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AN INVESTIGATION OF RELATIONSHIP BETWEEN LENGTH OF PREGNANCY WITH THE FIRST DAY OF THE LAST NORMAL MENSTRUAL CYCLE

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ABSTRACT
Background: Fertilization is a process of union (after mating) of the sperm with a mature ovum. It begins with Sperm-ova collision and ends with the formation of life called Zygote (single mononucleated cell). Pregnancy results from fertilization. ***Aim***: The study investigated the relationship between length of pregnancy with the first day of the last normal menstrual cycle. ***Materials and Methods***: The duration of pregnancy in 500 women living in Port Harcourt was studied and volunteer subjects were randomly recruited for this study. Consenting women who had their ante-natal care at the various hospitals: University of Port Harcourt Teaching Hospital, Braithwaite Memorial Specialist. ***Results:*** The mean duration was found to be 275.38 days, which was one week shorter than in Caucasians. This duration corresponds with the Negros studies elsewhere. The lengths of menstrual cycles were also studied and a mean of 28.01 days observed. This was compared with the conventionally accepted 28 days. Women with shorter menstrual cycle lengths showed longer duration of pregnancy and longer menstrual cycle lengths shorter duration of pregnancy. ***Conclusion***: The mean age of menarche in those studied was 14 years. However, length of menstrual cycle correlates with gestational duration, though many factors such as irregularities and duration variations of menstrual cycle at different stages of a woman's reproductive life affect it greatly, making the relationship inconsistent.

KEYWORDS: Ovulation, Menstruation, Fertilization, Pregnancy, menstrual cycle.

INTRODUCTION

Menstruation

Menstruation is the periodic shedding of the uterine lining (endometrium) accompanied by bleeding. Menstruation marks the fertile years of a woman's life when she is able to bear children.[1]

When a girl reaches sexual maturity, she has her first menstrual cycle, sometimes referred to as "*Menarche"*. This repeating process can begin as early as ten years and usually occurs by the age fifteen. Menstruation is a natural process that occurs in pre-menopausal women who are not pregnant or breastfeeding.[2-4]

The menstrual cycle continues until anywhere from 40 to 60 years but ovulation tends to be intermittent near the end of menstruation (post-menopause). For the past decades, the age of menarche is gradually declining with the improvement of nutrition and environmental conditions. On the average women have a complete cycle every 28 days. This may vary from as little as two weeks to more than two months for any individual woman especially near the beginning or end of fertility.[2-4]

Menstrual Cycle

The fertility cycle is said to begin on the first day of menstruation. The average length of the menstruation is approximately five days. Again some women experience longer periods with an average range of approximately one to eight days.[5-10]

The average blood loss during a period is 60ml. Upper limit menstrual loss 80m1 menses occurs in 9 — 14% of women. 70% of this loss occur within the first 48 hours. A woman's menstrual cycle begins each month when the pituitary gland secretes the follicle stimulating hormone. The 28-day cycle is divided as follows:

***During days 1 —5*:** There is a low level of female sex hormones in the body causing the uterine walls to disintegrate and its blood vessels to rupture. A flow of blood and tissue known as *'Menses',* passes out of the

vagina during menstruation, also known as the menstrual period or phase.[5-10]

***During 6th -13th day*:** Increased production of estrogen by an ovarian follicle causes the endometrium to thicken and become vascular and glandular. This is called the proliferative phase of the uterine cycle.[5-10]

Ovulation usually occurs on the fourteenth day of the 28-day cycle.

***During days 15—28*;** Increased production of progesterone the corpus luteum in the ovary causes the endometrium to double or triple in thickness (from 1mm to 203mm) and the uterine glands to mature producing a mucoid secretion. This is called the secretary phase of the uterine cycle.[5-10]

The endometrium is now prepared to receive the developing embryo. If pregnancy does not occur the corpus luteum degenerates and the low level of sex hormones result in the breaking of the uterine lining. Even while menstruation is occurring, the anterior pituitary gland begins to increase the production of follicles stimulating hormone and the process is repeated.[5-10]

The menstrual discharge consists of mainly a dark altered blood, mucus, vaginal epithelial cell fragments of endometrium prostaglandin, enzymes and bacteria.

Vasoconstriction is commonly considered to be the most important mechanism controlling menstrual blood loss. Physiologically, menstruation stops during pregnancy and lactation.

The 1enth of the menstrual cycle

The average length is 28 days. The length of the menstrual cycle is dependent upon variations in the time from the beginning of the cycle up to ovulation as illustrated below:

The location of ovulation determines the length of the cycle. The length time is from the beginning of menstruation up to ovulation can vary.[5-10]

The time between ovulation and the beginning of menstruation is referred to as the luteal phase and is usually two weeks long.

The Ovarian Cycle

A longitudinal section through the ovary shows so many follicles, each containing an oocyte —A female is born with as many as 2 million follicles but the number is reduced to 200,000 — 400,000, by the time of puberty. Only a small number of follicle about (400) ever mature because a female usually releases one matured egg per month during her productive years.[5-10]

As the follicle in the ovary undergoes maturation. It develops from the primary follicle to a secondary follicle to a (graafian follicle). During Oogenesis, the chromosome number is reduced and a secondary oocyte is formed and pushed to the side of a fluid filled cavity within the secondary follicle. In the Graafian follicle, the fluid-filled cavity increases to a point that follicle wall balloons out in the surface of the ovary and burst releasing matured oocyte surrounded by clear membrane and follicular cells. This is referred to as *ovulation*. It is process by which a mature egg is released from the surface of the ovary to be available for fertilization. Only one mature egg is released from each ovarian cycle.[5-10]

In relation to the menstrual period, the event occurs 14 days prior to the expected day of menstruation.

Fertilization

Fertilization is a process of meeting (after meeting of the sperm with a mature ovum. It begins with Sperm-ova collision and ends with the formation of life called Zygote (single mononucleated cell).[11-15]

The ovum immediately after ovulation is picked by the fimbriae end of the fallopian tubes and is rapidly transported to the ampullary part of the tube. Out of hundreds of millions of sperm deposited in the vagina during intercourse, only a thousand specialized sperm enter the uterine tube while only 300 — 500 reach the egg and only one is allowed to get into the mature ova. The sperm contains (22x) or (fly) pattern of chromosome while the egg contain only (22x).[11-15]

The sex of the child is determined by the pattern of chromosome supplied by the sperm. If the sperm contains 22x, a girl child with (46xx) chromosome is formed, on the other hand if it contains 22y, a body child with (46xy) chromosome pattern is formed. Actually, the second mitotic division is not completed unless fertilization occurs.

Formation of the Zygote

Both male and female pronuclear material form, nuclear membranes and within the membrane, there is synthesis and condensation of DNA. The two pronuclei approach and fuse, the nuclear membrane once again disappearing.[11-15]

Chromosome appear in the condensed DNA, and those from each pronuclear move together to unite and form the Zygote of maternal and paternal genetic material.

The individual has begun its march through life to death.[11-15]

Cleavage and Transport of the egg

The first cleavage of the Zygote occurs, within a four hours of fertilization. Once division of the egg starts, it proceeds rapidly, so that within a few days a solid mass of uniform cells has formed. This is the *Morula* Stage.

During the process of morula formation, the egg is gently propelled along the tube into the uterine cavity by the movement of cilia of the endosalphins.[11-15]

Once the ovum embeds in the decidua, the fluid from the decidual cells now passes through the canaculli of the Zona pellucida separates the cells of the morula, so that a cavity is formed. The egg is then called *Blastula or Blastocyst*.

Surface cells of the blastula differentiate into trophoblast. At the same time, some deep cells at one pole of the blastocyst aggregate to form the inner cell mass from which the embryo develops.[11-15]

Implantation of the Blastocyst

The adhesion of the surface cells to the maternal endometrial epithelium is followed rapidly by invasion. With adhesion between trophoblast and endometrium, a reaction between the bicarbonate and carbonic anhydrase occurs with the release carbon dioxide which is discharged through the trophoblastic plasma membrane, across the endometrial cells and stroma to reach the capillary circulation of the endometrium. The alteration in pH towards alkalinity leads to a disintegration of epithelial cells and permits penetration of trophoblast. The penetration supplies the trophoblast with glycogen from the disintegrated endometrial cells and invasion continues until a material capillary is reached, when the trophoblast can obtain its energy supplies and nutrients from glucose and amino-acids to the material blood by aerobic metabolic pathways.[11-15]

Development of the Embryo

Concurrent with the development of the trophoblast, changes occur within the egg. The inner cell mass becomes two layer by the 7th day after ovulation, the outer layer being formed of polyhedral ectodermal cells. A day later the ectodermal cells are separated from the implanting trophoblast by a cleft, which later enlarges to form the Amniotic cavity. By the 10th day, the zygote consists of a bilaminar cell mass and two preformed blastocyst cavity in which the endodermal cells of the inner cell mass lie. By the end of the first month, the placenta is forming. The embryo has a non-human appearance largely due to the presence of a tail, but also because of the arms and legs, which begins as limb buds, resemble paddles.[11-15]

Second Month

At the end of two months, the embryo's tail had disappeared and the arms and legs are more developed with fingers and toes. Internally/all major organs have appeared. Embryonic development is now finished.[11-15]

Third and Fourth Months

Fetal development intends from the third to the fourth month. Head growth slows down and the next of the body increases in length. Epidermal refinements such as eyelashes, eyebrows, hair on head, fingers and nipples, appear.

Cartilage is replaced by bone as ossification centers appear in bones. The skull has six large fontanels (membranous areas), which permit a certain amount of flexibility or the head passes through the birth canals and allows rapid growth of the brain during infancy. During the third month, it is possible to distinguish males from females. The testes differentiate and produce androgens especially testosterone.[11-15]

Fifth Through Seventh Months

During the fifth through seventh months, the mother begins to feel fetal movement. The fetal heart beat is loud enough to be heard when the physician applies a stethoscope to the mother's abdomen. The fetus is in the fetal position with the head bent down and in contact with the flexed knees.[11-15]

The wrinkled skin is covered by a fine brown called Lanugo. The lanugo is coated with a while greasy, cheese like substance called verine caseosa, which protects the delicate skin from the amniotic fluid. During three months, the eyelids are open fully.

At the end of this period, the fetus is 300mm (12in) and the weight has increased to 13 50g (31 b).

Eight and Ninth Months

As the end of development approaches, the fetus usually rotates so that the head points toward the cervix. At the end of Nine months, the fetus is about 530mm.[11-15]

MATERIALS AND METHODS

Research Design: This was a prospective study.

Sample Size and Sampling Technique: *A total of* 500 subjects were randomly recruited for this study.

***Criteria for Subject Selection*:** Consenting women who had their ante-natal care at the various hospitals: University of Port Harcourt Teaching Hospital, Braithwaite Memorial Specialist Hospital and Primary Health Care Centre, Ozuoba all in Rivers State, Nigeria.

***Ethical Clearance*:** Ethical clearance was obtained from the Research Ethics Committee of the University of Port Harcourt, Nigeria.

***Data Collection*:** Records were taken from antenatal cards and personal interviews with the women involved. They were followed from booking to delivery. Women who had documented their last menstrual period were preferred. The women in the analysis included those with a normal singleton pregnancy, Spontaneous onset of labour and vaginal delivery. Routine Antenatal care was given to the patients.

A hundred and fifty women in the group had done ultrasonography routinely or for other indications. The patients were observed and had vaginal delivery. The dates of delivery were recorded. After delivery, the exact number of days from the first day of the last normal menstrual period to parturitions was calculated and recorded for each patient. These were then analyzed in conjunction with the length of the menstrual cycle and the Menarche of the patients involved.

Data was collected from doctor's notes and pathograms of patients, while others were done by oral interviews with the concerned patients. All information was written in a note book.

Precautions

Women who had elective or emergency caesarean sections were not included. Also some who were not sure of their cycles were excluded.

RESULTS

Duration of Pregnancy

The mean duration of pregnancy in 500 women studied was 275 days with a standard deviation of 17.51 days.

When the expected date of delivery was calculated based on the Naegele's rule, only 6% of women delivered on the calculated dates 70% of the women delivered before the calculated dates whereas 24% delivered after the calculated dates. 80% of deliveries occurred between 260 and 295 days (31 —42 weeks) of gestation, normally defined as term.

About 74 percent of pregnancies lasted longer than 42 weeks. The longest duration in this study was 339 days in table 1.

Relationship between Gestational duration and length of menstrual cycle

The mean length of menstrual cycle observed in this study was 28.06 days with a standard deviation of 1.61 days. The longest duration of pregnancy was observed amongst those that have short menstrual cycles of less than 25 days. The duration fell consistently with an increase in the length of cycles and rose slightly in longer length of 30 days and above.

The average mean of menstruation (length) was 4.21 days with a standard deviation of 1.03 days. The shortest was 2 days and longest 7 days.

Menarche

The average age for menarche in this study was 14.26 years with a standard deviation of 1.51 days. Ninety percent of the women studied had their first menstruation (Menarche) between the ages of 12 and 16 years.

Table 1

Gestational Age (Weeks)	Frequency	Percentage (%)
Less than 33	2	0.6
34	2	0.4
35	9	1.8
36	37	7.4
37	48	9.6
38	55	11.0
39	50	10.0
40	105	21.0
41	62	12.4
42	57	11.4
43	43	8.6
44	29	5.8
Total	500	100

Table 2

Menarche	Frequency	Percentage (%)
10	3	0.6
11	6	0.2
12	45	9.2
13	117	23.4
14	117	23.4
15	111	22.2
16	65	13.0
17	19	3.8
18	15	3.0
19	1	0.2
Total	500	100

Table 3

Length of Cycle	Frequency	Percentage (%)
Less than 22	5	1.2
24	3	0.6
25	16	3.2
26	43	8.6
27	30	6.0
28	270	54.0
29	84	8.0
30 and above	8	1.6
Total	500	100

DISCUSSIONS

The findings of this research show that the mean duration of pregnancy observed was 275.38 days (standard deviation — 17.51 days) which corresponds to 39 weeks and 3 days. This is about one week shorter than that calculated from Naegele rule. Gini and Chilaka[21] in Enugu, Nigeria found the mean duration in Igbo women living in Enugu to be 273.75 days (standard deviation 24.15 days). Anderson *et al*[24] in the United States of America found the mean duration of gestation for Negro boys to be 274.4 days and girls 273.2 days. In this study, they found the corresponding duration of 279 days for white boys and 279.9 days for white girls. They reported there was no statistical differences in the duration between the two sexes but there was established significant difference between the two races.

Schwartz et al.,[25] found the duration of pregnancy in whites to be 277.9 days (standard deviation 15.3 days). Many other studies on white point to an average gestation duration of 280 days. Park[22] analyzed 2100 births amongst whites and found that most births (68 percent) occurred after the expected date of delivery, when, in the present study, only 24. percent of deliveries occurred after 280 days of gestation. He also found the average duration to be 41 weeks in this study. Anderson[23] quoted that only 4.1 percent of deliveries occurred on the expected date calculated from Naegele's rule.

In the present study, only 6 percent of deliveries occurred at gestational duration of exactly 280 days, while 70 percent of deliveries occurred before the expected date of delivery. Women with shorter menstrual cycle length had longer durations and the duration fell consistently with increase in length of cycle. The mean length in this study was 28.06 days (standard deviation of 1.61 days). This compared with the conventional accepted mean of 28 days, although lengths of 26—31 days are considered normal in most cases.

The mean age of menarche as observed in this study was higher than previous studies by Olotu and Oladipo[26] in 2006 who observed age decline in the onset of menarche in some studied communities in Nigeria. However, age at menarche had less correlation with the length of menstrual cycle and the length of pregnancy.

Most of the patients studied were literate, (had at least secondary education) and could give a written evidence of their last menstrual period. Other factors like nutrition status and stress may affect the length of cycle, though the relationship might be lost with the woman use of contraceptives and other gynecological factor.

Race is known to affect gestational duration.[23] The standard observed in this study compares effectively with that of observed by Anderson[24] amongst whites. The relationship between length of menstrual cycle and menarche was least consistent. Also no relationship was found between the gestation duration and menarche considering that no scientific evidence has been established. For instance, a woman who had an early menarche of 12 years may or may not have a fixed gestation duration thus menarche does not correlate with gestational duration:

CONCLUSION

The mean duration of pregnancy observed is 275.38 days (39 weeks). Most births occurred before the calculated expected date of delivery. This implies a redefinition of "term" for blacks which necessary adjustments to accommodate the observed shorter duration of pregnancy. The implication thus becomes important in consideration of conservative management of "post-maturity" as the black and white fetuses might be of the same gestational age but at different stages of post-maturity" which might affect the outcome of delivery.

The Naege's rule when used gives an average duration of 280 (40 weeks), and holds true for whites. It still provides a good guide but definitely needs modification in blacks. The Extra seven days added to the last menstrual period in blacks is unnecessary. Nine months should be added directly to or three months subtracted from the first day of the last normal menstrual period.

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CONFLICT OF INTEREST

We write to state that there is no conflict of interest.

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AUTHOR'S CONTRIBUTION

We write to state that all authors have contributed significantly, and that all authors are in agreement with the contents of the manuscript. 'Author A' (Josiah S. Hart) designed the study and protocol, 'reviewed the design, protocol, 'Author B' (Joy E. Olotu) examined the intellectual content, 'Author C' (Tarimobo M. Otobo) wrote the first draft of the manuscript, managed the literature search and 'Author D'(Boma Philip Aaron) managed the analyses of the study. All authors read and approved the final manuscript.

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