which FM was greatest while sitting. However, only six women comprised the study, and there was no actual counting of FM, only a "general impression" which was recorded in symbols.

Time of day.

Several authors have confirmed a peak in fetal movements between 2100 to 0100 and an existence of fetal circadian rhythms (Campbell, 1980; Carmichael, Campbell, & Patrick, 1984, Ehrström, 1984; Minors & Waterhouse, 1979, Patrick et al., 1982; Roberts et al., 1979). However, Birkenfeld (1980) failed to show a circadian peak in FM.

Drugs.

Ianniruberto & Tajani (1981) found a decrease in FM after 50 milliliters of a "strong" alcoholic drink. McLeod, Brien, Loomis, Carmichael, Probert, and Patrick (1983) found no change in FM after 30 milliliters of a 40% alcohol solution. In two mothers Ianniruberto and Tajani (1981) found no change in FM after an unspecified amount of marijuana had been inhaled. Ianniruberto and Tajani (1981) studied women sedated with 10 to 20 milligrams of diazepam prior to minor surgical procedures. "In five fetuses movements ceased after 1-3 minutes for a period from 20 to 180 min. [minutes] Eleven fetuses from 14 to 22 wga [weeks gestational age] showed an epileptic fit..." (Ianniruberto & Tajani, 1981, p. 179). Samueloff, Evron, & Sadovsky (1984) found no difference in FM in a group of mothers receiving intravenous isoxuprine and a control group.

Maternal emotional state.

Field, Sandberg, Quetel, Garcia, & Rosario (1985) found that ultrasound feedback reduced maternal anxiety levels and FM. Ianniruberto and Tajani (1981) noted hyperactivity in fetuses whose mothers were under high emotional stress.

Cigarette smoking.

Several authors found a decrease in FM after cigarettes. Eriksen, Gennser, Löfgren, and Nilsson (1983) stated that: "The number of epochs with total absence of gross fetal movements before smoking increased significantly during the postsmoking hour..." (p. 370). Goodman, Visser, and Dawes (1984) found a significant reduction in the percentage of time the fetus spent moving during the first 16 minutes of smoking two cigarettes, as did Thaler, Goodman, and Dawes (1980).

Amniocentesis.

Several authors found an increase in FM after second and third trimester amniocentesis (Gianopoulos, Elias, Simpson, & Tamura, 1986; Hill, Platt, & Manning, 1979). However, Platt, Lenke, and Sipos (1981) found no change in FM after second trimester amniocentesis.

Acoustic stimulation.

Gelman, Wood, Spellacy, and Abrams (1982) found a significant increase in FM with 2000 cyles per second of sound at 110 decibels for one minute. Schmidt et al. (1985) found no difference when fetal behavioral state was taken into account. Sontag and Wallace (1936) found an increase in FM after a vibratory stimulus was applied to the maternal abdomen, as did Divon et al. (1985) almost 50 years later. The presence of a "fetal startle response" was found in term fetuses after application of a mixed sound-vibratory device to the maternal abdomen (Divon et al., 1985). This fetal startle response was thought to be similar to the startle reflex response present in neonates born after 30 weeks gestation.

External physical stimulation.

Numerous authors have reported on the use of tactile pressure on the maternal abdomen in order to produce or increase FM for use with NSTs (Evertson & Paul, 1978; Homburg, Matzkel, Birger, & Insler, 1980;

Ianniruberto & Tajani, 1981; Lee, DiLoreto, & Logrand, 1976; Paine, Payton, & Johnson, 1986; Serafini et al., 1984; Vintzileos et al., 1983). Several have even incorporated fundal palpation into their NST protocols after a 20 to 30 minute period of non-reactivity (Evertson & Paul, 1978; Lee et al., 1976). Evertson and Paul (1978) used external manipulations to activate the resting fetus and reasoned that external manipulations would differentiate the healthy fetus in a resting phase from one who is distressed. However, none of the authors citing use of tactile pressure to increase reactivity in the NST reported any quantifiable results.

There are two studies in the English literature which focused on the effects of external physical stimulation of the maternal abdomen on FM (Richardson et al., 1981; Visser et al., 1983). Both used small sample sizes and studied FM with ultrasound.

Richardson et al. (1981) found no change in FM or FHR with external physical stimulation of fetuses near term. The sample included 17 healthy pregnant women between 36 and 42 weeks gestation. Fetuses were observed by ultrasound 90 minutes before and after a standard physical stimulus. Fetal behavioral state was not controlled. The physical stimulus consisted of "10 vigorous shaking movements of the fundal portion of the uterus followed by 10 rocking movements of the fetal head suprapubically" (p. 345). No change in fetal breathing movements or FHR was observed after this stimulus.

The authors concluded that fetal behavior, and not external physical stimulation, was the determining factor in changes in these variables.

Visser et al. (1983) studied 10 healthy nulliparous women "near term" for 60 minutes and found no change in the FHR, fetal breathing movements, and FM when external physical stimulation was applied after a 10 minute period of low FHR variablity. Clients were randomized to two different groups. The first group received external stimulation after the first observed period of low FHR variability and no stimulation after the second observed period of low FHR variability; in the second group the order was reversed. "External stimulation was performed over a 20 second period by the same investigator in all patients. The stimulation consisted of strong shaking movements of the uterus, from one side to the other" (p. 581). The authors concluded that: "It is not the heart rate pattern but the underlying fetal behavioral state which is properly described as nonreactive" (p. 583). The authors compared the use of tactile pressure to change fetal behavioral states to efforts (usually ineffective) to arouse the neonate from quiet sleep by using physical stimulation. However, as with the study done by Richardson et al. (1981), the small sample size presents a serious problem in accepting these conclusions.

The Use of Fetal Movements as an Indicator of Fetal Health Status

Fewer than 10 FM in 12 hours, a "movements alarm signal" according to Sadovsky, Ohel, Havazeleth, Steinwell, and Penchas (1983), was found to be associated with significantly poorer fetal/neonatal outcomes in 616 hospitalized high risk women. This movements alarm signal correlated with poorer outcomes in 664 low-risk women delivering at a nurse-midwifery maternity center (Fischer, Fullerton, & Trezise, 1981). This association between poor outcomes and the movements alarm signal is documented in many other studies (Liston, Cohen, Mennuti, & Gabbe, 1982; Pearson & Weaver, 1976; Sadovsky, Weinstein, & Polishuk, 1978). This decrease in FM is thought to be due to utero-placental insufficiency (Fischer et al., 1981; Sadovsky 1981). Hyperkinetic FM followed by cessation is also considered to be a sign of acute fetal distress, although the etiology underlying this pathologic hyperkinesis is not discussed (Ianniruberto & Tajani, 1981; Sadovsky et al., 1978).

Some authors feel that if a fetus fails to initiate movement or demonstrate increased FHR upon various stimuli such as amniocentesis, there is a possibility that fetal health is compromised (Ron, Yaffe, & Sadovsky, 1976). Other authors suggest that fetal quiet states (with few or no FM) are a normal behavioral phenomena and may not be alterable by any form of external stimuli (Dierker et al., 1982b; Schmidt et al., 1985; Timor-Tritsch et al., 1978). At this point, the issue of behavioral state and FM remains controversial. It is generally agreed that if there is any question of decreased FM, further fetal health assessment is indicated, through the use of direct monitoring of fetal heart rate, and if necessary, other parameters.

Summary

The historical evolution of FM follows a progressively complex and orderly pattern with increasing gestational age. There is an establishment of fetal behavioral states which continue in the neonatal period. Terms used to classify FM are ambiguous. Currently several classifications exist: types of FM, patterns of FM, and percentage time of FM. FM may be measured by subjective and objective methods. FM may be measured reliably based on maternal perception. The etiologies underlying discrepancies between maternally perceived FM and those measured by ultrasound are not known. The influence of various external stimuli on the fetus may be mediated by fetal behavioral state, the nature of the stimuli, and/or the health status of the fetus.

In two studies investigating physical stimulation on the maternal abdomen no effect on FM was found. However, both samples were too small for adequate statistical analysis. Maternal abdominal manipulation is often performed in order to stimulate FM in attempts to obtain a reactive NST (indicating fetal health). A fetus which does not respond with FM after external physical stimulation could be in a quiet behavioral state or in distress. Whether external manipulation can differentiate between a quiet and sick fetus is, at this point, controversial.

Conceptual Framework

One of the broad goals of prenatal care is to reduce preventable fetal deaths through surveillance of the fetus. One of the most significant components of prenatal care is the ability to make objective assessments in determining fetal health status. Antepartum FHR testing is an important part of this assessment.

The reactive NST has been shown to be a good measure of fetal health status and requires a minimum number of FM. The proximity of cardiovascular and motor neurons is the theoretical explanation for the phenomenom of FHR accelerations in response to FM. This concept has been detailed previously in the review of literature. In addition, it is sometimes desirable to have limited or no FM, such as during amniocentesis. Fetuses make transitions between behavioral states. In a quiet behavioral state there are limited numbers of FM, subsequently there are few FHR accelerations.

The relationships between the study concepts are: (a) the non-distressed fetus in a quiet behavioral state exhibits few FM; (b) applying tactile pressure may cause an increase in FM in much the same way as touching a sleeping infant causes a generalized flexion of the extremeties (Divon et al., 1985) and may also cause accelerations of the FHR through mechanisms which, at this point, are not well elucidated; and (c) documenting a strategy for increasing FM could cause the fetus to change from a quiet to a more active behavioral state, thus increasing the success rate in obtaining a reactive NST. If tactile pressure increases FM, then tactile pressure could be avoided before an invasive procedure such as amniocentesis.

Hypothesis

In view of the literature on FM, fetal behavioral states, and external physical stimulation, this study will test a null hypothesis. It is hypothesized that that there will be no significant difference in FM in with the application of tactile pressure compared with no tactile pressure.

CHAPTER II

Methods

Design

In order to minimize threats to internal and external validity a repeated measures quasi-experimental design was selected. Subjects served as their own controls. The independent variable was the application of tactile pressure to the maternal abdomen. The dependent variable was the number of FM counted before and after external physical stimulation of the maternal abdomen. Potential interacting variables included participants' expectations of the effects of tactile pressure on FM (Hawthorne effect), and variability in following study instructions.

Sample and Setting

Subjects were recruited from childbirth education classes in a large urban community in the Pacific Northwest. Subjects were required to be between 32 to 39 weeks gestation and have no major medical or obstetrical complications (see Appendix B). The researcher gained entry to childbirth education classes by obtaining permission from the director of a childbirth education association.

All data were collected at subjects' homes. Participants counted in the morning and in afternoon/evening times within a broad range of hours. Morning times include those hours between five a.m. and twelve noon, afternoon/evening hours include those hours between one p.m. to nine p.m.

Instruments

The data collection instrument used was developed by the author and can be found in Appendix A. This data collection instrument is similar to the FM chart used in many hospitals and clinics. The chart consists of horizontal lines labeled "date" (days one through four), time of day (for "AM" and "PM" counting periods), number of FM in the first 30 minutes of counting, and number of FM in the second 30 minutes of counting. There is a place on the chart which designates the five minute break between the first and second 30 minute periods of counting. In this space is written the strategy to be done at the end of the break, this space contains either the word "none" or "pressure". The last column is labeled "Total" for the total number of FM counted in a one hour period. The chart is arranged in tabular form. An example of two completed days is provided at the top of the chart.

The demographic questionnaire elicited information on gestational age (by asking for the woman's due date), parity, medical and obstetrical status, age, race, smoking and alcohol habits, maternal perception of FM patterns, information received while in the study, and participant comments about the study (see Appendix C). The demographic questionnaire was developed utilizing a standard format for the development of demographic questionnaires (Polit & Hungler, 1983, Chapter 14.).

Procedure

Recruitment and instructions.

At instructor-selected times during a Prepared Childbirth Association childbirth education class, the researcher approached the group with the following:

> "My name is Lynn Wheeler and I am a nurse and a graduate student at the Oregon Health Sciences University. I am conducting a research project on the effects of gentle physical stimulation on fetal movement with women in their third trimester of pregnancy. This study involves counting your baby's movements for one hour, twice a day for four days and applying gentle physical stimulation to your abdomen at specific times during your counting. This will not be harmful to you or your baby in any way. For those of you who are interested in participating, I need to explain a few more things and give you the instructions and forms. I would be happy to answer any questions you might have about this project."

It was explained that confidentiality would be maintained by placing only an identification number on questionnaire and data collection records. Participants expressing an interest in the study were shown the technique of physical stimulation to their abdomen and asked to provide a return demonstration. In addition, subject instructions were reviewed, the method of marking the FM chart explained, and questions pertinent to the study answered. Subjects were asked to read and sign the consent form. The researcher concluded the interaction by thanking the participant(s) for the time and effort required to complete the study. The researcher's name, mailing address, and a message number were included in the instructions in case participants had further questions. A self-addressed, stamped envelope was provided to each woman to mail back the FM chart and demographic questionnaire.

Clark and Britton (1985) identified several reasons why women do not fill out FM charts, including lack of client exposure to the chart, lack of return demonstration of how to mark the chart during client instruction, lack of follow-up by clinicians, difficulty in marking the chart, confusion over what constituted a FM, and having to begin at a specific time of day. This study attempted to increase completion of FM charts by familiarizing subjects with the FM chart, by asking for a return demonstration of external physical stimulation, by defining specifically what constitutes a FM, and by giving subjects flexible hours in which to count FM.

Appendices A, B, C, and D provide examples of the subject instructions, FM chart, demographic questionnaire, and consent form. A pilot study with three pregnant obstetrical nurses was conducted to evaluate the FM chart, participant instructions, and demographic questionnaire for efficiency, accuracy, completeness, and analysis of items. No comments were elicited from the one completed FM chart and questionnaire. All items requested were completed correctly and appropriate to the information being sought.

CHAPTER III

Results

Data analysis was performed using STATPAK 3, a computerized statistical software package (Smillie, 1983). Because fetal movement is a ratio level of measurement, parametric statistics were used. The significance level was set at the .05 level.

The researcher spoke to a total of 151 women, 51 of whom signed consent forms and received instructions, fetal movement charts, questionnaires, and self-addressed stamped envelopes. Potential subjects were approached over a five week period through 17 childbirth education classes from September 9, 1986 through October 14, 1986. Of 51 charts and questionnaires distributed, nine were returned and eight of these met study requirements (i.e., gestational age between 32 to 39 weeks, completeness, no major medical or obstetrical complications).

However one woman, identified in this study as subject number five, was excluded from the inferential data analysis due to a much higher than average number of FM compared to the rest of the sample. A total of seven data forms were utilized for the inferential statistical analyses.

Descriptive

Subjects ranged in age from 16 to 35, with a mean age of 23.6 years. Gestational ages ranged from 32.9 to 37.6 weeks with a mean of 35.4 weeks. However, when subject five was excluded, the gestation age ranged from 34 to 37.6 weeks, the new mean was 35.8 weeks.

Caucasians represented all but one of the subjects, who was Eurasian. None of the subjects smoked or drank alcohol. Seven of the eight subjects in the sample were nulliparous. The one multiparous subject had carried two children to term.

Subject number five, the mother with the high number of FM, took Synthroid 0.15 milligrams once per day: no other subjects took any drugs other than prenatal vitamins and/or iron. The amount of time this mother had been taking Synthroid is unknown.

One woman reported she had a form of thalassemia minor for which she took iron. Unfortunately, she did not fill out the dosage of iron she was taking, even though this information was requested. She did not report a state of anemia.

Table 1 shows individual FM ranges and means. Numbers of FM per 30 minute counting periods ranged from zero to one hundred twenty, 30 minute means ranged from 12 to 79. Subject number five had a two to three fold increase over most subjects' ranges and a mean two to six times higher.

Table 2 summarizes total sample means (including subject number five), and standard deviations for each 30 minute counting period. Means for each 30 minute counting period ranged from 20 to 47; standard deviations ranged from 10 to 38. The first period of pressure occurs on day two in the morning, there was an average increase of three FM for this period. The second period of pressure occurs on day three in the evening; there was an average increase of four FM for this period. The last two periods of pressure occur on

Table 1

Summary of Individual Ranges and Means for Number of FM per 30 Minutes ($\underline{N}$ = 8)

Subject	Range	Mean
1	6- 25	14.3
2	14- 52	26.1
3	2- 31	12.4
4	15- 75	37.3
5a	41-120	78.8
6	0- 25	12.9
7	6- 97	23.1
8	9- 40	17.4

a-This subject was excluded from the inferential data analysis.

Table 2

Summary of Sample Means and Standard Deviations for Each 30 Minute Period (N = 8)

		First 30 minutes			Second 30 minutes	
Day		M	SD		M	SD
1	AM	27.3	30.3		19.8	20.8
	PM	33.5	28.8		25.1	26.1
2	AM	25.5	24.1	Pressure	28.5	37.9
	PM	27.9	22.0		28.5	30.9
3	AM	22.4	23.1		24.5	24.5
	PM	25.1	14.6	Pressure	29.1	23.2
4	AM	27.9	19.5	Pressure	23.8	22.4
	PM	46.8	34.0	Pressure	29.0	10.4

day four, in the morning and evening. On day four in the morning, there was an average decrease of four FM; in the evening there was an average decrease of eighteen FM. In summary, no consistent pattern of FM change occurred after pressure was applied.

Table 3 presents sample means and standard deviations without subject number five. Subject number five was considered as an outlier due to the high number of FM and was excluded from subsequent data analysis. Without subject number five, group means for each 30 minute counting period ranged from 13 to 41; standard deviations ranged from 8 to 32. After the first period of pressure on the morning of day two, average FM decreased by three; after the second period of pressure on day three in the evening, FM showed no change. After pressure on day four in the morning there was an average decrease of five FM; in the evening FM decreased by an average of fourteen after pressure. Again, no pattern of FM change after pressure was identified.

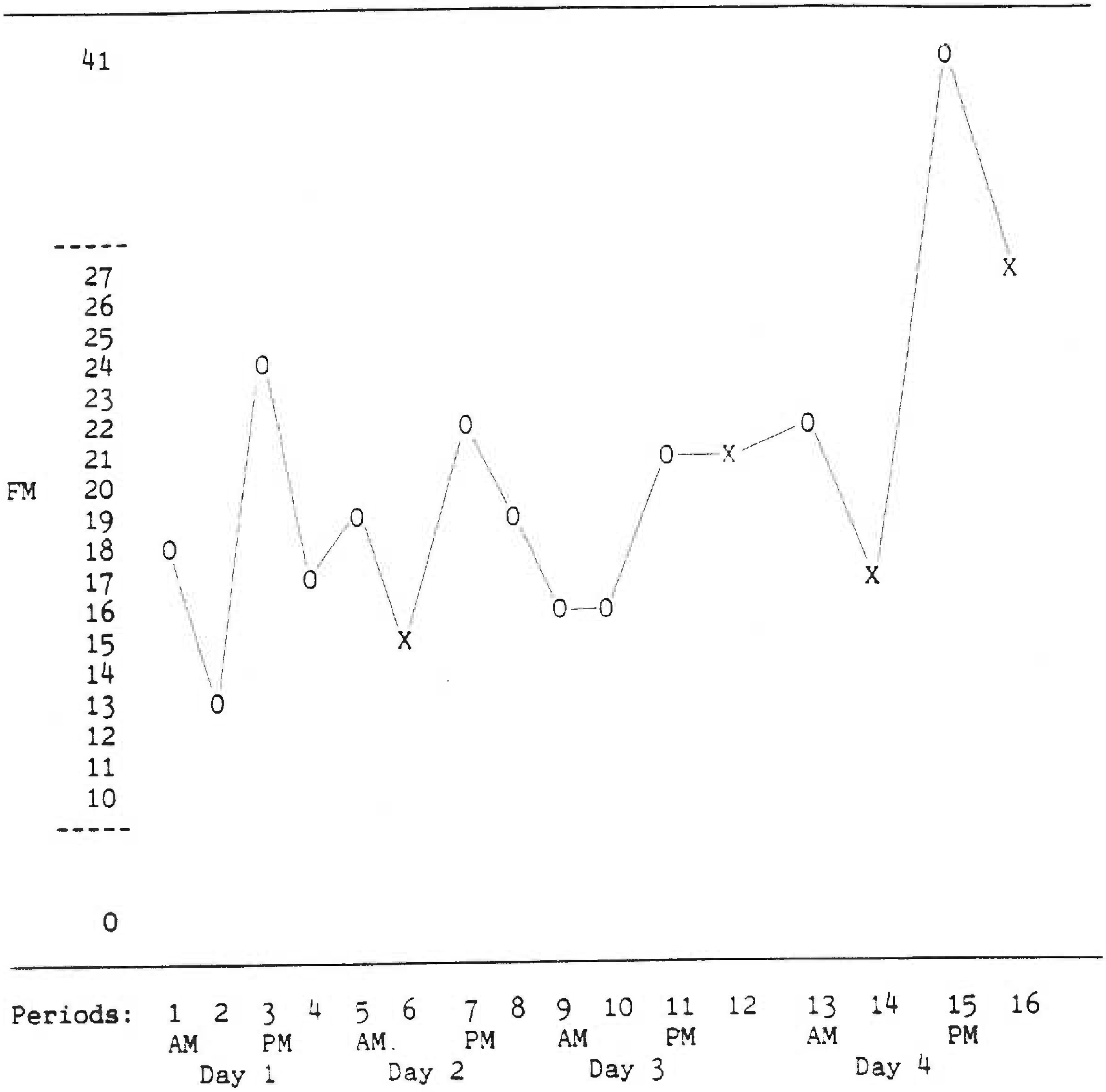
Although subject five did not differ directionally with the rest of the sample, the magnitude of her responses caused considerable changes in the mean, resulting in a positive skew for both sample means and standard deviations. Sample means were increased by as much as ten. Standard deviations were positively skewed by as much as 16 points.

Figure 1 presents a graphic depiction of sample means of FM before and after pressure. Pressure appears to have little effect on FM.

Table 3

Summary of Sample Means and Standard Deviation for Each 30 Minute Period Without Subject Number Five (N = 7)

		First 30 minutes			Second 30 minutes	
Day		M	SD		M	SD
1	AM	17.6	14.1		12.9	7.8
	PM	24.4	14.2		17.1	14.0
2	AM	18.6	15.2	Pressure	15.4	9.1
	PM	21.6	13.9		19.3	17.9
3	AM	15.7	14.5		16.1	7.1
	PM	21.1	10.0	Pressure	21.4	8.6
4	AM	21.9	10.2	Pressure	16.7	11.2
	PM	40.9	32.0	Pressure	27.3	9.9



Note: X signifies those periods following pressure, O signifies those periods without pressure.

Figure 1. Sample FM Means Before And After Physical Pressure. (N = 7)

In an attempt to discern whether patterns of correlation existed, a total sample intercorrelation was performed for all sixteen of the 30 minute FM counting periods. Correlations ranged from a negative .47 to a positive .91. Total mean correlation was .43. Periods following pressure had similar correlations to periods without pressure. No patterns of high or low correlations existed among any 30 minute intervals.

Table 4 represents the number of counting periods within various ranges of correlation. Each of the 30 minute counting periods was correlated against all other counting periods; this yielded a total of 120 correlations. These correlations were divided into three categories: no pressure vs. no pressure, pressure vs. no pressure, and pressure vs. pressure. This analysis was done to see if patterns of significant correlations existed more for one category than another. A correlation of .875 was significant at the .01 level. A correlation of .755 was significant at the .05 level. There was no trend or pattern noted for any category. Percentages of significant and insignificant correlations were similar for each category. It appears that physical stimulation does not affect FM.

As shown in Table 4, there were 66 correlations obtained for the no pressure vs. no pressure category. Of these 66, there were 14 (21%) correlations significant at the .05 level, four (6%) of these were significant at the .01 level. With 48 correlations in the no pressure vs. pressure category, there were seven (15%) correlations significant at the .05 level, three (6%) of these were significant at

Table 4. Frequency table and percentage (%) of Pearson's r correlations for total sample for three categories: no pressure vs. no pressure, pressure vs. no pressure, and pressure vs. pressure. (N = 7)

Range	No Pressure vs. No Pressure Number	%	No Pressure vs. Pressure Number	%	Pressure vs. Pressure Number	%
.88 to .99**	4	(6)	3	(6)		
.76 to .87*	10	(15)	4	(8)	1	(17)
.00 to .75	46	(70)	35	(73)	5	(83)
-.49 to -.01	6	(9)	6	(12)	0	
TOTAL	66	(100)	48	(100)	6	(100)

* $p < .05$, ** $p < .01$

the .01 level. With six correlations in the pressure vs. pressure category, one (17%) of these was significant at the .05 level. As these data indicate, FM does not appear to be affected by the application of pressure.

In testing for differences between group means in FM, two-tailed *t*-tests for dependent observations were performed using six degrees of freedom. The *t*-tests performed are discussed below. None of the *t*-tests performed below were statistically significant.

A comparison of those periods without and with physical stimulation was done in order to test the null hypothesis. This included those periods before and after physical stimulation and those periods in the second 30 minutes without pressure vs. those periods in the second 30 minutes following pressure.

Morning vs. evening differences were compared to see if time of day affected numbers of FM counted. This was performed for morning vs. evening periods without pressure and for morning vs. evening periods with pressure.

It was speculated that subjects might become more familiar with counting FM, and subsequently record more FM. The first four periods of counting (day one, morning and afternoon/evening) were compared with the second four periods of counting (day two in the afternoon/evening and day three in the morning).

Possible differences due to 30 minutes of rest were tested by comparing periods in the first 30 minutes without pressure with periods in the second 30 minutes without pressure. (Subjects were instructed to lie down in a lateral position when counting FM; during the first 30 minutes, subjects counted FM on their side, and this lateral position could have affected the second 30 minutes by increasing uterine blood flow.)

The *t*-test examines differences in group means only. In an effort to take into account variation both within groups and within individuals, a repeated measures analysis of variance was performed using the same comparisons as those for the *t*-test (i.e., pressure vs. no pressure, morning vs. evening, etc.). In addition, analysis of variance was performed for all of the 30 minute counting periods. Of all the above associations tested for, only that examining differences between all counting periods was significant, at the .01 level. There were significant differences in the number of FM reported by different individuals. Table 5 presents the results of F test analysis of FM for all 30 minute counting periods.

Table 5. Results of F-test analysis of FM for all 30 minute counting periods. (N = 7)

Source	SS	df	ms	F
Between people	7818	6	1303	
Within people	16340	105		
Periods	4518	15	301	2.29**
Error	11822	90	131	
Total	24160	111		

**p <.01

CHAPTER IV

DISCUSSION

Demographic Variables

Because Oregon has a low non-white birth rate (7.4%) (Gebbie & Carney, 1985), it was not unusual to find seven of eight participants of Caucasian race. More primiparas than multiparas are likely to attend childbirth education classes; in this sample seven subjects were primiparous. Because of the nature of the sample, it is not surprising that there were no major medical or obstetrical complications, since being able to physically attend childbirth education and expect a normal birth necessitates that the participants be reasonably healthy. The age mean of 23.6 years is similar to the mean age of the childbearing population in Oregon in 1985 (25.7 years) (Gebbie & Carney, 1985).

Hypothesis

It was hypothesized that that there would be no significant difference in FM in with the application of tactile pressure compared with no tactile pressure. In this study, the null hypothesis was supported. This is consistent with previously described research by Richardson et al., (1981) and Visser et al., (1983) which showed no effect on FM from external physical stimulation. The reasons why FM is not affected by external physical stimulation may include (1) FM is determined by fetal behavioral states which are not alterable by external physical stimulation, (2) the external physical stimulation used in this and other studies is inadequate to effect a change in FM patterns; (3) the sample size is too small to permit reliable conclusions; and (4) there are reasons hithero undiscovered.

This study did not control for fetal behavioral state, so associations between FM and fetal behavioral state were not known. In order to reliably determine the influence of physical stimulation or any other variable on fetal behavior, real time ultrasound would have to be utilized and fetal behavioral states meticulously identified. Although it is possible that more forceful pressure might exert an effect on FM, this would most likely be uncomfortable to the mother, and perhaps to the fetus.

Unfortunately, this study suffered from the same small sample present in previous research studies on tactile pressure and FM. Small sample sizes make it difficult to establish statistically reliable associations.

The high attrition rate experienced in this study has many implications. When discussing the attrition rate in this study however, it must be remembered that the situtaion of mothers returning FM charts for this study is not the same as when mothers are counting FM for fetal health screening. The importance of counting FM, as well as close followup were two items previously identified by Clark and Britton (1985) as contributing to increased compliance in mothers counting FM. Neither of these was operative in this study. This study called for a large time expenditure under fairly rigid conditions. Subjects were instructed not to smoke, eat, drink anything other than water, or exercise vigorously for one hour before counting and during the five minute break between 30 minute counting periods. Total time required of subjects was eight hours over a four day period, and subjects were not reimbursed financially. Many of the women had full or part time employment, making it difficult for them to schedule two hours of counting per day for four days. The study was designed to eliminate sources of invalidity, however this required that control periods of counting be established. These control periods increased the total time required of participants. In order to protect subjects' confidentiality the use of followup letters to encourage mothers to return FM charts and questionnaires was not possible.

The results of this study showed no significant differences between morning and evening sessions. The literature has shown an increase in FM in the evening hours (Carmichael et al., 1984, Patrick et al., 1982, Roberts et al., 1979). Possible reasons this study did not show an increase in FM could be that the counting hours did not coincide with previously identified peak periods of FM (i.e., between 2100 and 0100). This study did show significant differences in intra-individual variation, supporting the literature which states that FM is highly consistent within the individual, though with large variation among individuals (Sadovsky, 1981).

Other Data

It is of interest to note that every chart and questionnaire returned was filled out correctly and completely. This may be due to the researcher reviewing the FM chart with each participant and asking for a return demonstration of external physical stimulation. Other reasons could include a highly motivated population, and encouragement from childbirth education instructors.

One patient who was on Synthroid reported markedly elevated FM in comparison with the rest of the sample. It has been noted that a maternal hyperthyroid state may produce a hyperactive neonate (Danforth, Dignam, Hendricks, & Maeck, 1982). However, this patient's dosage of 0.15 milligrams of Synthroid per day, is within the usual therapeutic dose (0.10 to 0.20 milligrams per day). In addition, there is little transplacental passage of thyroid to the fetus at physiologic serum concentrations (Pritchard et al., 1985). It seems unlikely that Synthroid had a significant impact on this subject's reported FM.

In answer to the question of whether there was anything that mothers thought made their baby move more or less, six mothers felt the baby was more active while at they were at rest. Two mothers noted there was less FM when they were at work or active. Two mothers identified more FM with Kegels, two mothers felt more FM when leaning forward. One mother explained that she felt her baby moved more with her position changes as if to "get comfortable". One mother noted that vigorous music caused the baby to be "restless" and that loud penetrating sounds caused more disturbance. Drinking "tea and caffeine" were reported to cause more FM in one mother. Another mother identified more FM when arising and retiring. Only one mother responded that she was not aware of anything that made the baby move more or less.

The last question concerned comments about the study and the mothers' participation in it. Four mothers responded that they had enjoyed counting FM, one mother (subject number five) was surprised at how active her baby was. There were no negative responses to this question. One mother wrote the following: "I want to thank you for letting me do this, because this is my first baby and I have alot [sic] questions about the movements that go on inside me, and with this study maybe we can answer some of these questions that new mothers like me have and can make our pregnancy more enjoyable and not worry so much."

CHAPTER V

Summary, Conclusions, and Recommendatins

This study attempted to document whether applying tactile pressure to the maternal abdomen was effective in increasing FM. This applied specifically to FM. However, if applying tactile pressure to the maternal abdomen was found to be effective in increasing FM, this could have implications for reducing the number of equivocal and non-reactive NSTs. Applying tactile pressure to the maternal abdomen was found to be ineffective in increasing FM in this study.

This study was a modification of two studies on the effects of external physical stimulation on FM (Richardson et al., 1981, & Visser et al., 1983). These studies used samples of 17 and 10 and counted FM through ultrasound guidance.

Limitations

Internal Validity.

There was no way of controlling for the amount of information already possessed by the subjects on FM and/or their expectations of what effect the strategies would have on FM. Maturation effects which could interfere with the number of FM are increasing gestational age and a concomitant increase in the number and duration of quiet periods. This was somewhat controlled by limiting subjects to a range of gestational ages (actual range was 34 to 37.6 weeks), and by the use of subjects serving as their own control group. Testing effects should have been minimal due to the same pattern of counting FM, and by having subjects perform only counting on the first day.

The problem of variable attrition is a limitation of this study which could not be controlled. Sending followup letters to encourage people to return questionnaires was not possible since subjects were anonymous. The use of followup reminders, although increasing sample size, brings the additional burden to the researcher of deciding whether subjects who return their questionnaires later than others are similar enough to be considered in the same sample. Maternal life events and fatigue levels might be different for those who return questionnaires without followup reminders. In the end, a much smaller sample than hoped for was available for analysis.

It was notable that all FM charts and demographic questionnaires were filled out correctly and completely. Instrumentation was not a threat since the data collection record did not change, and only one person scored this record.

External Validity

Interaction of testing and intervention.

It is entirely plausible that women reported a change in FM after certain interventions just because of the intervention, although no clue to directionality was given in the cover letter and participants were instructed to count FM exactly as instructed, regardless of any expectations they might have. Although not significant, greater differences existed between those periods directly before stimulation in comparison with other periods of no stimulation when analyzing for no pressure vs. pressure differences. This difference may be due to the Hawthorne effect. An obvious limitation in generalizing any results of this study to those women actually involved in a NST is that women in this study were not monitored with doppler ultrasound during the counting and external stimuli. In addition, the home environment differs greatly from the office or clinic environment in which the NST is usually performed.

Interaction of selection and intervention.

The sample used in this study is extremely biased. More primiparas are likely to attend childbirth education classes, and the socioeconomic status of childbirth education class attendants may be higher than the general population (personal communication, M. Imle). Unfortunately, the sample was limited from the beginning, since there are many pregnant women who do not attend childbirth education classes, and those who do may have many characteristics not generalizable to the population.

History and intervention.

There is currently a variable interest in FM in the media and among obstetric practitioners. There was no means of controlling for information disseminated to the subjects while they participated in this study, however the questionnaire (see Appendix C) asked participants what information they received on FM during the course of the study. Only one subject indicated that she had recieved information. The information which she had been given was generalized and did not address physical stimulation to the abdomen. It is doubtful this information influenced her responses.

Suggestions for future research

Almost all of the research on FM has been published within the last 14 years, making FM a "new" topic in the obstetrical and nursing literature. The effects on FM of pharmacologic agents, maternal states and activities, and common environmental phenomena are all areas which are sparsley documented in the literature. Research on variables affecting FM must attempt to control for fetal behavioral state in order to be valid. Research designs should use control groups and utilize, whenever possible, large sample sizes in order to produce more generalizable results.

Client preferences and factors affecting client willingness and ability to document FM must be studied, as well as effective strategies for teaching mothers how to count and record FM. The issue of subjective and objective validity in counting FM has not been systematically addressed. The separation of multiple FM, and definition of what constitutes a FM is currently a very gray area.

In summary, this study found no effect on FM from tactile pressure to the maternal abdomen. Further research on the effects of tactile pressure should identify fetal behavioral states under ultrasound guidance. Nurses can play a primary role in teaching women to identify and record FM and can study factors which affect client preferences and compliance in counting FM.

References

Bekedam, D. J., Visser, G. H. A., DeVries, J. J., & Prechtl, H. F. R. (1985). Motor behavior in the growth retarded fetus. Early Human Development,12, 155-165.

Birger, M., Homburg, R., & Insler, V. (1980). Clinical evaluation of fetal movements. International Journal of Gynaecology and Obstetrics, 18, 377-382.

Birkenfeld, A., Laufer, N., & Sadovsky, E. (1979). Diurnal variation of fetal activity. (1980). Obstetrics and Gynecology, 55(4), 417-419.

Birnholz, J. C., Stephens, J. C., & Faria, M. (1978). Fetal movement patterns: A possible means of defining neurologic developmental milestones in utero. American Journal of Roentgenology, 130, 537-540.

Bocking, A., Adamson, L., Cousin, A., Campbell, K., Carmichael, L., Natale, R., & Patrick, J. (1982). Effects of intravenous glucose injections on human fetal breathing movements and gross fetal body movements at 38 to 40 weeks' gestational age. American Journal of Obstetrics and Gynecology, 142(6, Part I), 606-611.

Campbell, K. (1980). Ultradian rhythms in the human fetus during the last ten weeks of gestation, A review. Seminars in Perinatology, 4(4), 301-309.

Carmichael, L., Campbell, K., & Patrick, J. (1984). Fetal breathing, gross fetal body movements, and maternal and fetal heart rates before spontaneous labor at term. American Journal of Obstetrics and Gynecology, 148(5), 675-679.

Carter-Jessop, L. (1981). Promoting maternal attachment through prenatal intervention. Maternal Child Nursing, 6, 107-112.

Clark, J., & Britton, K. (1985). Factors contributing to client nonuse of the Cardiff count-to-ten fetal activity chart. Journal of Nurse-Midwifery, 30(6), 320-326.

Coleman, C. A. (1981). Fetal movement counts, An assessment tool. Journal of Nurse-Midwifery, 26(1), 15-23.

Comparetti, A. M. (1981). The neurophysiologic and clinical implications of studies on fetal motor behavior. Seminars in Perinatology, 5(2), 183-189.

Danforth, D.N., Dignam, W.J., Hendricks, C. H., & Maeck, J. V. S. (Eds.). (1982). Obstetrics and Gyencology. (4th ed.). Philadelphia: Harper & Row, Publishers.

David, H., Weaver, J., & Pearson, J. (1975). Doppler ultrasound and fetal activity. British Medical Journal, ii, 62-64.

Dawes, G. S., Visser, G. H. A., Goodman, J. D. S., & Levine, D. H. (1981). Numerical analysis of the human fetal heart rate: Modulation by breathing and movement. American Journal of Obstetrics and Gynecology, 140(5), 535-544.

Devoe, L. D., Castillo, R., Saad, S., McKenzie, J., Searle, N., & Davis, H. (1986). Percent acceleration time: A new method of fetal assessment. Obstetrics and Gynecology, 67(2), 191-196.

DeVries, J. I. P., Visser, G. H. A., & Prechtl, H. F. R. (1985). The emergence of fetal behavior. II. Quantitative aspects. Early Human Development, 12, 99-120.

Dierker, L. J., Pillay, S. K., Sorokin, Y., & Rosen, M. G. (1982a). Active and quiet periods in the preterm and term fetus. Obstetrics and Gynecology, 60(1), 65-70.

Dierker, L. J., Pillay, S. K., Sorokin, Y., & Rosen, M. G. (1982b). The change in fetal activity periods in diabetic and non-diabetic pregnancies. American Journal of Obstetrics and Gynecology, 143(2), 181-185.

Divon, M. Y., Platt, L. D., Cantrell, C. J., Smith, C. V., Yeh, S-Y., & Paul, R. H. (1985). Evoked fetal startle response, A possible intrauterine neurological examination. American Journal of Obstetrics and Gynecology, 153(4), 454-456.

Druzin, M. L., & Foodim, J. (1986). Effect of maternal glucose ingestion compared with maternal water ingestion on the nonstress test. Obstetrics and Gynecology, 67(3), 425-426.

Ehrström, C. (1979). Fetal movement monitoring in normal and high-risk pregnancy. Acta Obstetricia et Gynecologica Scandinavica, 80S, 1-32.

Ehrström, C. (1984). Circadian rhythm of fetal movements. Acta Obstetrica et Gynecologica Scandinavica, 63(6), 539-541.

Eriksen, P. S., Gennser, G., Lofgren, O., & Nilsson, K. (1983). Acute effects of maternal smoking on fetal breathing and movements. Obstetrics & Gynecology, 61(3), 367-372.

Evertson, L. R., Gauthier, R. J., Schifrin, B. S., & Paul, R. H. (1979). Antepartum fetal heart rate testing. Evolution of the nonstress test. American Journal of Obstetrics and Gynecology, 133(1), 29-33.

Evertson, L. R., & Paul, R. H. (1978). Antepartum fetal heart rate testing, The nonstress test. American Journal of Obstetrics and Gynecology, 132(8), 895-900.

Field, T., Sandberg, D., Quetel, T. A., Garcia, R., & Rosario, M. (1985). Effects of ultrasound feedback on pregnancy anxiety, fetal activity, and neonatal outcome. Obstetrics & Gynecology, 66(4), 525-528.

Fischer, S., Fullerton, J. T., & Trezise, L. (1981). Fetal movement and fetal outcome in a low-risk population. Journal of Nurse-Midwifery, 26(1), 24-30.

Gebbie, K. M., & Carney, J. D. (1985). Oregon vital statistics report for calendar year 1985. Oregon Department of Human Resources, Health Division. Portland, OR: Center for Health Statistics.

Gelman, S. R., Spellacy, W. N., Wood, S., Birk, S. A., & Buhi, W. C. (1980). Fetal movements and ultrasound, Effect of maternal intravenous glucose administration. American Journal of Obstetrics and Gynecology, 137(4), 459-461.

Gelman, S. R., Wood, S., Spellacy, W. N., & Abrams, R. M. (1982). Fetal movements in response to sound stimulation. American Journal of Obstetrics and Gynecology, 143(4), 484-485.

Gianopoulos, J., Elias, S. S., Simpson, J. L., & Tamura, R. (1986). Ultrasonic assessment of fetal response to second trimester amniocentesis. Obstetrics and Gynecology, 67(3), 410-413.

Goodman, J. D. S., Visser, F. G. A., & Dawes, G. S. (1984). Effects of maternal cigarette smoking on fetal trunk movements, fetal breathing movements and the fetal heart rate. British Journal of Obstetrics and Gynaecology, 91, 657-661.

Granat, M., Lavie, P., Adar, D., & Sharf, M. (1979). Short term cycles in human fetal activity. I. Normal pregnancies. American Journal of Obstetrics and Gynecology, 134(6), 696-701.

Grant, A., & Hepburn, M. (1984). Merits of an individualized approach to fetal movement counting compared with fixed-time and fixed number methods. British Journal of Obstetrics and Gynaecology, 91, 1087-1090.

Haller, U., Wille, F., Henner, H. D., Ruttgers, H., & Kubli, F. (1976). Quantification of active fetal movements in the first half of pregnancy. Part I. Excerpta Medica, 3966, 82.

Hertogs, K., Roberts, A. B., Cooper, D., Griffin, D. R., & Campbell, S. (1979). Maternal perception of fetal motor activity. British Medical Journal, 2, 1183-1185.

Hertz, R. H., Timor-Tritsch, I., Dierker, L. J. (Jr.), Chik, L., & Rosen, M. G. (1979). Continuous ultrasound and fetal movement. American Journal of Obstetrics and Gynecology, 135(1), 152-154.

Hill, L. M., Platt, L. D., & Manning, F. A. (1979). Immediate effect of amniocentesis on fetal breathing and gross body movements. American Journal of Obstetrics and Gynecology, 135(5), 689-690.

Homburg, R., Matzkel, A., Birger, M., & Insler, V. (1980). Management of patients with a live fetus and cessation of fetal movements. British Journal of Obstetrics and Gynaecology, 87, 804-807.

Ianniruberto, A., & Tajani, E. (1981). Ultrasonographic study of fetal movements. Seminars in Perinatology, 5(2), 175-181.

Lauersen, N. H. & Hochberg, H. M. (1982). Automatic detection of fetal movement by doppler ultrasound during non-stress testing. International Journal of Gynaecology & Obstetrics, 20, 219-222.

Leader, L. R., & Baillie, P. (1979). The accuracy of maternal observation of fetal movements. South African Medical Journal, 55, 836-837.

Leader, L. R., Baillie, P., & Van Schalkwyk, D. J. (1981). Fetal movements and fetal outcome: A prospective study. Obstetrics and Gynecology, 57(4), 431-436.

Lee, C. Y., DiLoreto, P. C., & Logrand, B. (1976). Fetal activity acceleration determination for the evaluation of fetal reserve. Obstetrics and Gynecology, 48(1), 19-26.

Lewis, P., Trudinger, B., & Mangez, J. (1978). Effect of maternal glucose ingestion on fetal breathing and body movements in late pregnancy. British Journal of Obstetrics and Gynaecology, 85, 86-89.

Liston, R. M., Cohen, A. W., Mennuti, M. T., & Gabbe, S. G. (1982). Antepartum fetal evaluation by maternal perception of fetal movement. Obstetrics and Gynecology, 60(4), 424-426.

Luterkort, M., & Maršál, K. (1985). Fetal motor activity in breech presentation. Early Human Development, 10, 193-200.

Manning, F. A., Platt, L. D., & Sipos, L. (1979). Fetal movements in human pregnancies in the third trimester. Obstetrics and Gynecology, 54(6), 699-702.

Maršal, K. (1983). Ultrasonic assessment of fetal activity. Clinics in Obstetrics and Gynaecology, 10(3), 541-563.

Mathews, D. D. (1975). Maternal assessment of fetal activity in small-for-dates infants. Obstetrics and Gynecology, 45(5), 488-493.

McLeod, W., Brien, J., Loomis, C., Carmichael, L., Probert, C., & Patrick, J. (1983). Effect of maternal ethanol ingestion on fetal breathing movements, gross body movements, and heart rate at 37 to 40 weeks' gestational age. American Journal of Obstetrics and Gynecology, 145(2), 251-257.

Minors, D. S., & Waterhouse, J. M. (1979). The effect of maternal posture, meals and time of day on fetal movements. British Journal of Obstetrics and Gynaecology, 86, 717-722.

Mor-Yosef, S., Sadovsky, E., Brzezinski, A., Levinsky, R., & Ohel, G. (1983). Fetal movements and intrauterine growth retardation. International Journal of Gynaecology & Obstetrics, 21, 315-318.

Neldam, S., & Jessen, P. (1980). Fetal movements registered by the pregnant woman correlated to retrospective estimations of fetal movements from cardiotocographic tracings. American Journal of Obstetrics and Gynecology, 136(8), 1051-1054.

Nijhuis, J. G., Prechtl, H. F. R., Martin, C., & Bots, R. S. G. M. (1982). Are there behavioral states in the human fetus? Early Human Development, 6, 177-195.

O'Leary, J. A., & Andrinopoulos, G. C. (1981). Correlation of daily fetal movements and the nonstress test as tools for assessment of fetal welfare. American Journal of Obstetrics and Gynecology, 139(1), 107-108.

Ohel, G., Samueloff, A., Navot, D., & Sadovsky, E. (1985). Fetal heart rate accelerations and fetal movements in twin pregnancies. American Journal of Obstetrics and Gynecology, 152(6, Part 1), 686-687.

Paine, L. L., Payton, R. G., & Johnson, T. R. B. (1986). Auscultated fetal heart rate accelerations. Part I. Accuracy and documentation. Journal of Nurse-Midwifery, 31(2), 68-72.

Patrick, J., Campbell, K., Carmichael, L., Natale, R., & Richardson, B. (1982). Patterns of gross fetal body movements over 24-hour observation intervals during the last 10 weeks of pregnancy. American Journal of Obstetrics and Gynecology, 142(4), 363-371.

Patrick, J., Fetherston, W., Vick, H., & Voegelin, R. (1978). Human fetal breathing movements and gross fetal body movements at weeks 34 to 35 of gestation. American Journal of Obstetrics and Gynecology, 130(6), 693-699.

Pearson, J. F. (1977, April 21). Fetal movements--A new approach to antenatal care. Nursing Mirror, 144, 49-51.

Pearson, J. F., & Weaver, J. B. (1976). Fetal activity and fetal wellbeing, An evaluation. British Medical Journal, 1, 1305.

Platt, L. D., Lenke, R., & Sipos, L. (1981). Amniocentesis in the second trimester: The effect on fetal movement. American Journal of Obstetrics and Gynecology, 140(7), 758-759.

Polit, D. F., & Hungler, B. P. (1983). Nursing research: Principles and methods (2nd ed.). (pp. 296-325). Philadelphia: J. B. Lippincott Company.

Pritchard, J. A., MacDonald, P. C., & Gant, N. F. (1985). Williams Obstetrics. Norwalk: Appleton-Century-Crofts.

Rayburn, W. F. (1980). Clinical significance of perceptible fetal motion. American Journal of Obstetrics and Gynecology, 138(2), 210-212.

Rayburn, W. F. (1982). Antepartum fetal assessment. Monitoring fetal activity. Clinics in Perinatology, 9(2), 231-252.

Richardson, B., Campbell, K., Carmichael, L., & Patrick, J. (1981). Effects of external physical stimulation on fetuses near term. American Journal of Obstetrics and Gynecology, 139(3), 344-352.

Roberts, A. B., Griffin, D., Cooper, D. J., Campbell, S. (1980). Fetal activity in 100 normal third trimester pregnancies. British Journal of Obstetrics and Gynaecology, 87, 480-484.

Roberts, A. B., Little, D., Mooney, R., Cooper, D. J., & Campbell, S. (1979). Normal patterns of fetal activity in the third trimester. British Journal of Obstetrics and Gynaecology, 86, 4-9.

Ron, M., Yaffe, H., & Sadovsky, E. (1976). Fetal heart rate response to amniocentesis in cases of decreased fetal movements. Obstetrics and Gynecology, 48(4), 456-459.

Rosen, M., Hertz, R. H., Dierker, L. J. (Jr.), Zador, I., & Timor-Tritsch, I. E. (1979). Monitoring fetal movement. Clinics in Obstetrics and Gynaecology, 6(2), 325-334.

Sadovsky, E. (1981). Fetal movements and fetal health. Seminars in Perinatology, 5(2), 131-143.

Sadovsky, E., Mahler, Y., Polishuk, W. Z., & Malkin, A. (1973). Correlation between electromagnetic recording and maternal assessment of fetal movement. The Lancet, i, 1141.

Sadovsky, E., Navot, D., & Yaffe, H. (1981). Antenatal evaluation of FHR accelerations associated with fetal movements. International Journal of Gynaecology & Obstetrics, 19, 441-445.

Sadovsky, E., Ohel, G., Havazeleth, H., Steinwell, A., & Penchas, S. (1983). The definition and the significance of decreased fetal movements. Acta Obstetricia et Gynecologica Scandinavica, 62(5), 409-413.

Sadovsky, E., & Perlman, M. (1978). Decreased fetal movements and polyhydramnios. Acta Obstetricia et Gynecolologica Scandinavica, 57(2), 177-178.

Sadovsky, E., & Polishuk, W. Z. (1977). Fetal movements in utero: Nature, assessment, prognostic value, timing of delivery. Obstetrics and Gynecology, 50(1), 49-55.

Sadovsky, E., Rabinowitz, R., Freeman, A., & Yarkoni, S. (1984). The relationship between fetal heart rate accelerations, fetal movements, and uterine contractions. American Journal of Obstetrics and Gynecology, 149(2), 187-189.

Sadovsky, E., Weinstein, D., & Polishuk, W. Z. (1978). Timing of delivery in high risk pregnancy by monitoring of fetal movements. Journal of Perinatal Medicine, 6, 160-164.

Sadovsky, E., & Yaffe, H. (1973). Daily fetal movement recording and fetal prognosis. Obstetrics and Gynecology, 41(6), 845-850.

Samueloff, A., Evron, S., & Sadovsky, E. (1983). Fetal movements in multiple pregnancy. American Journal of Obstetrics and Gynecology, 146(7), 789-792.

Samueloff, A., Evron, S., & Sadovsky, E. (1984). Fetal movements in isoxsuprine-treated patients. American Journal of Obstetrics and Gynecology, 148(8), 335-336.

Schmidt, W., Boos, R., Gnirs, J., Auer, L., & Schulze, S. (1985). Fetal behavioural states and controlled sound stimulation. Early Human Development, 12, 145-153.

Schmidt, W., Cseh, I., Hara, K., & Kubli, F. (1984). Maternal perception, tocodynamometric findings and real-time ultrasound assessment of total fetal activity. International Journal of Gynaecology & Obstetrics, 22, 85-90.

Serafini, P., Lindsay, M. B. J., Nagery, D. A., Pupkin, M. J., Tseng, P., & Crenshaw, C. (Jr.). (1984). Antepartum fetal heart rate response to sound stimulation: The acoustic stimulation test. American Journal of Obstetrics 148(1), 41-45.

Shawker, T. H., Schuette, W. H., Whitehouse, W., & Rifka, S. M. (1980). Early fetal movement: A real-time ultrasound study. Obstetrics and Gynecology, 55(2), 194-198.

Sheldon, T. A. (1978). Assessment of fetal movement. British Medical Journal, 2, 88-90.

Smillie, (1983). STATPAK 3: An APL statistical package. [Computer program]. (3rd ed., Version 1.1). Department of Computing Science. Edmonton, Alberta: University of Alberta.

Sontag, L. W., & Wallace, R. F. (1936). Changes in the rate of the human fetal heart in response to vibratory stimuli. American Journal of Diseases of Children, 51(3), 583-589.

Sorokin, Y., Bottoms, S. F., Dierker, L. J., & Rosen, M. G. (1982). The clustering of fetal heart rate changes and fetal movements in pregnancies between 20 and 30 weeks of gestation. American Journal of Obstetrics and Gynecology, 143(8), 952-957.

Sorokin, Y., & Dierker, L. J. (1982). Fetal movement. Clinical Obstetrics and Gynecology, 25(4), 719-734.

Sorokin, Y., Pillay, S. Dierker, L. J., Hertz, R.H., & Rosen, M. G. (1981). A comparison between maternal tocodynanometer and real-time ultrasonographic assessments of fetal movement. American Journal of Obstetrics and Gynecology, 140(4), 456-460.

Stark, C. R., Orleans, M., Haverkamp, A. D., & Murphy, J. (1984). Short- and long-term risks after exposure to diagnostic ultrasound in utero. Obstetrics & Gynecology, 63(2), 194-200.

Suzuki, S., & Yamamuro, T. (1985). Fetal movement and fetal presentation. Early Human Development, 11, 255-263.

Terao, T., Kawashima, Y., Noto, H., Inamoto, Y., Lin, T. Y., Sumimoto, K., Maeda, M. (1984). Neurological control of fetal heart rate in 20 cases of anencephalic fetuses. American Journal of Obstetrics and Gynecology, 131(3), 276-280.

Thaler, J., Goodman, J. D. S., & Dawes, G. S. (1980). Effects of maternal cigarette smoking on fetal breathing and fetal movements. American Journal of Obstetrics and Gynecology, 149(2), 201-208.

Timor-Tritsch, I. E., Dierker, L. J., Hertz, R. H., Deagan, N. C., & Rosen, M. G. (1978). Studies of antepartum behavioral state in the human fetus at term. American Journal of Obstetrics and Gynecology, 132(5), 524-528.

Timor-Tritsch, I. E., Dierker, L. J., Hertz, R. H., & Rosen, M. G. (1979). Fetal movement: A brief review. Clinical Obstetrics and Gynecology, 22(3), 583-592.

Timor-Tritsch, I. E., Dierker, L. J., Zador, I., Hertz, R. H., & Rosen, M. G. (1979). Fetal movements associated with fetal heart rate accelerations and decelerations. American Journal of Obstetrics and Gynecology, 131(3), 276-280.

Timor-Tritsch, I. E., Zador, E., & Hertz, R. H. (1976). Classification of human fetal movement. American Journal of Obstetrics and Gynecology, 126(1), 70-77.

Valentin, L., Löfgren, O., Maršál, K., & Gullberg, B. (1984). Subjective recording of fetal movements. I. Limits and acceptability in normal pregnancies. Acta Obstetricia et Gynecologica Scandinavica, 63(3), 223-228.

Vintzileos, A. M., Campbell, W. A., Ingardia, C. J., & Nochimson, D. J. (1983). The fetal biophysical profile and its predictive value. Obstetrics and Gynecology, 62(3), 271-278.

Visser, G. H. A., Laurini, R. N., DeVries, J. I. P., Bekedam, D. J., & Prechtl, H.. F. R. (1985). Abnormal motor behaviour in anencephalic fetuses. Early Human Development, 12, 173-182.

Visser, G. H. A., Zeelenberg, H. J., DeVries, J. I. P., & Dawes, G. S. (1983). External physical stimulation of the human fetus during episodes of low heart rate variation. American Journal of Obstetrics and Gynecology, 145(5), 579-584.

Vliet, M. A. T. van, Martin, C. B. (Jr.), Nijhuis, J. G., & Prechtl, H. F. R. (1985a). Behavioural states in growth-retarded human fetuses. Early Human Development, 12, 183-197.

Vliet, M. A. T. van, Martin, C. B. (Jr.), Nijhuis, J. G., & Prechtl, H. F. R. (1985b). Behavioural states in the fetuses of nulliparous women. Early Human Development, 12, 121-135.

Vliet, M. A. T. van, Martin, C. B. (Jr.), Nijhuis, J. G., & Prechtl, H. F. R. (1985c). The relationship between fetal activity and behavioral states and fetal breathing movements in normal and growth-retarded fetuses. American Journal of Obstetrics and Gynecology, 153(5), 582-588.

Wladimiroff, J. W., & Roodenburg, P. J. (1982). Human fetal breathing and gross body activity relative to maternal meals during insulin-dependent pregnancy. Acta Obstetricia et Gynecologica Scandinavica, 61(1), 65-68.

Wood, C., Walters, W. A. W., & Trigg, P. (1977). Methods of recording fetal movement. British Journal of Obstetrics and Gynecology, 84(8), 561-567.

Appendix A

Participant Instructions

Participant Instructions

Each day please set aside one hour in the morning (between 5 a.m. and 12 noon) and one hour in the afternoon/evening (between 1 p.m. and 9 p.m.) to lie down on your side and count your baby's movements. During each hour session you will count for 30 minutes, take a 5 minute break, and then count for another 30 minutes.

You may use the break to get up and go to the bathroom, stretch your legs, get a drink of water, etc. Please do not smoke, eat, exercise vigorously, or drink anything other than water during the break.

Except for hiccoughs, any movement your baby makes should be counted as a movement. These include but are not limited to: kicks, jabs, startles, stretching, squirming, and rolling motions. If your baby has a series of movements and you are not able to tell when one movement stops and another begins, count this as one movement. Each baby has his or her own rate of movement. This rate can vary between 4 to 1440 movements in 12 hours.

Please follow instructions exactly. For one hour before you begin counting, do not exercise vigorously, eat, smoke, or drink any beverage other than water. Please record the date you begin your four days of counting. Try to count four days in a row, if this is not possible, please try to complete the chart within a one week period. Be sure to have a clock within easy view.

Each one hour session will go as follows: While on your side, count your baby's movements for 30 minutes, then take a 5 minute break. After the break, count your baby's movements for another 30 minutes. There will be some days when you are asked to apply physical stimulation to your abdomen. Physical stimulation of your abdomen should always follow 30 minutes of counting your baby's movements. Physical stimulation takes place after you have completed your 5 minute break and will consist of placing each hand on either side of your abdomen at the level of your belly button and gently pushing 10 times alternately with each hand for a total of 20 stimulations. This should take about 20 seconds. The sequence of your counting is listed on the next page.

Sequence for counting your baby's movements:

Day 1:

Count your baby's movements for 30 minutes, take a 5 minute break, then count your baby's movements for another 30 minutes. Do this in the morning and afternoon/evening.

Day 2:

For the morning session, count your baby's movements for 30 minutes, take a 5 minute break, then apply physical stimulation to your abdomen. Count your baby's movements for another 30 minutes. You will apply physical stimulation for the morning session only.

For the evening session, count your baby's movements for 30 minutes, take a 5 minute break, then count your baby's movements for another 30 minutes.

Day 3:

For the morning session, count your baby's movements for 30 minutes, take a 5 minute break, then count your baby's movements for another 30 minutes. For the evening session, count your baby's movements for 30 minutes, take a 5 minute break, then apply physical stimulation to your abdomen. Count your baby's movements for another 30 minutes. You will apply physical stimulation for the evening session only.

Day 4:

Count your baby's movements for 30 minutes, take a 5 minute break, then apply physical stimulation to your abdomen. Count your baby's movements for another 30 minutes. You will apply physical stimulation to your abdomen for both the morning and evening sessions.

If you have any questions about how to count or record your baby's movements, you may leave a message for the researcher, Lynn D. Wheeler, at 297-8438. Your baby's movements may decrease, increase, or stay the same after physical stimulation.

If your baby has not moved or if you have had less than 10 movements at the end of any day of counting, you should notify your health care provider. If you are hospitalized for any reason before you begin counting or during the four days of counting, please notify the researcher.

Appendix B

Fetal Movement Counting Chart

Thank you very much for your participation in this study. A prompt (and fully completed please!) return of your baby movement chart and the questionnaire would be appreciated. You may wish to xerox a copy of this record for your baby book. Results of this study should be available in December, 1986 and may be obtained by writing to the following address:

Lynn D. Wheeler
3120 SW 180th Place
Aloha, OR 97006

Baby Movement Chart-Instructions

Please record date and time on chart.
The abbreviation "AM" means that you will start counting anytime between five a.m. and twelve noon. The abbreviation "PM" means you will start counting anytime between one p.m. and nine p.m. An example of two completed days is shown below.

Date	Time of day		30 minutes # of movements	5 minutes Strategy	30 minutes # of movements	TOTAL
Day One	6:02	AM	13	None	18	31
8/21	4:30	PM	25	None	8	33
Day Two	7:35	AM	10	Pressure	10	20
8/22	3:46	PM	26	None	34	60

Baby Movement Chart

DATE	TIME		First 30 minutes # of MOVEMENTS	5 minutes for break STRATEGY	Second 30 minutes # of MOVEMENTS	TOTAL
Day One	________	AM	________	None	________	________
________	________	PM	________	None	________	________
Day Two	________	AM	________	Pressure	________	________
________	________	PM	________	None	________	________
Day Three	________	AM	________	None	________	________
________	________	PM	________	Pressure	________	________
Day Four	________	AM	________	Pressure	________	________
________	________	PM	________	Pressure	________	________

Any questions? Call Lynn D. Wheeler (at 297-8438 or 225-8311:Beeper 112-1486).

Appendix C

Questionnaire

Questionnaire

Please place a check in the appropriate space and fill in other requested information on the lines provided. Thank you!

1. When is your due date? ______________________________

2. How many children have you carried to full term? (Do not include this pregnancy).

( ) None
( ) One
( ) Two
( ) Three
( ) Four
( ) Five or more

4. Are you having any medical or pregnancy-related problems (such as diabetes, high blood pressure, weight gain less than 15 pounds or more than 50 pounds, too little or too much amniotic fluid, too small or too big of baby, abnormal bleeding, or any problem not listed here)?

( ) Yes
( ) No

If yes, please list:

5. Please list <u>any</u> medications you take and the amount, other than prenatal vitamins and iron:

6 Please state your age on your last birthday: ________

7. What is your race?

( ) White (Caucasian)
( ) Black
( ) Asian
( ) Mexican-American
( ) American Indian
( ) Other (Please state)

8. Do you smoke?

( ) Yes
( ) No

If yes, how many cigarettes per day do you smoke? ____________

9. How much alcohol do you drink per week?

( ) None
( ) 1-3 drinks per week
( ) 4-7 drinks per week
( ) 8-14 drinks per week
( ) 15 or over drinks per week

10. Is there anything that you feel makes your baby move more or less? (For example, time of day, music, any activities you do.)

11. Is there any information you have been given while in this study from your doctor, other health care providers, or from the newspapers, radio or television on fetal movement?

( ) Yes (Please explain below.)
( ) No

12. Are there any comments you would like to make about this study and your participation in it?

~~~~~~

What you need to return in the stamped, self-addressed envelope are:

Baby Movement Chart
Questionnaire (both pages)

Please make sure you have filled these out completely, otherwise, they cannot be used in the study. Thank you <u>very</u> much for taking the time and effort to participate.
Lynn D. Wheeler, 3120 SW 180th Place, Aloha OR 97006
~~~~~~

Appendix D

Informed Consent

Oregon Health Sciences University
CONSENT FORM
Informed Consent to be a Research Subject

Lynn D. Wheeler, R.N., C., the principal investigator, is a graduate student who is performing an experimental study entitled: "Effects of Tactile Pressure on the Maternal Abdomen on Fetal Movement at 32 to 39 Weeks Gestation". The purpose of the study is to increase knowledge about fetal movement in healthy women. This research is being performed under the direction of Carol Howe, C.N.M., D.N.Sc.

This study will involve healthy pregnant women who are one to eight weeks from their due date. Because this is a time when many women attend childbirth education classes, Ms. Wheeler has contacted your childbirth education class instructor for permission to ask for your participation. If you agree to participate in this study, you will be asked to lie on your side and count your baby's movements for one hour, two times a day, for four days. You will be asked to record your baby's movements on the form provided and answer a brief series of questions concerning yourself and your pregnancy.

Your participation in this study is entirely voluntary, and you may withdraw at any time you wish. You are free to show any of the materials you have received to whomever you choose. Gentle physical stimulation of the abdomen has no known risks to you or your baby. You and your baby may derive some benefit by your resting on your side. The information you provide will not benefit you directly but will increase what we know about fetal behavior.

All information will be confidential; the coding numbers on your sheet refer only to your childbirth education class. Neither your name nor your identity will be used for publication or publicity purposes.

Any questions you have may be directed to Ms. Wheeler at (503) 297-8438, (or by paging Ms. Wheeler by calling 225-8311 and asking for beeper number 112-1486) or her advisor, Carol Howe, CNM, DNSc., at (503) 225-8383. It is not the policy of the Department of Health and Human Services, or any other agency funding the research project in which you are participating to compensate for medical treatment for human subjects in the event the research results in physical injury. The Oregon Health Sciences University, as an agency of the state, is covered by the State Liability Fund. If you suffer any injury from the research project, compensation would be available to you only if you establish that the injury occurred through the fault of the University, its officers or employees. If you have further questions please call Dr. Michael Baird, M.D., at (503) 225-8014.
-

_

I understand I may refuse to participate, or withdraw from this study at any time without affecting my relationship with, or treatment at, the Oregon Health Sciences University. I understand that I will not be identified in any way by returning the record of my baby's movements or the questionnaire attached. I also understand that I will not be reimbursed financially for my participation in this study.

Lynn D. Wheeler, R.N.,C. has offered to answer any questions I might have. I have read the foregoing and agree to participate in this study.

Date	Signature of participant
Date	Signature of witness

AN ABSTRACT OF THE THESIS OF

Lynn D. Wheeler

For the MASTER OF NURSING

Date of Receiving this Degree: March 6, 1987

Title: EFFECTS OF TACTILE PRESSURE TO THE MATERNAL ABDOMEN ON FETAL MOVEMENT AT 32 TO 39 WEEKS GESTATION

Approved: [redacted]

Carol H. Howe, D.N.Sc., C.N.M., Thesis Advisor

The evaluation of fetal activity through the use of maternal reporting of fetal movement (FM) is assuming an increasingly important part in the assessment of fetal health. Fetal activity, including FM and fetal heart rate (FHR), is influenced by the behavioral state of the fetus.

It is well documented that FM are associated with an increase in FHR in healthy fetuses. This relationship is used to assess fetal status by analyzing FHR patterns through the use of the non-stress test (NST). If the healthy fetus is in a quiet behavioral state while undergoing a NST, a falsely non-reactive test could be obtained. Tactile pressure on the maternal abdomen is frequently used by antepartum testing personnel to increase FM in a quiet fetus in order to decrease the false non-reactive rate when obtaining a NST.

The purpose of this quasi-experimental study was to determine whether tactile pressure of the maternal abdomen resulted in any change in FM. The independent variable in this study was tactile pressure. The dependent variable in this study was FM.

A convenience sample of seven mothers who were between 34 and 38 weeks pregnant counted FM in 30 minute periods for one hour twice a day and applied tactile pressure to their abdomen for four of these periods. Subjects served as their own controls. The level of significance was set at .05.

No effect from physical stimulation was found on FM when the data were analyzed with correlations of FM counting periods and _t_-tests. Using an analysis of variance, little inter-individual variation in FM was found, although there were significant differences in intra-individual rates of FM. The literature supports the highly individualized rate of FM. The reasons why FM is not affected by external physical stimulation may include (1) FM is determined by fetal behavioral states which are not alterable by external physical stimulation; (2) the external physical stimulation used in this and other studies is inadequate to effect a change in FM patterns; (3) the sample size is too small to provide adequate statistical analysis, and (4) there are reasons hithero undiscovered.

The literature confirms the lack of effect on FM. The application of tactile pressure to the maternal abdomen in an attempt to stimulate FM is not justified. However, previous research has been limited by small sample sizes and a lack of control of fetal behavioral states. In establishing guidelines for practice, fetal behavioral states must be documented when studying variables affecting FM.