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RELATIONSHIP BETWEEN PRE-PREGNANCY NUTRITIONAL
STATUS, AVERAGE WEIGHT GAIN DURING PREGNANCY
AND PRETERM DELIVERY IN SINGLETON PREGNANCY
: SIRIRAJ HOSPITAL

KRITSANA JONGSONSRERM

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: SIRIRAJ HOSPITAL

K. Jongsongsrerm.....

Kritsana Jongsongsrerm

Candidate

Ms. Pradipaun.....

Mandhana Pradipasen, M.D., M.S., Dr.P.H.

Major Advisor

Paradee Temchareon.....

Paradee Temchareon, B.Sc., M.Ed., M.P.H.

Co-advisor

Phutima Sirikulchayanonta.....

Chutima Sirikulchayanonta., M.D.

Co-advisor

Wongdyan Pandii.....

Wongdyan Pandii, B.Sc., M.Sc., M.S.P.H.

Co-advisor

M. Chulasamaya.....

Monthree Chulasamaya, M.D., Ph.D.

Dean

Faculty of Graduate Studies

Vicha Pungpapong.....

Vicha Pungpapong, M.S., M.P.H.,

Chairman

Master of Science (Public Health)

major in Nutrition

Faculty of Public Health

Thesis
entitled

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was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Science (Public Health) major in Nutrition
on 20 May, 1993

K. Jongsongserm.....
Kritsana Jongsongserm
Candidate

Mr. Pradipasen.....
Mandhana Pradipasen, M.D., M.S., Dr.P.H.
Chairman

Paradee Temchareon.....
Paradee Temchareon, B.Sc., M.Ed., M.P.H.
Member

Wongdyan Pandii.....
Wongdyan Pandii, B.Sc., M.Sc., M.S.P.H.
Member

Vicha Pungpapong.....
Vicha Pungpapong, M.S., M.P.H.
Member

P. Vacharakul.....
Praewpun Vacharakul, M.D.
Member

M. Chulasamaya.....
Monthree Chulasamaya, M.D., Ph.D.
Dean
Faculty of Graduate Studies

Somjit Supannatas.....
Somjit Supannatas, B.Ed., M.Ed., M.P.H.,
Dr.P.H.
Dean
Faculty of Public Health

BIOGRAPHY

Name : Kritsana Jongsongsrerm

Date of Birth : August 12, 1965

Place of Birth : Suphan Buri, Thailand

Institutions Attended :

Mahidol University, 1984–1988 :

Bechelor of Science (Nursing)

Mahidol University, 1990–1993 :

Master of Science (Public Health)

major in Nutrition

Research Grant Faculty of Graduate Studies,
Mahidol University, in the Academic
Year of 1991.

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ชื่อวิทยานิพนธ์	ความสัมพันธ์ระหว่างภาวะโภชนาการก่อนการตั้งครรภ์ และน้ำหนัก เฉลี่ยที่เพิ่มขึ้นระหว่างการตั้งครรภ์กับการคลอดทารกก่อนกำหนด ครรภ์เดียวในโรงพยาบาลศิริราช
ผู้วิจัย	กฤษฎา จงส่งเสริม
ปริญญา	วิทยาศาสตรมหาบัณฑิต (สาธารณสุขศาสตร์) สาขาวิชาเอกโภชนาวิทยา
คณะกรรมการควบคุมวิทยานิพนธ์	มัทนา ประทีปะ เสน M.D., M.S., Dr. P.H. ภาณี เต็มเจริญ B.Sc., M.Ed., M.P.H. ชุตินา ศิริกุลชยานนท์ M.D. วงเดือน บัณฑิต B.Sc., M.Sc., M.S.P.H.
วันที่สำเร็จการศึกษา	20 พฤษภาคม พ.ศ. 2536

บทคัดย่อ

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อศึกษาความสัมพันธ์ระหว่างภาวะโภชนาการก่อนการตั้งครรภ์และน้ำหนักเฉลี่ยที่เพิ่มขึ้นระหว่างการตั้งครรภ์ กับ การคลอดทารกก่อนกำหนดที่คลอดในโรงพยาบาลศิริราช กรุงเทพมหานคร โดยทำการเก็บรวบรวมข้อมูลตั้งแต่วันที่ 1 พฤศจิกายน 2534 ถึงวันที่ 31 เมษายน 2535 ได้มารดาครรภ์เดียว ที่ตั้งครรภ์เป็นครั้งแรก โดยกลุ่มมารดามีการคลอดก่อนกำหนดจำนวน 100 ราย และครบกำหนด จำนวน 100 ราย ซึ่งข้อมูลที่ศึกษาได้จากการสัมภาษณ์ข้อมูลย้อนหลังของมารดาภายหลังคลอด, ในบันทึกประวัติของโรงพยาบาลและบันทึกรายงานการคลอดของทารก

ผลการศึกษาพบว่าส่วนสูงและค่าดัชนีมวลกายของร่างกาย (BMI) ของมารดา ก่อนการตั้งครรภ์ ซึ่งในการศึกษานี้ได้ใช้ค่าส่วนสูงและค่า BMI นี้เป็นข้อบ่งชี้ถึงภาวะโภชนาการก่อนที่จะมีการตั้งครรภ์ของมารดา พบว่าในมารดาที่มีการคลอดทารกก่อนกำหนดและครบกำหนดนั้น

มีค่าส่วนสูงและค่า BMI ที่ไม่แตกต่างกัน ($P = 0.12$ และ $P = 0.47$ ตามลำดับ) ส่วนในเรื่องของภาวะโภชนาการและการตั้งครรภ์พบว่า ในกลุ่มมารดาที่มีการคลอดทารกก่อนกำหนดและในกลุ่มมารดาที่คลอดทารกครบกำหนด จะมีน้ำหนักเฉลี่ยที่เพิ่มขึ้นตลอดระยะเวลาของการตั้งครรภ์เท่ากับ 0.29 ± 0.08 กก./สัปดาห์ และ 0.33 ± 0.09 กก./สัปดาห์ ตามลำดับ ซึ่งแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($P = 0.001$) และพบว่าหากมารดาที่ตั้งครรภ์มีน้ำหนักเฉลี่ยที่เพิ่มขึ้นต่อสัปดาห์ น้อยกว่า 0.27 กก. จะทำให้มีโอกาสเสี่ยงต่อการให้กำเนิดทารกก่อนกำหนดถึง 2 เท่า เมื่อเทียบกับกลุ่มที่มีน้ำหนักที่เพิ่มขึ้นเฉลี่ยต่อสัปดาห์เท่ากับ 0.27 - 0.52 กก.

เมื่อพิจารณาน้ำหนักที่เพิ่มขึ้นโดยเฉลี่ยต่อสัปดาห์ในแต่ละไตรมาส พบว่าในไตรมาสแรกและไตรมาสที่สามารถค้ำทั้ง 2 กลุ่มจะมีน้ำหนักที่เพิ่มขึ้นไม่แตกต่างกัน ($P = 0.31$ และ $P = 0.59$ ตามลำดับ) ส่วนในไตรมาสที่สองพบว่ากลุ่มมารดาที่มีการคลอดทารกก่อนกำหนดและครบกำหนด มีน้ำหนักเฉลี่ยที่เพิ่มขึ้นเท่ากับ 0.29 ± 0.14 และ 0.39 ± 0.14 กก./สัปดาห์ ตามลำดับ ซึ่งพบว่าทั้ง 2 กลุ่มนี้มีน้ำหนักที่เพิ่มขึ้นแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($P = 0.003$) และหากมารดาที่มีน้ำหนักเพิ่มขึ้นในไตรมาสที่สองน้อยกว่า 400 กรัมต่อสัปดาห์จะทำให้มีโอกาสเสี่ยงต่อการให้กำเนิดทารกก่อนกำหนดถึง 5 เท่า เมื่อเทียบกับกลุ่มมารดาที่มีน้ำหนักเพิ่มขึ้นมากกว่าหรือเท่ากับ 400 กรัมต่อสัปดาห์

Thesis Title Relationship between Pre-pregnancy Nutritional Status, Average Weight Gain During Pregnancy and Preterm Delivery in Singleton Pregnancy: Siriraj Hospital.

Name Kritsana Jongsongsrerm

Degree Master of Science (Public Health)
major in Nutrition

Thesis Supervisory Committee

Mandhana Pradipasen, M.D., M.S., Dr.P.H.
Paradee Temchareon, B.Sc., M.Ed., M.P.H.
Chutima Sirikulchayanonta, M.D.
Wongdyan Pandii, B.Sc., M.Sc., M.S.P.H.

Date of Graduation 20 May B.E.(1993) 2536

ABSTRACT

The objective of this study was to illustrate the relationship between pre-pregnancy nutritional status, average weight gain during pregnancy and preterm delivery in singleton and first pregnancy. The study subjects included 100 mothers of the preterm and 100 mothers of the full-term delivered at Siriraj Hospital, Bangkok, Thailand during November 1, 1991 to April 31, 1992. The data were collected from the out-patient and delivery records and also by interviewing through the use of a formal questionnaire.

The overall results showed that :-

- The nutritional status before pregnancy, indicated by maternal height and pre-pregnancy body mass index (BMI), were not

significantly different between mothers of the preterm and those of the full-term. ($P = 0.12$ and $P = 0.47$ respectively).

- The nutritional status during pregnancy of mothers of the preterm, indicated by maternal weight gain during pregnancy and calculated as weekly weight gain, was significantly lower than that of mothers of the full-term ($P = 0.001$). Mothers with low rate of weekly weight gain during pregnancy (< 0.27 kg/wk) were twice as likely to experience a preterm delivery as those with normal weekly weight gain during pregnancy ($0.27-0.52$ kg/wk).

- Regarding the average weight gain during each trimester of pregnancy, it was found that the average weight gain in the first and the third trimesters were not significantly different between mothers of the preterm and those of the full-term ($P = 0.31$ and $P = 0.59$ respectively). The average weight gain during the second trimester of mothers of the preterm (0.29 ± 0.14 kg/wk) was significantly ($P = 0.03$) lower than that of mothers of the full-term (0.39 ± 0.14 kg/wk.). Mothers with average weight gain during the second trimester less than 400 gms.wk. were five times as likely to experience a preterm delivery as those with the average weight gain of 400 gms./wk. or more during the same trimester.

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CHAPTER I

INTRODUCTION

The most important factors in the improvement of the economic and social condition of the country are the quality of the people. This means everybody must be healthy both physiologically and psychologically. Thus, every country tries to make its population healthy, more intelligent, able to work more efficiently, and to have high resistance to illness. (1) In order to be healthy, one must have good nutrition since fertilization. This condition of good nutrition must be maintained according to the child's age. However, if the infant were born with malnutrition, it would be very difficult for him to grow and achieve good nutritional status later in life. The growth and development of a child can be divided into two periods:-

1. Prenatal period
2. Postnatal period.

There are two factors that involve in the prenatal growth: (2)

1. Genetic factor which is an internal control. Genetic factor is what a child inherited from parents since fertilization to define different characteristics. These include the potential of intelligence; therefore, this genetic factor can hardly be changed.
2. Environmental factor which has a parallel effect to the development of the child.

The environmental factors are those which stimulate the development process of a child after birth. During pregnancy, the

environmental factors are nutrition and the health of the mother. Moreover, the fetus' brain grows rapidly which the infant is inside its mother's womb. If the fetus does not receive adequate nutrition both in quality and in quantity, the growth of the brain will be stopped and may lead to low birth weight or prematurity. (3) The condition of low birth weight or prematurity can result in higher morbidity, congenital malformation and higher neonatal mortality. (4) In Thailand and other countries, the conclusion of the perinatal mortality and the involved factors shows that prematurity is the most vital cause of death to the infants. (5) (see table 1).

Table 1 Summary of causes and rate of perinatal mortality in Thailand and other countries.

Year of study	Name	Place	Perinatal mortality	Causes of death
1938 - 1952	Baird et al	Scotland	38.6	-Prematurity, Death of unknow causes and Malformation of babies
1951 - 1955	Vitoun Aostanon	Siriraj Hospital	33.0	-Hypoxia, Congenital malformation, Prematurity and Infection.
1961	Hunt and Goldstein	America	23.9	-Prematurity, Abnormal of Respiratory system, Congenital malformation and Trauma of labour.

Table 1 (Cont.)

Year of study	Name	Place	Perinatal mortality	Causes of death
1965 - 1967	Kamheang Chaturachinda	Ramathibodi Hospital	14.0	-Prematurity, and Congenital malformation.
1977	Mc Ilwaine	Scotland	18.0	-Congenital malformation, and Prematurity.
1977 - 1981	Pensri Pungchanon	Vachira Hospital	26.4- 19.0	-Respiratory failure, Prematurity, Hypoxia, and Incident of labour
1978 - 1980	Pratuk Aoprasertsawat and Kamheang Chaturachinda	Ramathibodi Hospital	10.1	-Prematurity, and Congenital malformation.
1979	Somma Tungsuwon	Siriraj Hospital	17.4	-Prematurity, Hypoxia, and Congenital malformation.
1979 - 1981	Prayouth Somprakit	Phrapokklao Hospital	55.0- 46.4	-Prematurity, Hypoxia, Congenital malformation, and other causes.
1980 - 1983	Chusri Kuchaisit	Ramathibodi Hospital	10.3- 8.3	-Macerated stillbirth, Prematurity, and other causes.
1984- 1985	Nuntha Aumkun	Sukhothai	19.9	-Prematurity, Low birth weight, Congenital malformation, and Trauma of labour.

According of the World Health Organization and American Academy of Pediatrics, the definition of the premature infant is that any infant was born before 37 weeks of gestational age. (6) In America, the incidence of prematurity in 1983 was 9.2% (4) and the result of the infant's death rate was as high as 75%. (7) In 1984, Perera and Lwin (8) reported that gestational age has a direct effect on the result of pregnancy outcome. They concluded that the fetal death rate was very high in case of prematurity (the gestational age before 37 weeks). This conclusion is in agreement with Gunn and Hayden. (9) Furthermore, the study of neonatal mortality with various length of pregnancy at Ramathibodi Hospital in 1977-1978 (see table 2) (10) shows that the survival rate changed in accordance with the gestational

**Table 2 Perinatal mortality rate of Ramathibodi Hospital
classified by gestational age : 1977-1978.**

Gestational age (weeks)	Death rate (per 1,000 cases)
≤ 35	251.5
36	25.0
37	11.9
38	6.1
39	4.2
40	5.6
41	3.3
42	8.9
≥ 43	29.4

age and it is likely to be so nowadays in hospitals with no ventilator and neonatologist. For hospitals with ventilator and neonatologist the death rate of premature infants (who deliver at 28th - 35th weeks) were about 5% (personal communication with *P. vacharangkul*) (79). In fact, the gestational age is far more important than the birth weight. The study showed that the infant with low birth weight and longer gestational age has lower death rate than those born with low birth weight and shorter gestational age. (11,12) For example, the mortality rate of the infant with birth weight 2,500 grams and gestational age under 37 weeks was 3 times more than that of those with the same weight and gestational age over 37 weeks. The infant with birth weight between 1,500-2,500 grams and born before 37 weeks of gestational age will have the death rate as high as 10.5%. However, this death rate will decrease to 3.2% if the gestational age is longer than 37 weeks. (7) The reason is that within 37 weeks the fetus does not have enough time to grow and develop inside its mother's womb. This means the development of the fetus has not yet been completed or is not strong enough to survive in the outside world. For example, the terminal air sacs or alveoli of the respiratory system will be formed when the fetus is 20 weeks. At 28 weeks, the system will develop very rapidly to the point that the fetus can survive outside its mother's womb. This is possible because the surfactant (the chemical which makes the air sacs in the lung expand), started to secrete when the fetus is 28 weeks. The surfactant will increase very rapidly between the 32th and 34th weeks, and will be completed when the fetus is 36 weeks. (13) Therefore, if the infant was born before a certain period of time, many health problems may occur later; such as, the respiratory distress syndrome, hyperbilirubinemia, aspiration, subnormal body temperature, and infection. (14) These are the reasons why the infant cannot have a normal life and possibly die soon.

In Thailand, the incidence of prematurity is very high but up until now we still cannot find the incidence of prematurity in certainty.

(4) Therefore, the premature infant is the group with the highest death rate. (15) According to the statistics of premature death rate at Ramathibodi Hospital in 1983, the death rate of premature infants 1,500–1,999 grams was 12.5% while that of those weighing 2,000–2,499 grams was only 1.34%. (16) In the rural area, they found that premature infant has even higher death rate. For example, at Phrapokklao Hospital, Junthaburi, in 1983 the death rate of prematurely born infants was 18.1%. At the Mother and Child Health Care Center 7 in Rajchaburi, the premature death rate was 16%. (15) In 1985, having studied the effect of gestational age, Nuntha Aumkun and companion found that the death rate of premature infants was 255 per 1,000 or 20 times of those who were born at term. (17)

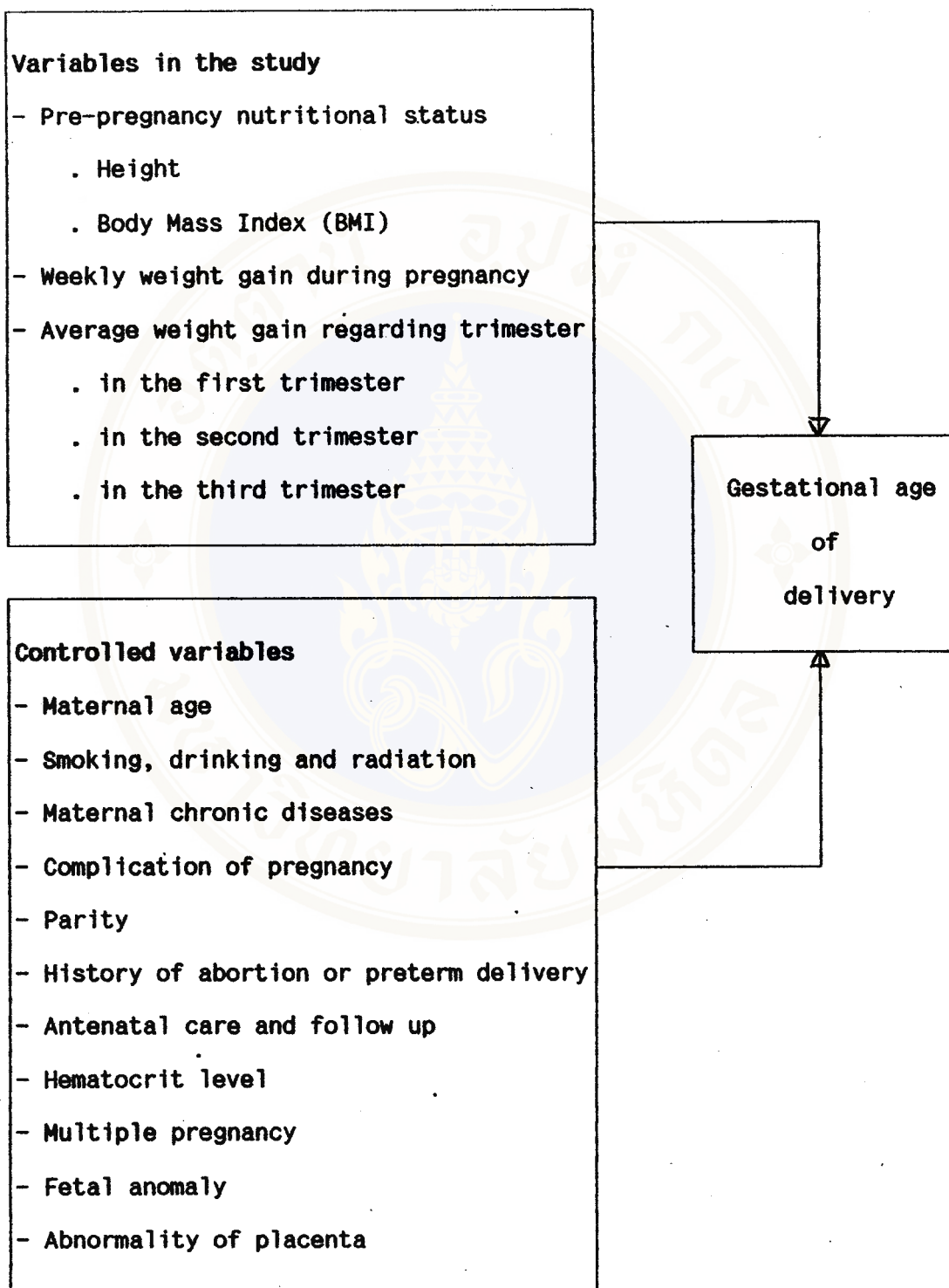
Thus, today much medical equipment has been improved and applied in order to decrease the premature death rate. (13) It is necessary that there must be more personnel who have knowledge and experience in taking care of these premature infants. In the United State of America, the budget of special health care for premature infants is more than a thousand million dollars per year or average 450 to 825 dollars per person (18). Even though there is no such fund available in Thailand, the high cost of this type of medical care is mostly taken care by the Thai government. (19)

Though the infant who was born prematurely can survive, universally 22% of these infants will have handicap. In addition, 10% of these infants can possibly be a handicap or have abnormality of

the central nervous system (20) including mental handicap and other abnormality of the nervous system (21), e.g. mental retardation, cerebral palsy, mental disorder, etc. These abnormalities are caused by the complication such as hypoxia, hypoglycemia and hyperbilirubinemia. (22) If the fetus is taken good care since fertilization, the preterm delivery will decrease from 8.2% to 3.7%. (20) Therefore, to improve one's health, one has to start right from the beginning of fertilization. Surely, the mother must be very healthy in all aspects, especially nutrition, both before and through out her pregnancy. Since the fetus needs nutrition and good environment from its mother to develop and to grow, the mother should pay special attention and care for her own health for the benefit of the infant.

Furthermore, under the right condition and environment, the fetus can grow and deliver at the right period of time. This will help decrease perinatal death rate and other handicaps caused by preterm delivery. In fact, unhealthy infants can later be the burdens of their families and societies. Thus, the research of any factor that involves or causes prematurity should be done more widely and seriously in order that appropriate preventive measures can reduce the expense of the family and the nation.

Conceptual Framework



Objective of this study

1. To study the association between pre-pregnancy nutritional status and preterm delivery.
2. To study the association between average weight gain during the pregnancy, of the 1st, the 2nd, and the 3rd trimester and preterm delivery.
3. To elucidate the appropriate nutritional delivery services in term of whom and when to get it.

Hypothesis

1. The mothers of the preterm are shorter than the mothers of the full-term.
2. The mothers of the preterm have less pre-pregnancy Body Mass Index (BMI) than the mothers of the full-term.
3. The mothers of the preterm have less weight gain during the pregnancy, of the 1st, or the 2nd, or the 3rd trimester than the mothers of the full-term.

Assumption under this study

1. The data were correctly recorded by Hospital and Public Health Centers.
2. The quality of data collection in these two sources is in the same standard.

Limitation of this study

The data from pilot study showed that very few mothers have preterm delivery, therefore, prospective study is impossible due to time limitation.

Scope of this study

The subject of this study were confined to mothers delivered in common ward at Siriraj Hospital and had received antenatal care and followed up at Hospital or Public Health Centers during pregnancy.

Definition and meaning of terminology used in this study

Pre-pregnancy nutritional status : means nutritional status before pregnancy indicated height and Body Mass Index (BMI).

Maternal height (cms.) : means the height in centrimeters at first attendance to the antenatal clinic. It refers to a long term effect of malnourishment on the nutritional status of pregnant women.

Body Mass Index (BMI) (kg./m²) : means pre-pregnancy weight of pregnant women (in kilograms) devided by square of height (in meters) of pregnant women. It refers to nutritional status in pre-pregnancy and were classified into 3 groups as following:

- 1) BMI < 20 kg./m.² : Malnutrition before pregnancy.
- 2). BMI 20-24.9 kg./m.² : Normal nutrition before pregnancy.
- 3) BMI ≥ 25 kg./m.² : Overnutrition before pregnancy.

Antenatal care and follow up : means women who have pregnancy to attendance at the Hospital or Public Health Centers in the first time and have to follow up by:

- once every 4 weeks until the 28th weeks,
- once every 2 weeks from 28th to 36th weeks,
- once a week up to the onset of labour.

Weight gain during pregnancy (kgs.) : means the difference in kilograms between weight at the last antenatal record and pre-pregnancy weight.

Weekly weight gain during pregnancy (kgs./wk.) : means weight gain during pregnancy (kgs.) divided by duration of gestational age in weeks, that calculated at the beginning of pregnancy to the last of antenatal care.

Average weight gain regarding trimester (kgs./wk.) : means weight gain (kgs.) per week of pregnant during each trimester:

1) Average weight gain in the first trimester: in this study, it refers to the average weight gain per week of maternal (expressed in kilograms) which was calculated from weight at 12nd (\pm 1st) week of gestational age minus weight at pre-pregnancy and divided by duration of gestational age.

2) Average weight gain in the second trimester: it was calculated from weight at 24th (\pm 1st) week of gestational age minus weight at 12nd (\pm 1st) week of gestational age (expressed in kilograms) divided by duration of gestational age.

3) Average weight gain in the third trimester : it was calculated from weight at the last antenatal care minus weight at 24th

(\pm 1st) week of gestational age (expressed in kilograms) divided by duration of gestational age.

Gestational age at delivery : means the time calculated from the first day of the last menstrual period to the day of delivery. (expressed in days)

Preterm delivery : means the delivery at 20th - 36th weeks of gestation (or 140 - 258 days) and premature infants examined by standard of Usher. (Appendix A)

Full-term delivery : means the delivery at 37th - 42nd weeks of gestation (or 259-294 days) and full-term infants examined and signed of term infants.

Infant birth weight (grams) : means the first weight of the infant after delivery.

Fetal well-being : means health of infants and can be divided into 2 groups: -

- healthy : refer to the good Apgar score of infants and/or can be discharged with their mothers.
- unhealthy : refer to poor Apgar score of infants and/or can not be discharged with their mothers.

CHAPTER II

REVIEW OF LITERATURES

Preterm delivery is an important determinant of infant mortality and morbidity because the survival of the neonate that birth should not occur until the fetal organ system, that are essential for postnatal survival, are sufficiently mature. (23) Many previous studies about factors associated with gestational age at delivery have been published. Most of them have been conducted in other countries.

Factors contributing to preterm delivery at various stage of pregnancy are periodically reviewed.

1. Maternal general characteristics

1.1 Socioeconomic status

Socioeconomic categories commonly used include income and education. Poor and uneducated women tend to be unhealthy before pregnancy. Especially its refer to malnourishment and its associated with preterm delivery.

Ven Katachalam in 1962 (24) found that the mothers who have high socioeconomic status had 13.8% of preterm delivery. While the mothers who have low socioeconomic status had 29.3% of preterm delivery.

Baird in 1964 (25) found that mothers in high social class had the lowest rates of prematurity.

Ericson et al. in 1984 (26) studied in Sweden, they divided the population into 3 groups, high, medium, and low socioeconomic status and has Relative risk of preterm delivery 1.0, 1.3 and 1.8 respectively.

Arbuckle and Sherman in 1989 (27) described that maternal education and family income had associated with preterm delivery.

Ketterlinus et al. in 1990 (28) found that maternal age, race and education had associated with preterm delivery.

1.2 Maternal age

The optimal age for pregnancy is between 20 and 30 years old (29). The following studies indicated that maternal age is an important factor for physiological and gynecological maturity:

Baird in 1964 (25) found that primigravida mothers younger than 20 years of age had a highest rate of prematurity because of is not of gynecological immaturity.

Zlatnik and Burmeister in 1977 (30) had similar findings. The uterus may somehow be structurally or functionally less able to carry a fetus to term and the uterine vasculature are less well-developed in those young women.

Lowson in 1977 (31) mentioned that mothers of younger (<20 years old) or older (>30 years old) groups may encounter special problems. It is possible that ovarian function is not stabilized when the mother is too young and her physical growth has not fully developed. Her reproductive system is not well prepared for pregnancy so that the hormonal effect on her reproductive organs is deficient. This factor may result in complicated pregnancy as well as preterm delivery.

Wen et al. in 1990 (32) evaluated a population of 17,000 indigent women. It was found that younger (< 17 years old) or older (> 30 years old) were related significantly to preterm delivery.

1.3 Maternal occupation

Heavy physical work, maternal emotions and stressful life events were once believed to be potent sources of harm to the fetus during pregnancy. The incidence of preterm delivery was 4.3% among professional and business groups and 10.9% among in Semi and unskilled manual workers. (20)

Mamelle et al. in 1984 (33) investigated the relationship between prematurity and occupational fatigue of mothers, the latter having been quantified by the index based on the 5 sources of fatigue (posture, work on industrial machine, physical exertion, mental stress, and environment). A significant relative risk between 1.6 and 1.9 is found for each source, when any one of these sources increases from low to high, so that each fatigue source can be considered as a prematurity risk factor.

Holmes and Rahe (34) studied base on the assumption that anxiety or stress is increased by changes in an individual's lifestyle and environment. It demonstrated that the occurrence of stress 6 months before delivery, or during the 2nd and 3rd trimester, is associated with an increased number of pregnancy complication.

2. Health practice

2.1 Maternal smoking

The effect of maternal smoking on infants was reported by many of the studies. Mothers who smoke heavily tend to have lower birth weight infants. Women who smoke also have a greater incidence of premature delivery, intrauterine growth retardation, spontaneous abortion, still birth and neonatal death (35).

Herriot et al. in 1962 (36) found that smoking was most common in the lower social class, the wives of semi-skilled and un-skilled manual worker tend to continue smoking during pregnancy. The habit was least common in the wives of professional and managerial group, they frequently reduce their smoking during pregnancy. In the babies of mothers who smoked, not only the mean birth weight was lower but also the prematurity-rate was higher than in babies of mothers who did not smoke. Smokers had a slightly shorter gestation period.

Witte in 1978 (37) reported that, the nicotin in cigarette smoke acts on the sympathetic ganglia and the adrenal medulla to release acetylcholine, epineprine and norepineprine. Increased levels

of these hormones result in increased maternal heart rate, vasoconstriction and increased blood pressure.

Vasoconstriction of placenta and fetal arteries can result in decreased blood supply, and consequently decreased oxygen and nutrients to the fetus. Thus a result of this finding was considered possible cause of retarded fetal growth, development and shorter gestation period. (38)

Wen et al. in 1990 (32, 39) studied the relationship between smoking and their combined effects on birth weight, intrauterine growth and preterm delivery. It was found that smoking, lowers birth weight both by decreasing fetal growth and by lowering gestational age at delivery significantly. Smoking in older women also was associated with more instances of preterm delivery and a lower mean gestational age when compared to women of 25 years old or younger.

2.2 Maternal alcohol consumption

Warnes and Rosett's study in 1975 (40) of the relationship between alcohol consumption during pregnancy and fetal development has been of medical concern for many year.

Sokol in 1981 (41) found that the heavy alcohol consumption by the mother during pregnancy has long been suspected of being a risk factor for abnormalities in the fetus or infant.

Research during the past several years has shown that women who drink heavily during pregnancy have a greater risk of producing infant with physical malformations, neurological, abnormalities and poor developmental problems than non-drinking women. The infant born with Fetal Alcohol Syndrome may be below average in birth weight and length. Heavy drinking during the first trimester probably has the greatest effect on fetal physical development. During the second and the third trimester fetal brain development may be affected and may have a greater effect on fetal size. (42)

Kennedy in 1984 (43) found that the placental weight was reduced with increasing alcohol intake.

2.3 Antenatal care

Prenatal care has been accepted as one of the basic ingredients in the establishment of good obstetric medical service. Recent studies of pregnancy outcome have shown a progressive decline of perinatal and infant mortality in all risk categories. The decline has come at a time of change in many aspects of maternal and infant care, with an increased availability of means for spacing or preventing pregnancies.

The purpose of antenatal care is to have the mother arrive at the end of her pregnancy in good health and to deliver a healthy infant. Mothers who attend antenatal care units have a complete medical check up at their first visit to detect abnormalities and assess fetal growth. Mothers are given advice about pregnancy and also given information on possible danger signs that detect early

complications, which endanger the life or health of the mother and infant. (44)

Mccarthy et al. in 1982 (45) found that the absence prenatal care during pregnancy increase the risk of preterm delivery and low birth weight. In the study, infants born after no prenatal care had six times higher neonatal mortality rate than did those born after prenatal care. While Nongnuch (46) and Sujitra (47) in a similar study noted that women without prenatal care during pregnancy was associated with more instance of preterm delivery when compared to the women with antenatal care during pregnancy.

Ketterlinus et al. in 1990 (28) noted that the gestational age at first attendance for antenatal care was significantly associated with the occurrence of preterm delivery.

3. Maternal nutritional status and food intake

3.1 Food intake

Food is essential to life and growth. Without an adequate supply of food and nutrients an organism cannot grow and develop normally and eventually dies. Pregnancy makes many demands on the prospective mother, especially her nutritional needs. During pregnancy two factors that determine energy requirements are changes in the mother's usual physical activity and an increase in her basal metabolism to support the work required for growth of the fetus and the accessory tissue. The goal of weight management during pregnancy

should be to promote optimum nutrition for the mother and child. (44) Thomson in 1959 (48) found a correlation between energy intake and weight gain in 489 pregnant women.

Beal in 1971 (49) found that the relationship between caloric intake and weight gain during pregnancy was a positive correlation, but the coefficient was statistically significant only for caloric intake in the second trimester, this series was similar to the report by Thomson and Hytten for intakes from 20th - 28th weeks of gestation. In the third trimester, when many women in this series were restricted caloric intake, the correlation with total weight gain was smaller and statistically in significance.

3.2 Maternal height

Maternal height reflects maternal nutrition during the growing year (50).

Baird in 1964 (25) studied Aberdeen primigravidas and classified their height into 3 groups:-

1. 64 inches and over (tall)
2. 63 inches to 61 inches (medium)
3. <61 inches (small)

It was found that incidence of preterm delivery was 4.9, 7.7 and 12.1 percent, respectively. The stunted growth of mothers give rise to a high rate of prematurity.

Garn and Petzold in 1983 (51) showed that the pregnancy of teenage mothers (13-19 years) had a higher incidence of prematurity and diminished birth size. Teenage mothers tend to be of small stature and weight. The size and gestational age at delivery of their infants are in proportion to their smaller size (small stature and weight).

Nondasuta et al. in 1986 (52) in a study of relationship between birth weight, gestational age and maternal height showed the increase of mean birth weight and gestational age with the increase in maternal height.

3.3 Pre-pregnancy weight and weight gain

Maternal pre-pregnancy weight and weight gain, which refers to maternal nutritional status during pregnancy, associated positively with preterm delivery. Several anatomic, physiological, and biochemical changes occur during a normal pregnancy. The purpose of these change is to create an internal environment which is conducive to the healthy development of the fetus and to prepare the mother for labour, birth, and lactation. These changes in physiology form the basic for the nutrient requirements of the pregnant woman. Fetal health is significantly influenced by the efficiency of nutrient transport by the placenta. The rapid growth of the fetus increases the need for all nutrients (53).

Ancrì et al. in 1977 (54) found that when the mother's weight gain and the week of delivery were compared, a positive correlation appeared.

Phillips and Johnson in 1977 (55) showed that the birth weight of infant is positively correlated to the number of week of gestation.

Leader et al. in 1981 (56) found that the fetal growth improved significantly with increasing maternal caloric intake. The weight gain change is less in the first trimester and more in the second and the third trimester. Hytten and Leitch in 1971 (57) reported similar findings.

Brown et al. in 1981 (58), studied the influence of weight gain during pregnancy. Duration of gestation and infant size at birth were examined among women beginning pregnancy with underweight and with normal weight. They reviewed 654 prenatal and postpartum care in a major hospital located in St. Paul, Minnesota, USA and delivered single infants between the year 1969 and 1976. Pre-pregnancy weight status was calculated as a percentage of normal weight, defined as the midpoint of the weight range given for a women's height and age in the Metropolitan Life Insurance table. Women weighing less than 80% of standard weight were designated as very underweight, those weighing from 80 to 90% as moderately underweight, and those weighing from 90 to 120% as normal weight. It was found that :-

- pre-pregnancy weight status was not associated with the amount of weight gained during pregnancy.

- underweight women who gained as the same amount of weight as normal weight women delivered infants at a younger gestational age and of lower birth weight and length.

Mitchell and Lerner in 1989 (59), studied the relationship of antenatal weight gain to pregnancy outcome in 362 pairs of underweight

women (< 90% Metropolitan Relative Weight, MRW) and normal weight (90% to 110% MRW) women. In comparison with normal weight women, underweight women had more preterm infants (8.8% and 9.4% respectively, $P < 0.01$). Mean antenatal weight gain of underweight women (9.3 ± 3.2 kgs.) was significantly higher than that of normal weight women (8.4 ± 3.1 kgs) ($P < 0.001$).

In both initial weight categories, weight gain below 9 kg. were associated with significantly more premature infants and a higher incidence of medical complication in the infants ($P < 0.05$). (Table 3).

Table 3 Pregnancy outcome by prenatal weight gain.

Variable	normal weight		underweight	
	< 9 kg	\geq 9 kg	< 9 kg	\geq 9 kg.
	(n=237)	(n=125)	(n=198)	(n=164)
Weight gain (kgs)	6.7 \pm 2.1 ^a	16.6 \pm 1.9	7.3 \pm 1.7	11.8 \pm 2.7
Infant birth weight (gm)	3,084 \pm 507 ^b	3,334 \pm 434	3,000 \pm 504	3,368 \pm 476
Premature < 37 weeks (%)	9.5 ^c	8.7	9.5	8.7

a = mean \pm SD

b = $P < 0.001$, for < 9 kg VS. \geq 9 kg.

c = $P < 0.05$, for < 9 kg VS. \geq 9 kg.

Wen et al. in 1990 (32) found that low maternal weight was statistically related to preterm delivery.

Women who are overweight prior to pregnancy are at an increased risk of complications such as toxemia, pre-eclampsia and diabetes mellitus. The maternal complications observed during pregnancy may lead to preterm delivery significantly. In Jamaica, a study showed a relationship between obesity in mothers and complication during pregnancy (diabetes mellitus and pre-eclampsia), which followed by poor fetal outcome and short gestational age. (60)

In several studies, the adequate weight gain is of critical importance to women beginning in pregnancy, it reflects the good outcome.

Baird in 1964 (25) showed that the lowest rate of prematurity was found in association with a weight gain of about 1 pound per week between the twentieth and thirty-sixth week of pregnancy. This rate of weight increase is also associated with the lowest perinatal mortality.

Pepiarnik and Kaminski in 1974 (61) showed a significant association between preterm birth and maternal weight gain of less than 5 kg. (11 lb) at 32 weeks gestation.

Berkowitz in 1981 (62) found that the odds ratio for "inadequate weight gain" adjusted for pregnancy duration was 4.28 (95% confidence interval 2.3, 8.0).

Gueri et al. in 1982 (63) found that the average weight increase is estimated to be approximately 12 kg, of which about 3.5 kg

(29%) represent the weight of the fetus at term; the uterus, amniotic fluid, and placenta account for about 2 kg and the breast for 1 kg. One and one-half kg are due to fluid retention and 4 kg. due to fat deposit. For practical purposes, it has been said that during the 2nd and 3rd trimesters of pregnancy a woman should put on 0.4 kg/wk.

Van den Berg and Oechsli in 1984 (64) reported that a low weekly rate of gain (less than 0.23 kg) after 20 weeks' gestation was associated with preterm birth.

Abrams et al. in 1989 (65) studied the relationship between maternal weight gain and preterm delivery in 2163 women between 1978-1986. Categories of rate of weight gain were defined as follows:

1. Low rate of gain = less than 0.27 kg/week
2. Average rate of gain = 0.27-0.52 kg/week
3. High rate of gain = more than 0.52 kg/week.

It was found that 37.3% of the preterm mothers gained less than 0.27 kg/week, compared with only 24.2% of the term group ($P < 0.002$). Women with a low rate of gain were more than twice as likely to experience a preterm delivery as those with a high gain (higher than 0.52 kg/week); the odds ratio was 2.54 (95% confidence interval 1.49, 4.88). The mean weekly weight gain of preterm mothers (0.33 ± 0.19 kg/week) was significantly ($P = 0.002$) lower than that of full-term mothers (0.39 ± 0.17 kg/week). This difference in weight gain appeared e after 20 weeks' gestation.

Hediger et al. in 1989 (66) studied in a cohort of 1790 teenagers. They found that an inadequate weight gain (less than 400 g/

week) during the late second and third trimesters significantly increased the risk of preterm delivery.

3.4 Haemoglobin and hematocrit levels

Haemoglobin and hematocrit levels decrease during pregnancy because the fetus will act as a parasite, depleting the mother of iron. If, however, at any point in the pregnancy the haemoglobin falls below 11 gm% or the hematocrit below 33%, the diagnosis is anemia (WHO). (49)

Kaltreider and Johnson in 1976 (67) found that if haemoglobin and hematocrit dropped to less than 9 gm% and 31% respectively, preterm delivery and low birth weight infants occurred. Boomer and Christensen in 1982 (68) had a similar finding.

Hudono in 1976 (69) reported that mothers with haemoglobin less than 10 gm% were found to have significantly higher incidence of preterm delivery.

Bakketeig and Hoffman in 1981 (70) showed that mothers with haemoglobin less than 7 gm% tended to bear risk of preterm delivery (Relative risk = 4.2).

4. Residual :-

Other factors have affected preterm delivery, such as previous abortion or preterm delivery (20, 32, 70, 71), races (28), multipara (72), obstetric complication during pregnancy (20), maternal of chronic diseases (73, 74, 75), fetal anomaly and abnormality of placenta (20).

CHAPTER III

MATERIAL AND METHOD

This is a Retrospective study (case-control study) using the descriptive survey method.

The study population

The study population consisted of mothers who delivered at the Obstetric Department of Siriraj Hospital from November 1991 to April 1992 and fulfilled the following criteria:

I. Criteria for the selection of the sample:-

1. Age : 20-29 years
2. Gestational age at delivery : between 28th weeks and 42nd weeks.
3. Hematocrit levels : not less than 33% during pregnancy.
4. Primigravida (no history of abortion)
5. No chronic disease and severe illness such as renal disease, heart disease and hypertension.
6. No complication during pregnancy.
7. No drink or smoke and having no history of radiation during pregnancy
8. Able to recall the first day of the last menstrual period and pre-pregnancy weight.
9. Normal labour with singleton delivery.
10. Blood pressure measured before delivery below 140/90 mmHg.
11. No abnormality of either the placenta or the newborn.

II. Allocation of the sample:-

Mothers who fulfilled all the selection criteria were classified into the case and control groups in the following manners:

1. Cases were those who delivered before the 37th weeks (259 days) of pregnancy and whose newborn infants could be confirmed as premature according to its special characteristics listed in Appendix A.

2. Controls were those who delivered between the 37th and 42nd weeks (259-294 days) of pregnancy. One control was recruited for each case, through a purposive sampling method, from the next full-term delivery who met all the selection criteria.

Sample size (76)

$$n = \left[\frac{Z_{\alpha} \sqrt{\pi_0(1-\pi_0)} - Z_{\beta} \sqrt{\pi_1(1-\pi_1)}}{\pi_1 - \pi_0} \right]^2$$

From the Pilot study, the incidence of preterm delivery in Siriraj Hospital was 4%.

When ;

$$\begin{aligned} \pi_0 &= 4\% = 0.04 \\ d &= 1\% = 0.01 \\ &= \pi_1 - \pi_0 \\ \pi_1 &= 5\% = 0.05 \\ \alpha &= 5\% \\ \beta &= 20\% \end{aligned}$$

So ;

$$n = \left[\frac{1.645 \sqrt{(0.04)(1-0.04)} - 0.84 \sqrt{(0.05)(1-0.05)}}{0.05 - 0.04} \right]^2$$

$$= \left[\frac{0.139}{0.01} \right]^2 = 193.99$$

$$\approx 200$$

According to the above study, 200 preterm mothers and 200 full term mothers, who fulfilled the selection criteria will be recruited as the case and control groups. In case that the premature delivery is less than what is expected from the pilot study, the number of sample size will be determined by the highest number obtained at the end of 6 month of sample recruitment.

The study instruments

The questionnaires were designed according to the information described in the objectives and hypothesis for the interview. Additional information was collected from hospital records of those pregnant women.

The questionnaires consisted of general characteristics, health practice, food intake, maternal nutritional status and pregnancy outcome.

Data collection

The data are collected from subjects as follows:

1. Interviewing :- used for general characteristics and food intake.
2. Delivery record:- used for data collection of pregnancy outcome.
3. Out patient record:- used for data collection of maternal nutritional status and health practice.

Data analysis

1. Variables

1.1 Dependent variables.

- Gestational age at delivery.

1.2 Independent variables.

- Maternal height
- Pre-pregnancy Body Mass Index (BMI).
- Weight gained by weekly during pregnancy.
 - . average weight gain in the first trimester.
 - . average weight gain in the second trimester.
 - . average weight gain in the third trimester.

2. Statistical analysis

The data is analysed by the computer using the SPSS/PC+ and Epi Info Version 5 programme.

2.1 Descriptive analysis; shown in percentage, means, and standard deviation.

2.2 Chi-Square test; applied in order to test the statistical association of variable data.

2.3 t-test; applied in order to test the statistical difference of quantitative data.

2.4 The statistical significant level was 0.05.



CHAPTER IV

RESULT

At the end of six months of data collection, there were 200 mothers who delivered in common wards at Siriraj Hospital and met the inclusion criteria. They were pairwise divided into 2 groups, 100 mothers of the preterm and 100 mothers of the full-term. The data were analysed by concentrating on the relationship between pre-pregnancy nutritional status, average weight gain during pregnancy and gestational age at delivery. The results to be presented covered the following areas :

1. General characteristics of samples.
2. General characteristics of infant.
3. Health practice.
4. Maternal nutritional status and food intake.

I. General characteristics of samples

General characteristics of the 2 groups of subject in this study included maternal age, race, religion, marital status, education level, occupation, family income.

Table 4 showed that mothers in both groups had a similar of most general characteristics, whereas the family income seem to be different in 2 groups, but the differences were not significant (Table 5).

It is interesting to note that the most of maternal occupation in both groups was in moderate activity. Only few cases were in heavy activity, that was not significant.



Table 4 Comparison of the general characteristics between groups of mothers of the preterm and full-term.

General characteristics of mothers	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
- Age (years)				
20 - 24	63	63.00	63	63.00
25 - 29	37	37.00	37	37.00
$\bar{X} \pm SD$	23.70 \pm 2.89		23.66 \pm 2.66	
- Race				
Thai	100	100.00	98	98.00
Chinese	0	0.00	2	2.00
- Religion				
Buddhism	100	100.00	98	98.00
Christianity	0	0.00	2	2.00
- Marital status				
Couples	97	97.00	97	97.00
Separated, divorced	3	3.00	3	3.00

Table 4 (Cont.)

General characteristics of mothers	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
- Education level				
None	3	3.00	3	3.00
Prathomsuksa	68	68.00	67	67.00
Mathayomsuksa	17	17.00	18	18.00
Above mathayomsuksa	12	12.00	12	12.00
- Maternal occupation				
House-wife	36	36.00	41	41.00
Merchant, goverment official	5	5.00	17	17.00
Employee	56	56.00	41	41.00
Student	1	1.00	0	0.00
Labourer	2	2.00	1	1.00
- Family income (bahts/month)				
≤ 5,000	42	42.00	43	43.00
5,001 - 9,999	45	45.00	51	51.00
≥ 10,000	13	13.00	6	6.00
$\bar{X} \pm SD$	6,205.30 ± 2,463.61		5,651.00 ± 1,888.31	

Table 5 Comparison of the means of maternal age and family income between groups of mothers of hte preterm and full-term.

Variables	Preterm group	Full-term group	t-test	d.f.	P-value
	(n = 100)	(n = 100)			
	$\bar{X} \pm SD$	$\bar{X} \pm SD$			
Maternal age (years)	23.70 \pm 2.89	23.66 \pm 2.66	0.10	198	0.92
Family income (bahts/month)	6,205.30 \pm 2,463.61	5,651.00 \pm 1,888.31	-1.79	185	0.80

II. General characteristics of Infants (Table 6)

- Gestational age

It was found that the average of gestational age at delivery of the preterm group was 35.02 \pm 1.89 wks. and the full-term group was 39.59 \pm 1.19 wks.

- Placenta weight :-

Most of these mothers of the preterm (74 percent) and full-term (90 percent) had placental weight of 500 gms or more. The average placental weight in mothers of the preterm was 562.90 \pm 104.29 gms., in those of the full-term was 607.20 \pm 99.04 gms.

- Infant birth weight :-

The majority of the preterm infants (51.00 percent) were born with 2,500-2,999 gms. birth weight, whereas the majority of the full-term infants (57.00 percent) were born with 3,000 gms. or more birth weight. The average birth weight of the preterm group was $2.731.10 \pm 439.51$ gms. and the full-term group was $3,068 \pm 344.32$ gms.

- Infant's sex :-

The majority of the preterm infants (56.00 percent) was found to be male, whereas that of the full-term infants were female. The likely male infants to be born prematurely was 1.9 times that of female infants. (Table 7)

- Fetal well-being :-

It was found that 8.00 percent of preterm infants were unhealthy, whereas only 2.00 percent in the full term infants. Comparing the 2 groups found that the risk to be unhealthy in the preterm infants was more than 4 times that of the full-term infants. (Table 7).

Table 6 Comparison of the characteristics of infants at birth between groups of mothers of the preterm and full-term

characteristics of infants at birth	Preterm group (n = 100)		Full-term group (n = 100)	
	n	%	n	%
	- Gestational age (wks.)			
27 - 30	5	5.00	-	-
31 - 33	15	15.00	-	-
34 - 36	80	80.00	-	-
37 - 39	-	-	60	60.00
40 - 41	-	-	40	40.00
$\bar{X} \pm SD$	35.02 \pm 1.89		39.59 \pm 1.19	
- Placenta weight (gms.)				
< 500	26	26.00	10	10.00
\geq 500	74	74.00	90	90.00
$\bar{X} \pm SD$	562.90 \pm 104.29		607.20 \pm 99.04	
- Infant birth weight (gms.)				
< 2,000	9	9.00	0	0.00
2,000 - 2,499	14	14.00	2	2.00
2,500 - 2,999	51	51.00	41	41.00
\geq 3,000	16	16.00	57	57.00
$\bar{X} \pm SD$	2,741.10 \pm 439.51		3,068.20 \pm 344.32	

Table 6 (Cont.)

characteristics of infants at birth	Preterm group (n = 100)		Full-term group (n = 100)	
	n	%	n	%
	- Infant's sex			
Male	56	56.00	40	40.00
Female	44	44.00	60	60.00
- Fetal well-being				
Unhealthy	8	8.00	2	2.00
Healthy	92	92.00	98	98.00

Table 7 Infant's sex and fetal well-being by mothers of the preterm and full-term

Variables	Preterm group (n = 100)	Full-term group (n = 100)	\hat{OR} (95% CI)	χ^2	P-value
- Infant's sex					
Male	56	40	1.91	5.13	0.02
Female	44	60	(1.05-3.49)		
- Fetal well-being					
Unhealthy	8	2	4.26	3.77	0.05
Healthy	92	98	(0.81-29.88)		

III. Health practice

- Antenatal care (number of visits):

Table 8 showed that 70 percent and 63 percent of mothers of the preterm and full-term respectively attended antenatal clinic between 5-9 times. The mean value of A.N.C. attendance of mothers of the preterm was 5.32 ± 1.34 times and mothers of the full-term was 7.94 ± 2.44 times.

Table 8 Number and percentage distribution of mothers of the preterm and full-term classified by number of antenatal visits.

A.N.C. (number of visits)	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
< 5	30	30.00	11	11.00
5 - 9	70	70.00	63	63.00
≥ 10	0	0.00	26	26.00
$\bar{X} \pm SD$	5.32 ± 1.34		7.94 ± 2.44	

- Gestational age at first attendance for antenatal care :-

Table 9 showed that 62 percent and 45 percent of mothers of the preterm and full-term respectively attended antenatal clinic at the first time when their gestational age were in the second trimester. The gestational age at first attendance for antenatal care in the first and the second trimester was significantly different between mothers of the preterm and full-term. ($P = 0.04$) (Table 10)

Table 9 Number and percentage distribution of mothers of the preterm and full-term classified by gestational age at first antenatal clinic attendance.

Gestational age of mother at 1 st attendance for A.N.C.	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
with in the 1 st -12 nd weeks	26	26.00	36	36.00
with in the 2 nd -25 th weeks	62	62.00	45	45.00
with in the 26 th weeks	12	12.00	19	19.00

Table 10 Gestational age of mother at 1st attendance for A.N.C. by mothers of the preterm and full-term.

Gestational age of mother at 1 st attendance for A.N.C.	Preterm group n	Full-term group n	Total N
with in the 1 st -12 nd weeks	26	36	62
with in the 13 rd -25 th weeks	62	45	107
Total	88	81	169

$\chi^2 = 4.01, P\text{-value} = 0.04$
 $\hat{OR} = 1.91, 95\% \text{ CI} = 0.97-3.78$

- Hematocrit level :-

From table 11, the mean value of hematocrit for mothers of the preterm was 37.19 ± 2.47 percent and those of the full-term was 36.92 ± 2.26 percent, the difference of which was not of statistical significance ($P = 0.26$) (Table 12).

Table 11 Number and percentage distribution of mothers of the preterm and full-term classified by hematocrit level.

Hematocrit level (%)	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
33 - 35	36	36.00	34	34.00
36 - 38	48	48.00	40	40.00
39 - 41	14	14.00	23	23.00
≥ 42	2	2.00	3	3.00
$\bar{X} \pm SD$	37.19 ± 2.47		36.92 ± 2.26	

Table 12 Comparison of the means of hematocrit level between group of mothers of the preterm and full-term.

Variables	Preterm group	Full-term group	t-test	d.f.	P-value
	(n = 100)	(n = 100)			
	$\bar{X} \pm SD$	$\bar{X} \pm SD$			
Hematocrit level (%)	37.19 ± 2.47	36.92 ± 2.26	-1.13	198	0.26

IV. Maternal nutritional status and food intake.

- Pre-pregnancy weight :-

Table 13 showed that 63 percent and 61 percent of mothers of the preterm and full-term respectively had a pre-pregnancy weight between 40-49 kgs. The mean value of pre-pregnancy weight for mothers of the preterm was 47.30 ± 6.24 kgs. and those of the full-term was 47.17 ± 6.29 kgs., the difference of which was not of statistical significance. ($P = 0.88$) (Table 23)

Table 13 Number and percentage distribution of mothers of the preterm and full-term classified by pre-pregnancy weight.

Pre-pregnancy weight (kgs.)	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
< 40	6	6.00	9	9.00
40 - 49	63	63.00	61	61.00
50 - 59	24	24.00	26	26.00
≥ 60	7	7.00	4	4.00
$\bar{X} \pm SD$	47.30 ± 6.24		47.17 ± 6.29	

- Maternal height:-

From table 14, 69 percent and 75 percent of mothers of the preterm and full-term respectively were between 150-159 cms. of height. The mean value of maternal heights for mothers of the preterm was 154.14 ± 4.83 cms. and of the full-term was 155.23 ± 4.98 cms. The average maternal heights between the two groups were not significantly different. ($P = 0.12$) (Table 23)

Table 14 Number and percentage distribution of mothers of the preterm and full-term classified by maternal heights.

Maternal heights (cms.)	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
< 150	13	13.00	8	8.00
150 - 159	69	69.00	75	75.00
≥ 160	18	18.00	17	17.00
$\bar{X} \pm SD$	154.14 ± 4.83		155.23 ± 4.98	

- Pre-pregnancy Body Mass Index (BMI) :-

Table 15 showed that 60 percent and 66 percent of mothers of the preterm and full-term respectively had pre-pregnancy BMI less than 20 kgs/m². The mean value of pre-pregnancy BMI for mothers of the preterm was 19.79 ± 2.07 kgs/m² and those of the full-term was 19.58 ± 2.14 kgs/m², the difference of which was not of statistical significance. (P = 0.47) (Table 23)

Table 15 Number and percentage distribution of mothers of the preterm and full-term classified by pre-pregnancy Body Mass Index (BMI).

pre-pregnancy BMI (kgs/m ²)	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
< 20	60	60.00	66	66.00
20 - 24.9	37	37.00	32	32.00
≥ 25	3	3.00	2	2.00
$\bar{X} \pm SD$	19.79 ± 2.07		19.58 ± 2.14	

- Weekly weight gain during pregnancy :-

From table 16, Most of mothers of the preterm (60 percent) and those of the full-term (74 percent) gained 0.27 - 0.52 kg/wk. during pregnancy. The mean weekly weight gain of mothers of the preterm was 0.29 ± 0.08 kg/wk. and those of the full-term was 0.33 ± 0.09 kg/wk. Table 27 showed that the weekly weight gain during pregnancy was significantly associated with gestational age at delivery. ($P = 0.001$)

From table 17, the weekly weight gain during pregnancy of less than 0.27 kg./wk. was significantly associated with preterm delivery. ($P = 0.03$) Mothers with low rate of weekly weight gain during pregnancy (< 0.27 kg./wk.) were twice as likely to experience a preterm delivery as those with normal weekly weight gain during pregnancy (0.27-0.52 kg./wk.).

Table 16 Number and percentage distribution of mothers of the preterm and full-term classified by weekly weight gain during pregnancy.

Weekly weight gain during pregnancy (kg./wk.)	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
< 0.27	39	39.00	25	25.00
0.27 - 0.52	60	60.00	74	74.00
> 0.52	1	1.00	1	1.00
$\bar{X} \pm SD$	0.29 ± 0.08		0.33 ± 0.09	

Table 17 Weekly weight gain during pregnancy by mothers of the preterm and full-term.

Weekly weight gain during pregnancy (kg/wk)	Preterm group (n = 99)	Full-term group (n = 99)	Total
< 0.27	39	25	64
0.27 - 0.52	60	74	134
Total	99	99	198
$\chi^2 = 4.50,$ $P\text{-value} = 0.03$ $\hat{OR} = 1.92,$ $95\% \text{ CI} = 1-3.7$			

- Average weight gain regarding trimester of pregnancy :-

1. average weight gain in the first trimester

From table 18, most of mothers of the preterm (59.26 percent) and mothers of the full-term (70.73 percent) gained less than 0.1 kg./wk. in the first trimester. The average weight gain of mothers of the preterm was 0.14 ± 0.17 kg./wk. and those of the full-term was 0.11 ± 0.12 kg./wk. Table 27 showed that the average weight gain of the 2 groups in the first trimester was not significantly different. (P = 0.31)

Table 18 Number and percentage distribution of mothers of the preterm and full-term classified by average weight gain in the first trimester.

Average weight gain in the 1 st trimester (kg/wk)	Preterm group(n=27)		Full-term group(n=41)	
	n*	%	n*	%
≤ 0.10	16	59.26	29	70.73
0.11 - 0.30	8	29.63	8	19.51
0.31 - 0.50	2	7.41	4	9.76
> 0.50	1	3.70	0	0.00
$\bar{X} \pm SD$	0.14 ± 0.17		0.11 ± 0.12	

* Number of sample is markedly less than 100 because many of the mothers did not attend the antenatal clinic during the 12nd (± 1) and 24th (± 1) week of pregnancy.

2. average weight gain in the second trimester.

Table 19 showed that 62.96 percent of mothers of the preterm gained 0.30 kg./wk. or less in the second trimester, but 65.85 percent of mothers of the full-term gained 0.31 kg./wk or more. in the second trimester. The average weight gain in the second trimester of mothers of the preterm (0.29 ± 0.14 kg.) was significantly ($P = 0.03$) lower than that of the full-term (0.39 ± 0.14 kg.) (Table 23).

In table 20, it is interesting to note that mothers in both groups whose height is less than 150 cms. had a similar of average weight gain in the second trimester during pregnancy ($P = 0.59$).

From table 21, the average weight gain of less than 0.39 kg. in the second trimester was found to significantly associate with preterm delivery ($p = 0.003$). The mothers with average weight gain in the second trimester less than 0.39 kg. were five times as likely to experience a preterm delivery as those with average weight gain in the second trimester ≥ 0.39 kg.

Table 19 Number and percentage distribution of mothers of the preterm and full-term classified by average weight gain in the second trimester.

Average weight gain in the 2 nd trimester (kg/wk)	Preterm group(n=27)		Full-term group(n=41)	
	n	%	n	%
≤ 0.10	1	3.70	-	-
0.11 - 0.30	16	59.26	14	34.15
0.31 - 0.50	7	25.93	20	48.78
> 0.50	3	11.11	7	17.07
$\bar{X} \pm SD$	0.29 ± 0.14		0.39 ± 0.14	

Table 20 Average weight gain in the second trimester classified by mothers of the preterm and full-term whose height less than 150 cms.

group of mothers	Maternal height less than 150 cms. (n)	Average weight gain in the 2 nd trimester (kg./wk.) ($\bar{X} \pm SD$)
Preterm	5	0.30 \pm 0.19
Full-term	6	0.37 \pm 0.19
Z = -0.46, P-value = 0.66		

Table 21 Average weight gain in the second trimester by mothers of the preterm and full-term.

Average weight gain in the 2 nd trimester (kg./wk.)	Preterm group	Full-term group	Total
< 0.39	21	17	38
\geq 0.39	6	24	30
Total	27	41	68
$\chi^2 = 8.58,$ P-value = 0.003 $\hat{OR} = 4.94,$ 95% CI = 1.49-17.36			

3. average weight gain in the third trimester

Table 22, it was found that 48.00 percent and 57.00 percent of mothers of the preterm and full-term respectively gained 0.31-0.50 kg./wk. in the third trimester. The average weight gain of mothers of the preterm was 0.44 ± 0.18 kg./wk. and those of the full-term was 0.45 ± 0.13 kg./wk. Table 27 showed that the average weight gain of the 2 groups in the third trimester was not significantly different ($P = 0.59$).

Table 22 Number and percentage distribution of mothers of the preterm and full-term classified by average weight gain in the third trimester.

Average weight gain in the 3 rd trimester (kg./wk.)	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
< 0.10	-	-	-	-
0.11 - 0.30	25	25.00	13	13.00
0.31 - 0.50	48	48.00	57	57.00
> 0.50	27	27.00	30	30.00
$\bar{X} \pm SD$	0.44 ± 0.18		0.45 ± 0.13	

Table 23 Comparison of the mean of pre-pregnancy weight, maternal height, pre-pregnancy BMI, weekly weight gain during pregnancy and average weight gain regarding trimester between group of mothers of the preterm and full-term.

Variables	Preterm group (n = 100)	Full-term group (n = 100)	t-test	d.f.	P-value
	$\bar{X} \pm SD$	$\bar{X} \pm SD$			
-Pre-pregnancy weight (kgs.)	47.30 \pm 6.24	47.17 \pm 6.29	0.15	198	0.88
-Maternal height (cms.)	154.14 \pm 48.83	155.23 \pm 4.98	-1.57	198	0.12
-Pre-pregnancy BMI (kg/m ²)	19.79 \pm 2.07	19.58 \pm 2.14	0.72	198	0.47
-Weekly weight gain during pregnancy (kg./wk.)	0.29 \pm 0.08	0.33 \pm 0.09	-3.27	198	0.001*
-Average weight gain regarding trimester (kg./wk.)					
in the first trimester	0.14 \pm 0.17 ^(a)	0.11 \pm 0.12 ^(b)	1.04	40	0.31
in the second trimester	0.29 \pm 0.14 ^(a)	0.39 \pm 0.14 ^(b)	-3.07	66	0.03*
in the third trimester	0.44 \pm 0.18	0.45 \pm 0.13	-0.54	180	0.59

* Significant at $\alpha < 0.05$

(a) ; n = 27

(b) ; n = 41

-Food taboo during pregnancy :-

It was found that 93 percent and 98 percent of mothers of the preterm and full-term respectively did not refrain of food during pregnancy. (Table 24)

Table 24 Number and percentage distribution of mothers of the preterm and full-term classified by food taboo during pregnancy.

Food taboo during pregnancy	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
No	93	93.00	98	98.00
Yes :-				
- meat	2	2.00	1	1.00
- milk	-	-	1	1.00
- egg	3	3.00	-	-
- fried food	2	2.00	-	-

- Drinking milk during pregnancy:-

From table 25, drinking milk or not during pregnancy was significantly associated with preterm delivery ($P = 0.002$). Mothers who did not drink milk during pregnancy were 2.6 times as likely to experience a preterm delivery as those who drank milk during pregnancy.

Table 25 Drinking milk during pregnancy by mothers of the preterm and full-term.

Drinking milk during pregnancy	Preterm group n	Full-term group n	Total N
No	41	21	62
Yes	59	79	138
Total	100	100	200

$\chi^2 = 9.35, P\text{-value} = 0.002$
 $\hat{OR} = 2.61, 95\% CI = 1.34 - 5.13$

CHAPTER V

SUMMARY DISCUSSION AND RECOMMENDATIONS

SUMMARY

This research was conducted on the purpose of studying relationships between pre-pregnancy nutritional status, average weight gain during pregnancy and preterm delivery in single pregnancy in Siriraj Hospital. Height and pre-pregnancy BMI were used to indicate the nutritional status of mothers before pregnancy. For the nutritional status during pregnancy the average weekly weight gains during pregnancy and each trimester were used. Mothers with factors that may affect the gestational age are ; maternal age under 20 or over 30, smoking and drinking habit, history of radiation exposure, chronic diseases, complication of pregnancy, multiparity, previous history of abortion or preterm delivery, absent or irregular antenatal care and follow up, multiple pregnancy, hematocrit levels lower than 33%, fetal anomaly and abnormal placenta were excluded. The results of this study can be summarized as the followings:

1. The maternal height was 154.14 ± 4.83 cms. in mothers of the preterm and 155.23 ± 4.98 cms. in those of the full-term. There is no significant difference in the average height of mothers of the two groups ($P = 0.12$).

2. Pre-pregnancy BMI in both groups of mother, which indicated nutritional status before pregnancy, were less than 20 kg/m^2 . The mean value of pre-pregnancy BMI for mothers of the preterm was 19.79 ± 2.07

kg/m². and 19.58 ± 2.14 kg/m². for those of the full-term, the difference of which was not of statistical significance ($P = 0.47$).

3. The mean weekly weight gain in mothers of the preterm was 0.29 ± 0.08 kg. and that of the full-term was 0.33 ± 0.09 kg., the difference of which was statistically significant ($P = 0.001$). Mothers with low rate of weekly weight gain during pregnancy (< 0.27 kg/wk) were twice as likely to experience a preterm delivery as those with normal weekly weight gain during pregnancy ($0.27-0.52$ kg/wk).

4. For the average weight gain during each trimester of pregnancy, the difference was found only during the second trimester. The average weight gain during the second trimester of mothers of the preterm (0.29 ± 0.14 kg/wk.) was significantly lower ($P = 0.03$) than that of mothers of the full-term (0.39 ± 0.14 kg/wk). Mothers with average weight gain during the second trimester less than 0.39 kg/wk were five times as likely to experience a preterm delivery as those with average weight gain in the second trimester more than 0.39 kg/wk.

5. Gestational age at first antenatal clinic attendance, only 26% of mothers of the preterm had first antenatal clinic attendance in the first trimester and 62% in the second trimester. For mothers of the full-term 36% had their first antenatal clinic attendance in the first trimester and 45% in the second trimester. The gestational age at first attendance for antenatal care in the first and the second trimester was significantly different between mothers of the preterm and those of the full-term.

DISCUSSION

Maternal height

Even though maternal height were consistently found to be one of the factors effecting gestational age [Baird (25), Garn and Petzold (51), Nondasuta et al. (52)], no significant difference in the average height between the two groups of mothers was found in this study, 13% of mothers of the preterm were found to be shorter than 150 cms. comparing to 8% for mothers of the full term (Table 9). This evidence showed a tendency of shorter mothers to have preterm delivery but more confirmation is still needed. Since one of the criteria for selection of subjects specified the inclusion of normal labour only, a few cases of short mothers who could not deliver normally and needed cesarean section were excluded, and they were very likely to belong to the full term group.

In cases of small-for-gestational age baby, the association of this incident with small size of mother, as a natural survival mechanism for mothers, could be explained by either a limitation of pelvic cavity or the association between mother's heart size and her body size (25). In the latter case, mothers with small size tend to have small heart i.e. less blood supply to the feto-placental unit, which resulted in small-for-gestational age fetus. In cases of premature baby, however, the above explanation could not be applied. A possible explanation, in our own opinion, might be that at the beginning there may be a very good compensatory mechanism in some cases of small mother so that enough blood supply goes to the placenta and produce normal growth of the fetus. Later on, when the fetal growth becomes more rapid, the demand of blood supply to the uterus becomes too much

that mothers cannot compensate any longer, the inadequate blood supply may trigger a labour mechanism resulting in premature delivery.

Pre-pregnancy BMI

Wen et al. (32) and Michell and Lerner (59) found that maternal malnourishment before pregnancy effected the gestational age at labour, this evidence is conflicting with our finding. The maternal nutritional status before pregnancy in their study was indicated by weight for height and in our study was BMI which was based on the same measurements, the relationship found with gestational age at delivery should be similar. However, in our study the pre-pregnancy weight had to be relied on mothers' memory and over 70% of our study mothers were low educated, so we could not assure the reliability of pre-pregnancy weight and BMI of our mothers.

- Weight gain during pregnancy

A weakness of using weight gain of the whole pregnancy in the comparison between mothers of the preterm and full-term groups is that pregnant women do not gain weight uniformly through out their pregnancy. Mothers who delivered full-term, i.e. longer gestational age, will naturally have higher weight gain than those delivered preterm due to their longer period of exposure to a rapid rate of weight gain in the third trimester. In order to control for this bias, the average weekly weight gain for the whole pregnancy and also for each trimester were compared in this study.

Weekly weight gain during pregnancy

The result of this study is consistent with the finding of Abrams et al. (65), the average weight gain during pregnancy of mothers of the full-term in their study was 0.39 ± 0.17 kg/wk. which was slightly higher than our finding (0.33 ± 0.09 kg/wk) and the weekly weight gain in their mothers of the preterm was slightly higher (0.33 ± 0.19 kg/wk) than that found in ours (0.29 ± 0.08 kg/wk.).

The average weight gain in each trimester of pregnancy

For the same reason of an ununiformly increase in weight during each trimester, weight gain in each trimester in relation to delivery status were analyzed. It was found that the weekly weight gain during the first and the third trimester of the two groups were not significantly different, but the weekly weight gain during the second trimester of mothers of the preterm was (0.29 ± 0.14 kg) significantly less ($P = 0.03$) than that of mothers of the full-term (0.39 ± 0.14 kg.).

Even though our result is similar to that of Baird (25) and Hediger et al. (66) who used the weight gain during the last two trimester, we strongly believed that our results are even more reliable because we had excluded the effect of shorter duration of higher weight gain during the last trimester whereas they had not. Naturally mothers of the full-term would have longer duration with higher rate of weight gain during the third trimester than mother of the preterm. In our study, by using the average weight gain during the second trimester we had excluded the effect of different duration being in the third trimester. Our finding of difference in weight gain during the second trimester between the two groups was also similar to that reported by Papiernik and Kaminski(61) but they used weight gain during the first two trimesters.

- Dietary intake during pregnancy

The positive correlation between caloric intake and maternal weight gain was reported by Thomson (48) and Beal (49). The theory, the study of dietary intake of mothers should include not only the quantity and quality of foods but also the gestational age at which supplementary food was given. Therefore this kind of study needs a prospective research design and is impossible in the retrospective one. However some of the food that are good source of nutrients required during pregnancy and are always recommended to pregnant women, such as milk, may be quite well remembered and obtainable retrospectively.

In this study we found that mothers who did not drink milk during pregnancy were 2.6 times as likely to deliver pretermly as those who drank milk regularly during pregnancy. But we did not know the gestational age when they start to drink milk or the quantity of milk mothers drank each day during their pregnancy.

Regarding the effect of low weight gain during the second trimester in shortening the gestational age at delivery, our study was concordant with the result found in Rush's study (77). Among the 3 groups of pregnant women receiving high protein supplement, high calories supplement, and no supplement groups, the gestational age was found to be shorten in the high protein supplement group. This finding was also similar with Riopelle's study (78) of protein-deprived rhesus monkeys, in which the monkeys on high protein diet had shorter length of gestation at delivery. This evidence explained that a high protein diet given to unaccustomed subject may lead to untoward results because the level of protein much higher above the usual threshold may become a burden causing protein loading effect on the placenta and

lead to a premature decrease of placental function which triggers uterine contraction and delivery.

Even though no detail information of dietary intake during pregnancy could be obtained in this study but the pattern of weight gain during each trimester suggested that the dietary intake of mothers of the preterm was inadequate during the second trimester, which resulted in low weight gain during this trimester, but the normal weight gain during the last trimester in this group show a tremendous increase in the amount of dietary intake after the second trimester. As a common practice in the antenatal clinic, when mothers first attended the ANC clinic late in the second trimester with abnormally low weight gain, they will be advised to improve their nutritional status by increasing the dietary intake, which is likely to be high in protein. With a successful dietary practice, pregnant women's weight increases in the third trimester but the high protein diet also show its loading effect, in shortening the gestational age. Therefore an increase in food intake, particularly protein, should be recommended since very early in pregnancy so as to accustomize the placenta to higher protein intake which will lead to successful weight gain and full-term delivery.

Health practice

From this study it was found that a significantly higher percentage of mothers of the preterm first attended the antenatal clinic in the second trimester. According to the result of weight gain and the mechanism explained previously, a great proportion of preterm delivery would be prevented if we could encourage pregnant women to attend the ANC and received the dietary advice since early pregnancy, that is during the first trimester.

RECOMMENDATION

From the results of this study it is recommended that

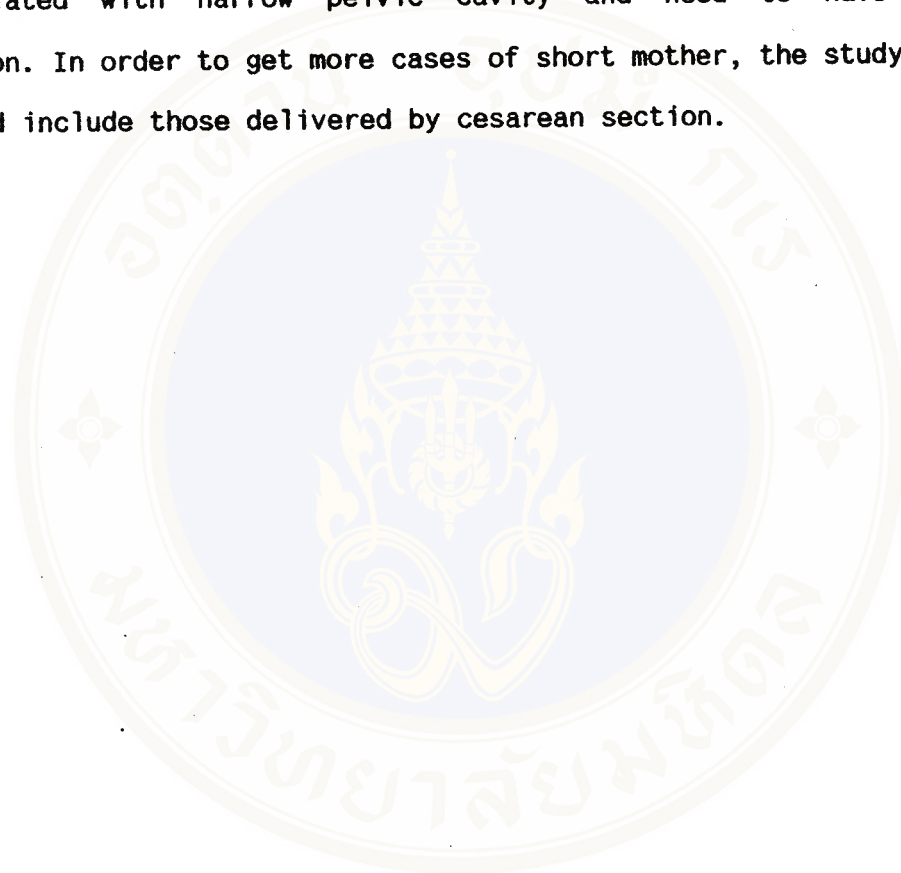
1. Weight gain of at least 400 gm/wk or 1.5 kg/month during the second trimester be a target for every pregnant woman in order to lessen the chance of preterm delivery.
2. Every pregnant woman be encouraged to attend the antenatal clinic in her first trimester in order that health and nutrition education can be given and practiced before the second trimester of pregnancy.
3. For pregnant women who first attend the antenatal clinic late in the second trimester with low weight gain, she should be advised to increase dietary protein intake so gradually as to prevent protein loading effect on the placenta.
4. Milk drinking, if possible, be promoted in early pregnancy. If it is not possible, other form of food riched in protein and calcium should be recommended.
5. Pregnant women be educated to look after their own weight gain. Whenever their weight gain during the second trimester is less than 400 gm/wk. or 1.5 kg/month they should seek for medical or dietary consultation from their doctor, nurse or nutritionist.

For further study it is recommended that

1. The study be a prospective study beginning at the first trimester and follow up until delivery in order that the quantity and quality of food intake can be accurately collected. The results obtained will be very valuable for improving the standard of antenatal services concerning dietary intake of pregnant women.

2. The duration of sample collection should be longer and cover more cases than in this study so that the sample size would be larger.

3. Mothers whose height is below 150 cms. are likely to be associated with narrow pelvic cavity and need to have cesarean section. In order to get more cases of short mother, the study subject should include those delivered by cesarean section.





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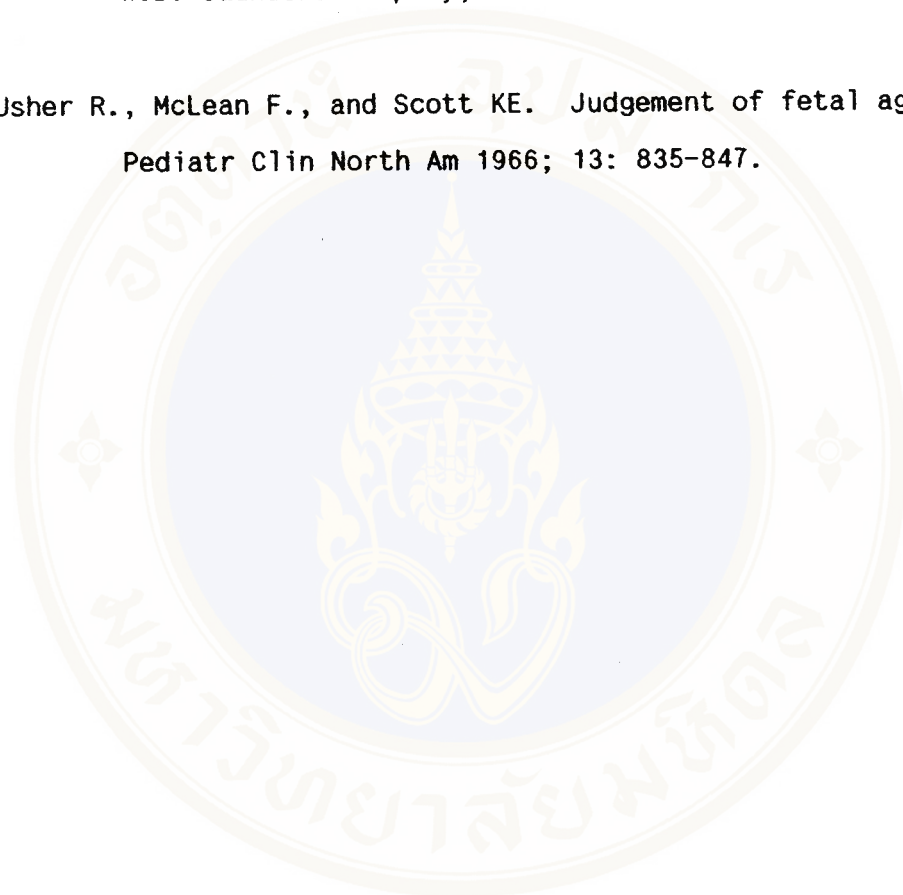
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APPENDIX A

Detailed clinical examination of the premature infants (80, 81)

A true premature infant is small and immature because he is delivered before the completion of gestation. The bodily proportions diverge from those of the normal full term infant to a greater or lesser extent depending on the duration of pregnancy. The premature infant has a head tend to be rounded and large in relation to body size and may represent 46-47 cms. of the length of the body size.

There is a striking absence of subcutaneous fat in the premature infant which, with the small bulk of the immature skeletal muscles, gives him a scrawny, shrunken appearance with a pinched, little old man' face. The skin is bright red and is often covered on the trunk and limbs by fine, downy lanugo hair. At birth the skin is usually covered with a large amount of lard-like vernix caseosa. Other features include lack of cartilage in the external ears, absence of breast tissue, power of sucking feeble or absent, cry weak and immaturity of the external genitalia.

Clinical criteria for gestational assessment by Usher (82)

	Gestational age		
	To 36 weeks	37-38 week	39 weeks or more
Sole creases	Anterior transverse crease only	Occasional creases anterior two thirds	Sole covered with creases
Breast nodule diameter	2 mm.	4 mm.	7 mm.
Scalp hair	Fine and fuzzy	Fine and fuzzy	Coarse and silky
Earlobe	Pliable-no cartilage	Some cartilage	Stiffened by thick cartilage
External genitalia			
- Male	Testes in lower canal, scrotum small, few rugae	Intermediate	Testes pendulous, scrotum full, extensive rugae
- Female	Labia majora widely separated, labia minora protruding	Labia majora almost cover labia minora	Labia majora completely cover labia minora.

APPENDIX B

Statistics used in the analysis

1. Compute for mean (\bar{X})

$$\bar{X} = \frac{X}{n}$$

- where X = Arithmetic mean
 X_1, X_2, \dots, X_n = Observed values
 X = Sum of all observed values
 n = Sample size

2. Compute for percentage

$$\text{percent} = \frac{100 f_i}{n}$$

- where f_i = Frequency of the i^{th} group
 n = $\sum f_i$
 i = 1, 2, , r , r = total groups

3. t-test

- 3.1 t-test ($\sigma_1 = \sigma_2$)

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{\bar{X}_1 - \bar{X}_2}}$$

$$df = n_1 + n_2 - 2$$

- where n_1 = Size of sample 1
 n_2 = Size of sample 2
 X_1 = Mean of sample 1
 X_2 = Mean of sample 2
 S_1 = Standard deviation of sample 1
 S_2 = Standard deviation of sample 2

$$S^2_{\bar{X}_1 - \bar{X}_2} = \left(\frac{1}{n_1} + \frac{1}{n_2} \right) \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$$

3.2 t-test ($\sigma_1 \neq \sigma_2$)

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

$$d.f. = \frac{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}{\frac{1}{n_1 + 1} \frac{S_1^2}{n_1} + \frac{1}{n_2 + 1} \frac{S_2^2}{n_2}}$$

where n_1 = Size of sample 1

n_2 = Size of sample 2

\bar{X}_1 = Mean of sample 1

\bar{X}_2 = Mean of sample 2

S_1 = Standard deviation of sample 1

S_2 = Standard deviation of sample 2

4. The Chi-square test

$$\chi^2 = \frac{n(ad - bc)^2}{R_1 R_2 C_1 C_2} \frac{n}{2}, \text{ d.f.} = 1$$

Variable 1	Variable 2		total
	1	2	
1	a	b	R_1
2	c	d	R_2
Total	C_1	C_2	n

APPENDIX C

THE HUSBAND'S HABIT:

Table 26 Husband's habit of smoking and drinking alcohol by mother of the preterm and full-term.

Variables	Preterm group(n=100)		Full-term group(n=100)	
	n	%	n	%
The husbnad's habit				
- Smoking				
No	43	43.00	46	46.00
Yes	57	57.00	54	54.00
$\chi^2 = 0.18, \text{d.f.} = 1, \text{P-value} = 0.67$				
$\hat{\text{OR}} = 1.13 \text{ (95\% CI = 0.62 - 2.05)}$				
- Drinking alcohol				
No	29	29.00	39	39.00
Yes	71	71.00	61	61.00
$\chi^2 = 2.23, \text{d.f.} = 1, \text{P-value} = 0.14$				
$\hat{\text{OR}} = 1.57 \text{ (95\% CI = 0.83 - 2.95)}$				

APPENDIX D
QUESTIONNAIRE

Relationship between pre-pregnancy nutritional status, average weight gain during pregnancy and preterm delivery in singleton pregnancy: Siriraj Hospital.

No

Name HN AN.....

Date of interview

LMP

Date of delivery

Gestational age of delivery wk days.

Address

.....

Section 1 General characteristics

- 1.1 Maternal age year.
- 1.2 Race
- 1.3 Religion
- 1.4 Marital status
- 1.5 Education level
- non Prathomsuksa
- Mathayomsuksa Above mathayomsuksa
- 1.6 Occupation
- 1.7 Family income (bahts/month)bahts

Husband's habit

- 1.8 Smoking No Yes
- 1.9 Drinking alcohol No Yes

Section 2 Health practice

- 2.1 Thinking of abortion on preterm delivery.
- No Yes
- 2.2 Antenatal care (attending)
- No Yes
- 2.3 Gestational age at first attendance for antenatal care
..... trimester, number of visiting time.
- 2.4 Hematocrit level %

Section 3. Maternal nutritional status and food intake

- 3.1 Pre-pregnancy weight kgs.
- 3.2 Maternal height cms.
- 3.3 BMI kg/m^2
- 3.4 Weight during pregnancy
- | | | | |
|-----------------|------------|--------|------------|
| gestational age | week | weight | kgs. |
| | week | weight | kgs. |
| | week | weight | kgs. |
| | week | weight | kgs. |
| | week | weight | kgs. |
| | week | weight | kgs. |
| | week | weight | kgs. |
| | week | weight | kgs. |
| | week | weight | kgs. |
| | week | weight | kgs. |
- Weight before delivery kgs.
- 3.5 Total weight gain kgs.
- 3.6 Weekly weight gain during pregnancykg/wk.
- 3.7 Average weight gain in each trimester of pregnancy
- average weight gain in the first trimester kg/wk.
 - average weight gain in the second trimesterkg/wk.
 - average weight gain in the third trimesterkg/wk.
- 3.8 Food taboo during pregnancy.
- No Yes.....
- 3.9 Drinking milk during pregnancy.
- No Yes.....



Section 4 Pregnancy outcome.

4.1 Placenta weight gms.

4.2 Infant birth weight gms.

4.3 Infant's sex

4.4 Fetal well-being.

Healthy

Unhealthy

