Subclinical Mastitis Is Common Among Ghanaian Women Lactating 3 to 4 Months Postpartum

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Abstract

Subclinical mastitis (SCM) is an asymptomatic inflammation of mammary tissue and has been associated with lactation failure, suboptimal growth in early infancy, and increased risk of mother-to-child transmission of HIV via breast milk. A rapid survey was carried out to determine the prevalence of SCM among lactating Ghanaian women between 3 and 4 months postpartum. Bilateral breast milk samples were obtained from 117 lactating women in Manya Krobo, Ghana and analyzed for sodium (Na) and potassium (K). An elevated sodium/potassium ratio (Na/K) above 1.0 was considered indicative of SCM. Overall, SCM prevalence was observed among 45.3% of the women. About 30% of the women had unilateral SCM. Na/K was associated with maternal age. The high SCM prevalence in Manya Krobo suggests the need for lactation support to reduce SCM and the risk of poor infant outcomes. *J Hum Lact*. 24(3):263-267.

Keywords: breastfeeding, infant growth, subclinical mastitis, sodium/potassium ratio, Ghana

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Introduction

Suboptimal breast health may compromise maternal ability to breastfeed and the well-being of a breastfeeding infant. Subclinical mastitis (SCM) is an asymptomatic inflammatory condition of the lactating breast.[1] The condition is associated with a number of adverse outcomes including lactation failure,[2] infant growth faltering during the early postpartum period,[2,3] and increased risk of mother-to-child transmission of HIV.[4]

Subclinical mastitis is thought to be caused primarily by milk stasis,[5] which results from inadequate milk removal from the breasts. Milk stasis can increase the risk of bacterial infection of stagnated milk in the breast, occasionally leading to infectious mastitis.[6] During an episode of SCM, the tight epithelial junctions separating milk and plasma become compromised, leading to the leakage of plasma components, including sodium and chloride ions into milk.[7] An elevated sodium/potassium ratio (Na/K) above 1.0 is considered indicative of SCM.[4,5]

The present study was carried out to determine the prevalence of SCM among lactating Ghanaian women during the 3 to 4 month postpartum period. This study was conducted in Ghana as part of a larger study to determine the mechanism(s) linking SCM with infant growth faltering.

Methods

Study Area and Participants

The study was conducted in the Manya Krobo district in the eastern region of Ghana between November 2005 and February 2006. Most communities in the district have access to potable water and health services that include prenatal clinics and infant growth monitoring, immunizations, and vitamin A supplementation that are accessible at child welfare clinics (CWCs). Manya Krobo has a population of 165 409 living mostly in rural communities.[8] The majority of the women recruited into the current study, however, were residing in periurban communities where CWCs were most accessible. In 2005, HIV prevalence in Manya Krobo was 5.0%, a decline from 7.4% in 2002.[9] During the study period, there were 3 health institutions in the district that provided HIV voluntary counseling and testing services and infant feeding counseling to reduce the risk of mother-to-child transmission of HIV.

We hypothesized that SCM would be detected in at least one quarter of lactating women at 3 to 4 months postpartum based on the findings from a study in South Africa, which reported that 25% of lactating women had Na/K > 1.0 at 3 months.[1,4] A sample size of 110 women was therefore estimated, based on a statistical power of 80% to demonstrate the suggested prevalence in this population of lactating Ghanaian women.[1,4] Confidence interval limits were set at 95%. A total of 117 lactating women were recruited from 10 CWCs for this study. Women were invited to participate if they were 3 to 4 months postpartum, at least 18 years old, and resided in the Manya Krobo district. Written informed consent was obtained from all participants.

Ethical approval was obtained from the Institutional Review Boards of Iowa State University and the Noguchi Memorial Institute for Medical Research at the University of Ghana. Additionally, a formal letter of approval and support was obtained from the Manya Krobo district health administration.

Data Collected From Participants

Study participants completed a brief survey on the following self-reported health indicators to determine their associations with the development of SCM: overall health evaluation (*How would you describe your health today?*); breast health (*Have you had breast pain since you had this child? If yes, when did it occur?*); and recent disease symptoms (*Have you had any other health problems in the last week?*). Maternal age and number of live births were collected also. Mid-upper arm circumference (MUAC), a crude indicator of nutritional status, was measured on each participant to the nearest 0.1 cm on the left arm using a nonstretchable tape measure (Chasmors Ltd, London, United Kingdom).

Milk Collection Protocol and Storage

A spot milk sample of at least 10 mL was obtained by manual expression from each breast of each participant. Before expressing breast milk, the women washed both hands thoroughly with disinfectant liquid hand soap and running water, rinsed with deionized water and dried their hands with clean paper towels. The first drops of expressed milk were discarded after which the nipple and surrounding areola were cleaned with cotton gauze soaked with 70% ethyl alcohol. Milk expressed thereafter was collected in 60 mL plastic vials with snap-on caps. On completion of expression from one side, hand rinsing was repeated with deionized water and breast surface cleaning with ethyl alcohol before milk was expressed from the other breast. This hand-washing protocol was observed by the women as well as the field staff who assisted the women to express the milk. The reason for the hand-washing protocol was to reduce contamination of the milk by perspiration on the hands and breast of the woman. The alcohol swab was used to reduce microbial contamination of the sample as a portion of milk was cultured for bacterial infection. All milk samples collected were immediately stored in a cold chest for transport to the field laboratory and stored at −18°C. Samples were subsequently transported to Accra, for storage at −32°C until analysis.

Laboratory Methods

Milk sodium (Na) and potassium (K) content analyses of breast milk samples were performed using standard methods that employ ion selective electrode analyzer.[10] Briefly, all analyses were performed on whole milk without any sample pretreatment. Samples were thawed to room temperature (25°C). Thawed milk was then mixed using a vortex mixer to allow the aqueous and lipid compartments to mix uniformly and 0.1 mL of sample was aspirated for analyses of sodium and potassium using ATAC 8000 ion-selective electrode analyzer (Clinical Data Inc, Smithfield, Rhode Island). In addition to the internal saline standards used by the ATAC 8000, analytical quality was monitored by simultaneous analyses of milk and a saline standard with known electrolyte concentration. A majority of milk analyses were carried out once. Duplicates were only performed when unusually high sodium concentrations (> 10 mmol/L) were

recorded. Mean values of duplicate measurements were used in analyses.

Data Analyses

All data were analyzed using SPSS 11.0 (SPSS Inc, Chicago, Illinois). Descriptive statistics including arithmetic mean, median, and standard deviations were computed for maternal age and MUAC data. MUAC data were compared with a MUAC reference threshold of 18.5 cm for screening moderate undernutrition.[11] Categorical maternal health data were summarized into frequencies. Results of the milk analyses were expressed as Na/K ratio for each sample. Geometric mean was computed to describe the asymmetric distribution of Na/K data. SCM status groups were defined based on Na/K ratio in either one (unilateral) or both (bilateral) breasts. Analysis of variance was used to test group differences in natural log transformed Na/K data. Differences were considered significant in this study at $P < .05$. The prevalence of SCM was computed as the percentage of women with Na/K > 1.0.[4,5]

Results

Population Characteristics

Over a period of 3 months, we screened 1296 women who attended the selected CWC, of whom 154 women were 3 to 4 months postpartum. Of these, 6 women refused to participate while 31 were excluded because the mother was either not available at the clinic (n = 21), under 18 years old (n = 3), had a twin birth (n = 1), or was previously enrolled into the study at an earlier visit (n = 6). In total, 117 women met the inclusion criteria and were enrolled in the study (Figure 1).

About 42% (n = 49) of women in our study were between 18 and 25 years of age, whereas 23% (n = 27) were 30 years or older (Table 1). The median MUAC of the women was 26.6 cm. More than 81% (n = 95) of the women had 3 or fewer live birth experiences; 30% were primiparous (n = 35). Although most of the women (92%; n = 108) reported being in good health, a few complained of general body pains (5.1%), waist pain (3.4%), fever (3.4%), and headaches (2.6%) within the last 7 days. A total of 16 women reported postpartum breast health problems, including engorgement (11.9%) and breast pain (6.7%) with 5.1% reporting both engorgement and pain. One woman each reported sore nipples and a boil on the breast. Only 4 of the reported symptoms occurred within the 2 weeks prior to enrollment into the study.

A total of 229 breast milk samples were collected constituting 112 bilateral samples and 5 unilateral samples (participants were unable or unwilling to provide milk from the second breast). The duration of milk expression was 5 to 10 minutes for each breast.

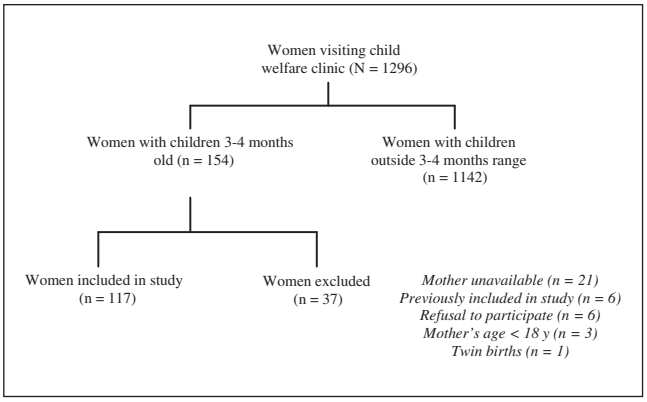

Figure 1. Flow chart of sample selection.

Table 1. Characteristics of Lactating Ghanaian Women, 3 to 4 Months Postpartum (N = 117)

Maternal Characteristics	$\bar{x} \pm SD$	*Median*	*Range*
Age, y	27.0 ± 5.8	27.0	18.0-46.0
Live births, no.	2.5 ± 1.4	2.0	1.0-9.0
Mid-upper arm circumference, cm	27.3 ± 3.3	26.6	19.3-36.5

Table 2. Sodium and Potassium Levels in Milk of Lactating Ghanaian Women, 3 to 4 Months Postpartum[a]

	Geometric Mean	*SD*	*Range*
Right breast, n = 116			
Sodium, mmol/L	11.23	16.78	4.56-115.90
Potassium, mmol/L	13.53	12.57	4.56-91.50
Sodium/potassium ratio	0.83	2.25	0.05-16.98
Left breast, n = 113			
Sodium, mmol/L	11.43	12.11	5.00-116.70
Potassium, mmol/L	12.43	14.53	7.14-90.40
Sodium/potassium ratio	0.85	1.57	0.06-16.34

[a]Normal values: sodium, 5-6 mmol/L; potassium, 13-14 mmol/L; sodium/potassium ratio, ≤ 0.6.

Na/K and SCM prevalence

The sodium and potassium levels in milk from right and left breasts are presented in Table 2. A wide range in milk sodium and potassium levels from both right and left breasts was observed. We found no significant differences between left and right breast milk samples for sodium ($P = .80$) and potassium ($P = .89$).

The geometric mean breast milk Na/K was 0.84; there was no difference in Na/K between right and left breasts. Mean Na/K in unilaterally elevated breasts was significantly greater than mean Na/K of women without elevated Na/K in both breasts ($P < .01$). There was no

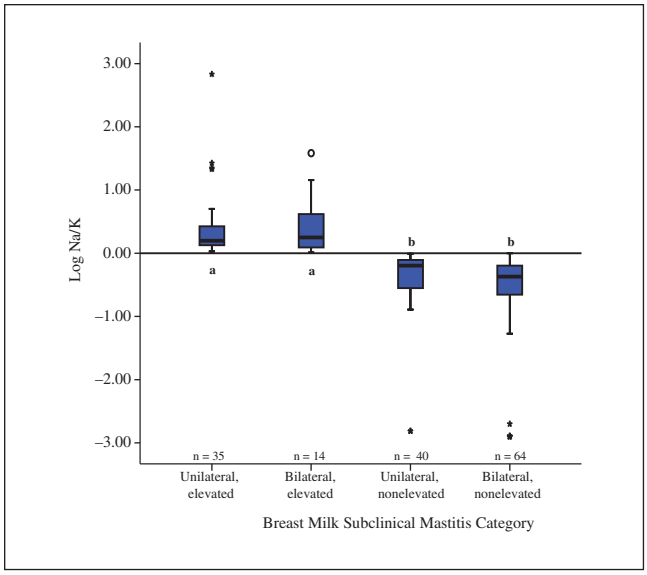

Figure 2. Sodium/potassium ratio (log Na/K) of milk from lactating Ghanaian women, 3 to 4 months postpartum, by subclinical mastitis status. Box plot categories represent women who had elevated Na/K in affected breast (unilateral, elevated), elevated Na/K in both breasts (bilateral, elevated), normal Na/K in unaffected breast (unilateral, nonelevated), and normal Na/K in both breasts bilateral, nonelevated). The box plot includes the 25th and 75th percentiles delineated by the box, the median is represented by the dark horizontal line, the whiskers represent 1.5 × interquartile range, outlier values (○) are 1.5 to 3 times the interquartile range, and extreme values (*) are more than 3 times the interquartile range. Dissimilar superscript letters represent significant group differences.

significant difference between Na/K in milk from women with bilateral and those with unilateral SCM. Na/K was not associated with parity, reported maternal health perception, and reported breast health problems at anytime after delivery. However, maternal MUAC less than 29 cm ($P < .003$) and age less than 34 years ($P < .017$) were both associated with higher Na/K.

Using Na/K ratio of 1.0 as a threshold, 45.3% of participants had elevated breast milk Na/K indicative of SCM. Unilaterally elevated Na/K was observed in 29.9% of the study population whereas bilaterally elevated Na/K was observed in 15.4%. There was a significant between-breast difference in Na/K ($P < .01$) among women with unilaterally elevated Na/K (Figure 2).

Discussion

This study documented very high rates of elevated Na/K among lactating women reporting excellent health and no indication of malnutrition. Previously published reports of the prevalence of Na/K > 1.0 have ranged between 9% and 25% at 3 months postpartum.[1,4] We focused on women who were between 3 and 4 months postpartum for two reasons: first, to provide data beyond the third month postpartum period because most of the available data on SCM report data up to 3 months postpartum, and second, the 1-month interval between 3 and 4 months was to reduce a dilution effect of the prevalence estimate because SCM prevalence typically reduces over time postpartum.[1,12] Our results therefore confirm previously reported sustained high SCM prevalence of 23%[4] and 25%[1] at 14 weeks postpartum, suggesting that SCM may occur far beyond the third month postpartum.

It has been reported that healthy women at 1 month postpartum had breast milk Na/K ≤ 0.6.[10] Some studies have reported moderate SCM, diagnosed as Na/K > 0.6 but ≤ 1.0.[1,3,13] Moderate SCM may therefore have a lower predictive power for outcomes associated with SCM, compared with Na/K > 1.0. In their study of HIV infected women, Willumsen et al[4] reported significant elevation of breast milk viral load in women with breast milk Na/K > 1.0 compared with those with 0.6 < Na/K ≤ 1.0. Average breast milk sodium and potassium concentration ranges between 5 to 6 mmol/L and 13 to 14 mmol/L, respectively, beyond the lactogenesis and weaning periods.[10] Both lactogenesis and weaning are associated with increased mammary permeability and leakage of plasma electrolytes into milk spaces, thereby increasing breast milk sodium concentration.[5,7]

It is not known whether SCM at this later stage in lactation (ie, 3-4 months postpartum) continues to affect weight gain and other infant and maternal outcomes. If it does, there will be need for interventions to reduce SCM rates beyond the early lactation period. A trial in Bangladesh has indicated a protective effect of lactation counseling before or after parturition on the rate of SCM during the early postpartum period.[13] The effect of a similar intervention on the rate of SCM occurring at a later period in lactation remains untested.

Detailed information on infant feeding was not collected in this rapid survey. Results from other studies,[4] however, lead us to assume that early introduction of complementary feeding may partly explain the high SCM prevalence observed in this community. Typically, complementary feeding starts at 3 months or earlier in Ghana.[14] Early introduction of complementary feeds has been associated with infrequent breastfeeding and reduced breast emptying, both of which can lead to milk stasis and subsequent elevation of breast milk Na.[15]

MUAC ≤ 18.5 cm is considered an indicator of moderate malnourishment among adults.[11] Women in our study who had MUAC below 29 cm had higher Na/K. Filteau et al[3] have demonstrated that maternal supplementation with vitamin E reduced Na/K. Low maternal MUAC may suggest underlying low to moderate malnutrition although the link between low MUAC and poor micronutrient status can be implied but has not been clearly established. The lower Na/K observed among women aged 34 years and above may be a function of higher parity and lactation experience. Earlier studies have reported association between mastitis and maternal age and parity. Primiparous women[16] and women between 21 and 35 years[17] were reported to have higher risk of mastitis.

Although SCM has been found to be high among populations with high HIV prevalence,[4,12] the effect of HIV infection on SCM in this community remains unknown because we did not test for HIV. At the current HIV prevalence of 5%, its effect on SCM prevalence among our study participants is likely to be small. We, however, recommend that future studies assess HIV status to allow determination of the contribution of HIV infection to the incidence of SCM.

Conclusion

The high prevalence of SCM observed in this community suggests the need for further investigation to determine the factors that promote elevated Na/K among these women and immediate interventions to decrease the prevalence of SCM and the risk of adverse outcomes to the infants. Interventions should be targeted at younger and malnourished mothers who are at a higher risk of elevated Na/K.

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Resumen

La mastitis subclínica (MSC) es una inflamación sintomática del tejido mamario y se ha asociado con el fracaso de la lactancia materna, crecimiento subóptimo en la primera infancia, y aumento del riesgo de la transmisión madre-hijo del VIH a través de la leche materna. Hicimos una encuesta rápida para determinar la prevalencia de la MSC entre mujeres lactando en Ghana entre los 3 y 4 meses postparto. Se obtuvieron muestras bilaterales de leche de 117 mujeres lactando en Manya Krobo, Ghana y se analizó el sodio (Na) y el potasio (K). Niveles elevados del rango sodio-potasio (Na/K) sobre 1.0 se consideraron indicativos de MSC. En general, la prevalencia de SCM fue de 45.3% de las cuales 29.9% fueron unilateral. El Na/K se asoció con la edad materna. Alta prevalencia de MSC en Manya Krobo sugiere la necesidad de apoyo a la lactancia para reducir la MSC y el riesgo de impacto en la salud del bebe.