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Pilot Study of Normal Development of Nipples during Pregnancy

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Abstract

Background: Numerous factors, both in the mother and in the infant, are involved in achieving breastfeeding. One maternal factor is normality of the nipples. However, no definition of normal nipple length or width or normal range and changes in pregnant women exists.

Objective: This study aimed to demonstrate the change of nipple length and width and areola width during pregnancy in Thai women.

Methods: This descriptive study was conducted from March 2010 to July 2011. A total of 56 pregnant women with nipple length ≥ 7 mm on both sides were recruited for the study. All women were at 8 to 12 weeks of gestation. The patients were scheduled for nipple and areola measurements up to 9 times, depending on the routine antenatal care appointments and delivery date. Nipple length and width and areola width of all participants were consecutively evaluated in each prenatal visit.

Results: The mean nipple length was 9.3 ± 1.5 mm at the first visit and significantly increased to 11.2 ± 1.8 mm by the time of the last visit ($P < .001$). Similarly, the nipple width was 13.6 ± 1.8 mm in the first trimester and widened to 15.9 ± 2.3 mm at term ($P < .001$). No differences of nipple length or width change were observed between both sides. The areola width of both sides considerably increased by 12.3 ± 6.1 mm during pregnancy ($P < .001$).

Conclusion: During pregnancy, nipple length and width as well as areola width increased significantly.

Keywords

areola width, breastfeeding, nipple length, nipple width, pregnancy

Well Established

An appropriate nipple-areolar complex is essential for successful breastfeeding, and short nipples may influence breastfeeding outcomes. However, little is known about the pregnancy-related changes in nipple (length and width) and areola (width) characteristics.

Newly Expressed

This study revealed a significant increase in the length and width of apparently normal nipples as well as areola width during the prenatal period.

Background

The initiation and duration of breastfeeding vary in different countries.[1,2] Breastfeeding is generally promoted in Thailand, and the exclusive breastfeeding rates at 3, 4, and 6 months are 48%, 26%, and 11%, respectively.[3] Achievement of successful breastfeeding depends on multiple maternal and infant factors. For example, positive psychological drive,[4] parity, nipple prehensibility, and even areolar skin gland development have all been shown to be important factors.[5] Several publications have documented changes to the breast, areola, and nipple.[5-8] Ziemer and Pigeon[6] reported that the average diameter of the erectile portion of the nipple was 1.6 cm and the length was 0.7 cm in the postpartum period of 20 Caucasian women. Hytten and Baird[9] described that while 40% of primigravidae had a "bite" of the nipple of 4 mm or less in early pregnancy, this increased to 80% in the puerperium. However, there is only 1 study describing and comparing the average value of nipple length and diameter in pregnant women between the first and second half of pregnancy.[10] Unexpectedly, neither a definition of normal nipple

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nor the normal range of nipple length in pregnant women exists. Acknowledging the great importance of breastfeeding, in our hospital, a team composed of both doctors and nurses has been set up to prepare and support pregnant women to achieve success in breastfeeding. According to our previous study, the mothers with nipple length less than 7 mm usually had a breastfeeding problem. This cross-sectional study revealed that the success rate of breastfeeding in the mother with nipple length equal to or greater than 0.7 cm on at least 1 side was greater than in the mother with short nipple length on both sides (86.60% and 58.82%, respectively).[10]

The aim of this study was to demonstrate gestational change of nipple length, nipple width, and areola width among Thai pregnant women. The results of this study will become the basis of further research on abnormal nipple length changes with or without interventions.

Methods

Approved by the Siriraj Institutional Review Board, the research was conducted at Siriraj Hospital from March 2010 to July 2011. Pregnant women who attended their first antenatal care appointment were informed, screened, and then enrolled according to the inclusion and exclusion criteria. The inclusion criteria consisted of pregnant women age 18 years or older, who were nulliparous and in their early gestation of 8 to 12 weeks, with no previous pregnancy reaching 12 weeks of gestation, and having nipple length on both sides greater than or equal to 7 mm. Women with a history of disease, injury, or surgery of the breast or with abnormal nipples such as inverted or pseudoinverted nipples or who were unable to continue antenatal care in our hospital were excluded.

After giving informed consent, the patients were scheduled for nipple and areola measurements up to 9 times, depending on the routine antenatal care appointments and delivery date. For each evaluation, Siriraj Areola and Nipple Assessment (SANA) technique[10] was performed by the same experienced nurse in a temperature (25°C) controlled room. The participant was placed in the upright sitting position in a private room before her upper attire was removed. Then, nipple rolling[11] was applied on each side for 5 seconds. Using a standard digital caliper (Vernier Polycal Digitronic Caliper MW110-15DBL, Tonan Asia Autotech Company, Bangkok, Thailand), the nipple length was measured perpendicularly from the base to the top; the nipple and the areola width were assessed for the largest diameter, respectively. Nipple and areola assessment was performed 3 times in each visit. These 3 readings were used to calculate the mean for that visit. Women's demographic data, gestational age, nipple length, and nipple and areola width were recorded.

Statistical Analysis

Statistical analysis was performed using SPSS 18.0. Normality of the data was tested by Shapiro-Wilk test. The reliability of the caliper was tested with intraclass correlation coefficiency. A 2-sided paired *t* test was used to compare the changes in nipple length, nipple width, and areola diameter between the first and last measurements of each patient. A P value $< .05$ was considered to be statistically significant.

Results

In 300 pregnant women, only 60 subjects were eligible and enrolled into the study. There were 4 cases having only 1 to 2 visits due to loss of follow-up or miscarriage, and they were excluded from the statistical analysis. The data were normally distributed. The intraclass correlation of the measurement was 94.5%, revealing the high agreement of each measurement. The mean age of the participants was 28.5 ± 5.4 years. The number of visits of each woman ranged from 5 to 9. The mean gestational age at delivery was 38.4 ± 2.5 weeks.

From early gestation to term, the mean nipple length and width increased significantly from 9.3 ± 1.5 mm to 11.2 ± 1.8 mm and 13.6 ± 1.8 mm to 15.9 ± 2.3 mm, respectively ($P <$ .001). The areola width also showed substantial expansion from 37.9 ± 8.9 mm to 50.1 ± 10.9 mm, but no significant difference between both sides was observed. Therefore, the mean increase of the average nipple length, nipple width, and areolar width was 1.9 ± 1.2 mm, 2.4 ± 1.2 mm, and 12.3 ± 6.1 mm, respectively. There were no significant differences of nipple elongation and nipple widening between the left and the right sides. The average nipple length and nipple width and the mean areola width for women of different gestational ages are presented in Table 1.

Discussion

This is the first prospective study that demonstrates the change of nipple length and width during pregnancy in Thai women. The results showed that both the length and width of the nipple as well as the areola width increased from early to late gestation, and no differences were found between the right and left sides. Therefore, gestational nipple elongation and widening and areola expansion exist along the passage of pregnancy. Such development may be due to hormonal changes during pregnancy.

The nipple is the opening of the mammary gland. There are 11 to 48 central ducts inside the nipple and these merge to leave only 6 to 8 ductular orifices at the tip.[12] Both the nipple and areola contain smooth muscle, including the inner longitudinal and the outer circular and radial arranged muscular layers.[13] Contraction of these muscles results in the protrusion of the nipple.[8] During the prenatal period, nipples become more erect.[8]

In addition, elevated estrogen promotes mammary duct growth while progesterone induces glandular bud development.[14] Hormonal effects, especially prolactin, are responsible for gestational change of the nipple. A positive relationship between the nipple cross-sectional area enlargement and the plasma prolactin level during pregnancy was reported.[15]

Table 1. Average Nipple Length, Nipple Diameter, and Areola Diameter at Every 3- to 4-Week Interval during Pregnancy

Gestational Age, wk	No. of Cases	Mean Nipple Length, Mean (SD), mm	Mean Nipple Diameter, Mean (SD), mm	Mean Areola Diameter, Mean (SD), mm
8	17	9.1 (1.0)	13.2 (1.8)	37.3 (11.4)
12	16	8.9 (1.1)	14.0 (1.4)	39.0 (11.7)
16	16	9.7 (1.3)	14.6 (1.1)	42.9 (6.4)
20	16	9.28 (1.1)	14.7 (1.2)	45.2 (7.6)
24	22	10.2 (1.8)	15.2 (2.8)	46.5 (9.2)
28	16	10.8 (2.2)	16.2 (3.0)	49.2 (8.3)
32	11	10.3 (2.0)	15.6 (1.6)	50.1 (8.8)
36	20	11.5 (1.4)	15.7 (1.6)	48.0 (8.4)
39	4	13.7 (2.0)	18.8 (1.9)	60.0 (13.7)

Furthermore, this development may be assisted by relaxin. Relaxin is bound specifically to epithelial cells, smooth muscle cells, blood vessels of the human female reproductive tract, and mammary glands and nipples, indicating its physiological role in these tissues.[16] However, there are only animal studies that directly elucidate the association of relaxin and nipple growth. Experiments in rats revealed that dams treated with a highly purified monoclonal antibody specific for rat relaxin had short nipple length, smaller nipple diameter, smaller cross-sectional area of lactiniferous duct lumen and blood vessels, and a higher collagen component than the controls.[17,18] The direct subcutaneous injection of relaxin at the base of the nipple increased the nipple length.[19] Although there is a clear function for this hormone in rats, due to the diversity between the species, its effect on the human mammary gland awaits further exploration. In addition, in mice, the parathyroid hormone and parathyroid hormone-related protein receptor (Ppr) were found to be essential for gestational mammary gland development. A large reduction in Ppr levels prevented whole gland development while a lesser reduction resulted in small nipples with altered epidermis and connective tissue.[20]

Prolactin, relaxin, and parathyroid hormone are all potential substances that are thought to regulate nipple development during pregnancy. Despite providing evidence of the principle in animal models, this highlights the paucity of systematic information regarding the hormonal effect of this change in humans.

As with nipples, the areola width increased significantly as has been previously demonstrated.[10,21] In these studies, human placental lactogen promoted this change.[15] The areola contributes an important role in forming a teat with the nipple.[22] Its dramatic expansion increases the elasticity that supports such formation, extending the reformed nipple. This is of benefit in the case of short nipples, when helping to form a pseudo-nipple for the infant to latch on to. One limitation of this research is that we were unable to predict pregnancy-related changes in nipple morphology among women whose nipple length was less than 7 mm, as these women were excluded from the study.

Conclusion

This study provides new insights into the physiological changes that occur in the nipple during pregnancy. Gestational nipple elongation and widening, as well as areola expansion, were shown to exist during pregnancy. Future research should be conducted among women with shorter nipples (ie, < 7 mm), to assess the changes in nipple and areola growth during pregnancy. In addition, it would be useful to conduct longitudinal studies evaluating the potential relationship between nipple/areola growth during pregnancy and breastfeeding outcomes.

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