Short Report

Unexpected Changes in Maternal Breast Size During Pregnancy in Relation to Infant Sex: An Evolutionary Interpretation

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Objectives: This study evaluated changes in breast size during pregnancy depending on infant sex. Due to larger nutritional needs during lactation, male infants may stimulate greater changes in maternal breast size than female infants.

Methods: Data were collected by an online questionnaire survey of 120 women from Poland, who had at least one child.

Results: Changes in breast circumference during pregnancy were associated with the infant's gender. Surprisingly, mothers of female infants had greater breast circumference changes than the mothers of male infants ($P = 0.03$).

Conclusion: The observed difference is surprising in the light of studies reporting that mothers of male infants produced milk that had greater energy content. However, breast size alone does not determine the quality and quantity of produced milk. It is suggested that the larger difference in breast size for mothers of female infants results from a trade-off between direct energy allocations to the growing fetus and to breast enlargement. Perhaps, as in other primates maintaining sexually attractive attributes during pregnancy, early breast enlargement in women is a primary sexual stimulus. The ultimate function of early breast enlargement may function to ensure greater involvement from partners, which is especially important to mothers expecting daughters, who might be in poorer nutritional condition, as predicted by Trivers-Willard hypothesis. Am. J. Hum. Biol. 00:000–000, 2011.

In humans, breast enlargement is one of the first visible signs of pregnancy, usually detectable as early as during the second month. Breast growth rate is extremely fast-during the first trimester the number of alveoli/lobule in mammary glands increases tenfold (Jahnson 2010).

Infants sex seems to influence the energy content of breast milk, which is 25% greater for males than for females infants (Powe et al., 2010). Changes in maternal breast size are related to the quality of milk produced, however in the only study conducted so far, this does not appear to have been associated with infants sex (Powe et al., 2010).

Here, it is hypothesized that changes in breast size during pregnancy may be related to the sex of the offspring. Males tend to grow faster in the womb (Loos et al., 2001), and tend to be heavier at birth than females (Marsál et al., 1996). It is, therefore, possible that males have higher nutritional demands after birth, and thus, greater changes in breast size may occur in women expecting sons. This study evaluated changes in maternal breast size before and directly after pregnancy in relation to infant's sex.

METHODS

Data were collected using an online questionnaire targeting Polish women who had at least one child. Invitation to participate in the survey was posted on three Polish online discussion sites–mother and baby forums. Mothers answered questions about their reproductive history, birth characteristics of the most recent child, and about the course of last pregnancy. They also provided information about their body size measurements, including bra size before pregnancy, and directly after giving birth. Breast circumference was calculated based on self-reported measurements–under breast circumference and cup size. The sum of under breast circumference and the mean number of centimeters for a given cup size range (i.e., 9 cm when cup size was AA; 11.5 cm for size A, etc.), was calculated. Taking into consideration the fact that women often miscalculate their bra size (i.e., choosing a smaller cup but larger under breast circumference), the used method seems to be the most accurate way to estimate the real breast size.

One hundred and twenty complete surveys were included in the analysis. Maternal age varied between 21 and 41 years of age (mean age 30.9 years, SD 4.48 years). Sixty-one women gave birth to a boy and 59 women gave birth to a girl as the most recent child. Mean change in breast circumference during pregnancy was 7.1 cm (SD 4.43 cm).

RESULTS

Changes in breast circumference during pregnancy, estimated on the basis of self-reported bra size before and directly after the last pregnancy, were associated with the sex of the infant. However, in contrast to the hypothesis, mothers of female infants had greater changes in breast circumference than mothers of male infants ($t = -2.07$; $P = 0.03$). Breast circumference increased on average by 8.0 cm in mothers of daughters and by 6.3 cm in mothers of sons (Table 1). In simple regression models changes in circumference were positively correlated with maternal weight change during pregnancy ($R^2 = 0.05$; $P = 0.01$)

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Received 5 September 2010; Revision received 15 February 2011; Accepted 23 February 2011

DOI 10.1002/ajhb.21177

Published online in Wiley Online Library (wileyonlinelibrary.com).

TABLE 1. Changes in breast circumference (cm) in relation to infant's sex

	Son	Daughter	
	Mean (SD)	Mean (SD)	P-value
Breast circumference			
Before pregnancy	93.6 (10.10)	91.6 (6.53)	0.21
After pregnancy	99.9 (9.87)	99.6 (6.63)	0.88
Changes in breast circumference	6.34 (4.48)	8.00 (4.24)	0.03

P-value was derived from Student's t-test.

and negatively correlated with the breast circumference before pregnancy ($R^2 = 0.08$, $P < 0.01$). In the analysis of covariance, that controlled both for maternal weight change during pregnancy and breast circumference before pregnancy the differences in the changes of breast size depending on infant's sex remained statistically significant ($F_{1.116} = 5.82$; $P = 0.01$).

There was no difference in changes in breast circumference between first-time mothers ($N = 69$) and multiparous mothers ($N = 51$, $P = 0.99$). Mothers of male infants had greater pre-pregnancy body weight (63.0 vs. 59.2 kg; $t = 2.14$; $P = 0.03$) but they were not significantly taller than mothers of female infants (167 vs. 166 cm; $P = 0.37$).

DISCUSSION

Presented results suggest that women who invested less in breast development prior to pregnancy, which could be caused by the fact that women in poorer condition are less likely to invest in reproductive effort, compensated that with greater changes in breast size during pregnancy. However, this explanation is not sufficient to account for observed changes in breast circumference, which was depended on the sex of the infant, even after controlling for breast circumference before pregnancy.

Male infants are more energetically demanding and their mothers produce milk that has greater energy content (Powe et al., 2010). Results of this study, however, show that mothers of female infants experienced greater changes in breast size. It should be noted that breast size alone does not determine the quality and quantity of produced milk and insufficient lactation was reported only in cases when prenatal breast enlargement was very small (Neifert et al., 1990).

On a proximate level, hormone secretion from the placenta during pregnancy, that is, human chorionic gonadotropin–hCG, may be dependent on the sex of a fetus (Yaron et al., 2002). Differences in hormones levels may provide the mechanism for sex-based differences in the changes of breast size.

From an evolutionary perspective, it is possible that human females developed two strategies for milk production, depending on the infant's sex, and possibly similar to rhesus macaque females–by synthesizing richer milk for sons but more milk for daughters (Hinde, 2009). Mammary glands themselves can adjust milk production to infant's demand under the influence of prolactin levels, which are sensitive to sucking stimuli. Findings observed in this article may results from a trade-off between energy allocations to the growing fetus and to breast enlargement. The faster growth rate during fetal development and greater birth weight of males (Loos et al., 2001; Marsál et al., 1996) may suggest that males are given greater energy directly, at the expense of the growth of breast.

Human females experience breast changes from the beginning of a pregnancy. Before the end of the second trimester, mammary gland enlargement allows women to breast-feed a child that is born premature (Hartmann et al., 2003). Such ability can be beneficial only in economically developed populations where a prematurely born child has a chance of survival, and therefore is a highly unlikely evolutionary scenario. In contrast, in farm animals, in which the process of breast enlargement is best documented, development of mammary glands begins after mid-pregnancy, that is, sheep (Pulina and Nuda, 2004), heifer (Dagoon, 1989), or even as late as 2–4 weeks before parturition in case of parous cows.

Presented findings question the old wives' tale claiming that "girls steal some of their mother's beauty." But perhaps these results, as well as the early growth of mammary glands in human pregnancy, could still be explained in the context of beauty. Women, compared to other mammalian females, are distinguished by the fact that they have significantly larger breasts than males from pubescence, even when they are not pregnant or lactating. Males should prefer larger breasts, because they are related to high estradiol levels and, thus to higher reproductive potential in women (Jasienska et al., 2004). Even if in few populations very large breasts are not particularly attractive to men, there are strong indications that the female breast evolved as a universal sexual stimulus (Marlowe, 1998).

Several primate species, including humans, do not restrict mating to the female's fertile periods and continue copulatory behavior during gestation. Females maintaining sexual activity during pregnancy can be regarded by males as regularly cycling estrous females, because they are investing in the development of attributes that may be sexually stimulating for their sexual partners, like genital swelling in chimpanzees (Wallis and Lemmon, 1986) or intense color of perineal skin in rhesus monkeys (Bielert et al., 1976). It could be hypothesized that similar phenomena occur in the case of pregnant women. Very early growth of mammary glands during pregnancy could be interpreted as a strategy to attract a partner to ensure his presence and support.

According to the Trivers-Willard hypothesis (1973), women in poorer condition are more likely to bear daughters than sons, and in this study this prediction is supported by maternal pre-pregnancy weight comparisons. Greater changes in breast size in women expecting daughters could be more attractive for men and, therefore, allow for better access to resources. Women in poor condition tend to invest less in current reproduction (Jasienska, 2003), therefore, it is likely that greater changes in breast size could result from a manipulation of the female fetus, who receives less of direct energy investments than the male fetus. It is worth noting, that level of hCG in maternal serum, which controls the levels of hormones responsible for changes in mammary glands, is significantly higher in the presence of a female fetus as early as during the third week post-fertilization (Yaron et al., 2002).

The limitations of this study should be considered. The method of estimating breast size based on self-reported bra size may not be entirely accurate, but it has been used in previous studies (Hartmann et al., 2003; Powe et al., 2010). Further, women who are Internet users may differ from the rest of the population in terms of socio-economic status, place of residence or education level. Even though presented findings refer to well-nourished women from an economically developed society, they could be reminiscent of past evolutionary strategies.

ACKNOWLEDGMENTS

I am very grateful to all women who participated in the study. I would like to thank two anonymous reviewers who provided valuable comments on earlier versions of the manuscript. I am also grateful for helpful comments from Heidi Colleran, Anna Ziomkiewcz-Wichary, Ilona Nenko, Magdalena Walas, Katarzyna Janusik, and Grazyna Jasienska.

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