Urinary Lactose as an Index of Lactation Performance

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Abstract

This lactation performance study aimed at the measurement of milk output as mothers frequently say that they have difficulty in lactation out put. We conducted a cross-sectional study in a rural area of Bangladesh, on 129 lactating mothers with their infants of 2 weeks to 8 months old (study group) and 112 ages matched non-lactating, non-pregnant mothers.

Both urinary lactose and L: C molar ratio significantly correlated with lactation performance ($r=0.63$, $P<0.001$, $r=0.74$, $P<0.001$ respectively with FMS and $r=0.51$, $P<0.001$ and $r=0.64$, $P<00.001$, respectively with RS). Feeding frequency and feeding time were two important variables having significant correlation with urinary lactose and molaeraho ($r=0.58$, $P<0.001$ and $r=0.56$, $P<0.01$) and .001 $r=0.42$, $p<.001$ and $r=0.52$, $p<.001$, respectively). Lactation performance showed a positive correlation with maternal serum albumin ($r=0.19$, $p<0.05$) and infant's Wt/Ht ratio ($r=0.17$, $p<0.05$).

Key words : Urinary lactose, Lactation Performance

Introduction

First Morning urinary Sample (FMS) is a better indicator than Random urinary Sample (RS) and urinary L: C molar ratio is a better marker of the biosynthetic activity of mammary glands than lactose level in urine indicating good milk out put.

Breast-feeding brings a lot of positive effects on the health of a sucking baby. For a healthy well-nourished and well-developed infant, the nursing mother must feed her baby sufficient quantity of good quality (having adequate nutritive value) breast milk regularly and for sufficient period of time.

Breast-feeding is universal in Bangladesh but colostrums rejection is well documented. In studies it has been shown that 50 to 100[1] percent mothers tend to reject this highly beneficial milk. Pre-lacteal feeding is common in rural as well as urban area[2]. Exclusive breast feeding rate at 0-1 month of age is 90% but at 4th month

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it is reduced to only 3-4% (Progotir Pathay 97, BBS-UNICEF). Due to various reasons most of the mothers practice feeding additional food along with breast milk. However the most common cause of discontinuation of exclusive breast feeding and introduction of additional food before reaching weaning age is mother's loss of confidence for successful and satisfactory lactation with mere assumption that the child in not getting sufficient milk.

Lactation failure has been attributed in modern literature predominantly to psychological interference with the release of milk[3]. In human it has been proposed that there are women who can not produce milk. Many factors influence lactation performance, of them, socio-economic condition, nutrition education, ante-natal breast feeding counseling etc. play key role. The World Health Organization also has launched breast feeding campaign and has stressed the need for additional research in the physiology of lactation[4] and as such there will be improvement in health and nutritional status of the new born and reduction in child malnutrition as well as in infant morbidity and mortality.

In human lactation study, milk intake and milk production are usually estimated by rater invasive procedures, like a) 8/12/24 hour test-weighing & infants, b) Breast milk expression using hand or electric pumps and c) Measurement of heavy water (H_2O) enrichment in saliva of infants. A more simple, acceptable and feasible measure would definitely be helpful for the measurement of maternal milk output capacity in research and clinical practice. Maternal urinary lactose excretion has been proposed as a simple measure of lactation performance[5,6,7]. We have in sufficient information about the epidemiology of lactation failure in our country. There are only few reports on human lactation, lactation performance and lactation failure especially in rural Bangladesh. Thus it is, therefore, desirable to study current lactation pattern, attitude towards breast feeding among the rural mothers and assess the feasibility of utilizing urinary lactose as an indicator of lactation and performance.

Materials and Methods

One union of Mohonpur Thana of Rajshahi district, named Mougachhi, was selected for the study. The study was conducted on 244 women out of 2684 mothers of the selected union. The responding mothers were divided into two groups - study and control group. Study group included 132 lactating mothers with three infants aged

ranging from 2 weeks to 8 months and the control group included 112 age-matched, non-lactating and non pregnant mothers, who had completely stopped breast feeding their last child at least six months ago. The idea of dividing the mothers into two groups was to compare Urinary lactose level between groups. Lactating mothers were studied by three Test weighing schedule during eight hours in a day for consecutive three days. Non-lactating and non pregnant mothers were studied on 2nd or 3rd day of their menstrual period. Under the direct supervision of two graduate doctors, Local Family Welfare Visitors (FWV), Family Welfare Assistants (FWA), Female Field level Workers of Mohonpur CCDB and local Traditional Birth Attendants (TBA) were employed for collection of data.

Criteria for selection of subjects:

- Lactating mothers from rural community having their last child within 2 weeks to 8 months of age.
- Infants (2 weeks to months of age) of these mothers.
- Non-pregnant and non-lactating mothers (who have given up breast feeding their babies at least for the last six months).
- Mother's age ranged between 18 and 40 years.
- Parity of mothers one to six.
- Socio-economic status of the mothers within 'low' and 'middle' income groups (monthly family income from Tk.1,000/- to Tk.5,000/-)
- Subjects free from any serious disease or chronic illness.

Questionnaires were designed to collect information about subject's socio-economic status, obstetric history, lactation history, infant's feeding history, maternal and infant nutritional status and infant morbidity. The same information was also collected from the control subjects. Before data collection the selected mothers were informed and listed in the evening and were asked to remain fast till the investigation team reached their households on the next day at 8 a.m. The team stayed in the study household for 8 hours to complete collection of relevant information for three consecutive days. Socio-economic data were collected through interview. Anthropometric data as well as blood and two urine samples were collected on the same days of Test-weighing.

Test weighing: Test weighing is the procedure of weighing of baby just before and just after each episode of breast feeding. A beam balance known as Heavy Duty Solution Balance, Ohaus was used for test weighing. This instrument has an accuracy of up to1.0 gram. Before feeding, the infants were weight (pre-feeding weight) and

then allowed to feed breast milk. On completion of feeding, infants were weighed again and the weights were recorded (post feeding weight). By subtracting the first weight from second weight the amount of breast milk consumed by the infant was estimated. By adding the values of milk intake recorded during each and every breast feeding episode throughout 8 hour study period, total milk intake by the baby in 8 hours was obtained. Time between every pre-feeding and post-feeding weighing was also recorded. Mothers were requested to keep the frequency and duration of their usual normal lactation pattern.

Anthropometric measurement: Body weight of study mothers was measured on 2nd day of each 3 days Test weighing period and for control mothers on 2nd and 3rd day of menstrual period. Measurements were done in minimum clothing, empty stomach and empty bladder using an electronic, digital display machine (UNICEF's) sensitive to 10 gm. Heights of the mothers in cm were measured in standing position, without sandals, by a body height measuring scales. Mid Arm Circumference (MAC) was measured using a TALC (UK) tape.

Blood: Blood samples were collected for estimation of haemoglobin and serum albumin by standard Cyanmethemoglobin method. For study lactating mothers samples were collected on 2nd day of the 3 day Test weighing period. Samples from control mothers were collected on 2nd day of their menstrual cycle.

Urine: Urine samples were collected for estimation of lactose level and creatinine level. Lactose concentration was expressed as the amount of lactose in unit volume of urine as well as Lactose: Creatinine molar ratio. Two types of urine samples were collected from each mother. One First Morning Urine Sample (FMS) and another Random Sample (RS). Mothers were instructed beforehand to collect their day's first urine voided early in the morning for each day of the 3 day Test weighing period and labeled as First Morning Sample or FMS. Whereas urine samples from control group mothers were collected for first, second and third day of their menstrual cycle. Another urine sample was collected from the same mothers in between 1:00 PM to 4:.00 of the same days. All the samples were quickly stored in a deep freeze at a temperature of about -20^{0}C. These sample were transferred into a labeled capped glass test tube and was stored in a cold box. The cold box had insulated walls and was equipped inside with flat, plastic, ice-filled bottles. Temperature inside the box remained around 0^{0}C for about 9 – 10 hours. At the end of the 8-hours study, the samples were brought to the laboratory for analysis. About 1.0ml urine sample from each test tube was transferred to a capped plastic Eppendorff's tube and was later used for urinary lactose estimation. Remaining urine samples in test tubes were used for estimation of urinary creatinine level.

Results

Except Hemoglobin level, age, weight, height, MAC, Serum Albumin level were not significantly different between study and control groups (Table 1). Figure 1 shows the percent distribution of infants according to their mother's Lactation Performance (milk produced in grams in 8 hours) based on four categories – milk produced less than or equal to 150g, 151g to 250g, 251g to 350g and more than 350g. It showed that the lactation performance of the mother of 10.8% infants were in the ≤ 150 g category, 54.3% were in 151 g to 250 g category, 31.8% were in 251 g to 350 g category and only 3.1% were in more than 350 g category.

Table: 1 Characteristics of the mothers

Characteristics	Study group (n=129) Mean ± SD	Control group (n=112) Mean ± SD	Mean Test
Age (y)	25 ± 4.8	26 ± 6.0	p>0.05 NS
Body Weight (kg)	43.6 ± 5.14	42.6 ± 4.0	p>0.05 NS
Height (meter)	1.49 ± 0.058	1.5 ± 0.046	p>0.05 NS
Mid Arm Circumference (cm)	23.2 ± 1.86	23.4 ± 1.6	p>0.05 NS
Serum Albumin (g/dl)	4.08 ± 0.6	4.13 ± 0.4	p>0.05 NS
Haemoglobin (g/dl)	10.6 ± 1.25	12.3 ± 2.8	p<0.05 S

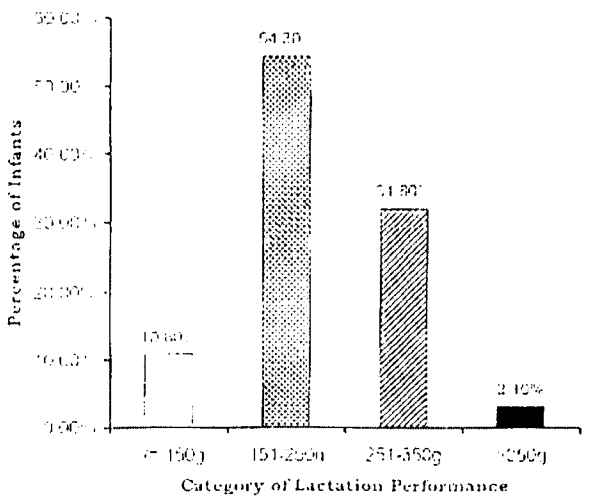

Figure 1: Distribution of Infants by Their Mother's Lactation Performance

Table 2: Characteristics of the infants

Age of Infant	(n)	Length (cm)	Weight (kg)	MAC (mm)	CC (mm)
2 w	07	48.4 ± 1.76	3.0 ± 0.21	92.6 ± 2.3	103.4 ± 2.5
1 m	15	50.0 ± 2.1	3.45 ± 0.86	93.2 ± 8.0	107.6 ± 7.7
2 m	15	53.3 ±2.18	4.3 ± 0.15	106.7 ± 6.3	123.2 ± 5.8
3 m	15	55.5 ± 2.04	5.1 ± 0.3	122.5 ± 3.9	140.2 ± 6.8
4 m	16	61.0 ± 1.6	5.5 ± 2.8	124.8 ± 7.5	147.7 ± 6.9
5 m	17	62.5 ± 1.8	6.06 ± 2.4	134.2 ± 5.7	156.5 ± 4.3
6 m	15	64.2 ± 1.2	6.66 ± 2.76	135.3 ± 3.1	160.8 ± 2.6
7 m	15	65.6 ± 1.8	6.8 ± 7.3	135.8 ± 10.3	163.4 ± 10.3
8 m	14	67.4 ± 1.8	7.6 ± 3.6	149.8 ± 6.1	172.8 ± 6.2

- All values expressed as Mean±SD

Table 2 shows the sample characteristics of the respondent infants. Mean length (cm) weight (kg), Mid Arm Circumference (mm) and calf circumference (CC in mm) were found observed to increase with age.

Table 3: Test-Weighing results

Age of Infant	(n)	Milk Intake(g) in 8 hours Mean ± SD	No. of Feeds in 8 hours Mean ± SD	Intake per Feed (g)
2 weeks	07	198.3 ± 56.0	4.14 ± 0.9	47.9
1 month	15	204.4 ± 72.0	4.28 ± 0.7	47.8
2 months	15	231.3 ± 46.1	4.93 ± 0.4	47.4
3 months	15	239.0 ± 60.1	4.86 ± 0.6	49.7
4 months	16	260.8 ± 33.0	5.26 ± 0.8	49.5
5 months	17	237.1 ± 80.5	4.50 ± 0.5	52.7
6 months	15	258.1 ± 70.8	4.80 ± 0.8	53.8
7 months	15	215.7 ± 57.7	4.00 ± 0.6	53.9
8 months	14	208.2 ± 33.5	4.10 ± 0.8	50.8

The Test-weighing results are presented in Table-3. Number of feeds during 8 hours study period increased from 2nd week (4.14 ±0.9 times) up to 4th months (5.26±0.8 times) and then feeding frequency gradually decreased from 5th months to a value of 4.1 ±0.8 times at the age of 8th months. The amount of milk consumed per feed also increased gradually with age of infant till 7th months. The amount of milk per feed was 47.9g at 2nd week and 53.9g at 7th months but at 8th month which came down to 50.8g.

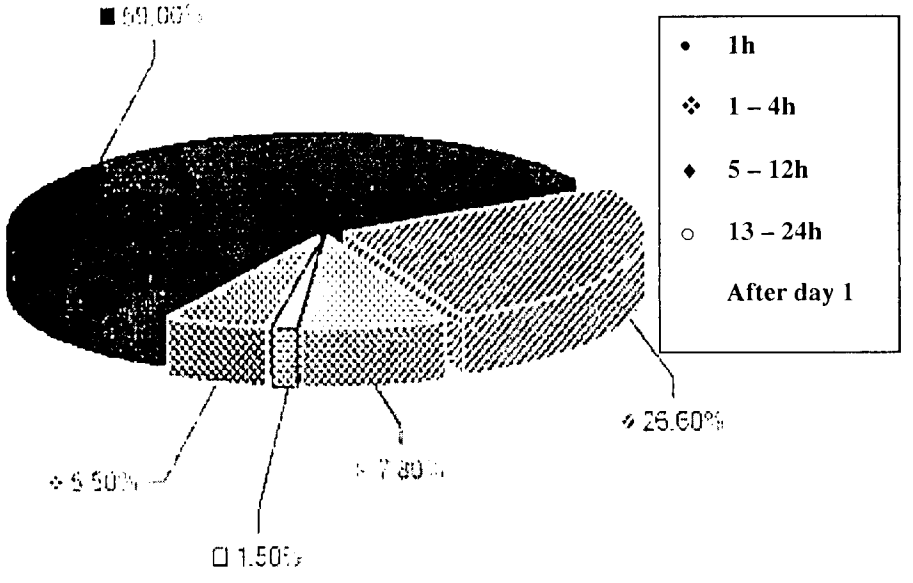

Figure 2: Distribution of infants by time of onset of breast feeding

Figure 2 illustrates time of onset of breast feeding after delivery. Most (54.0%) of the babies were put to the breast within one hour of their birth. About 26.6% babies were put to breast within 1 – 4 hours, 7.8% within 5 – 12 hours, 1.5% within 13 – 24 hours and 5.5% after first day of delivery.

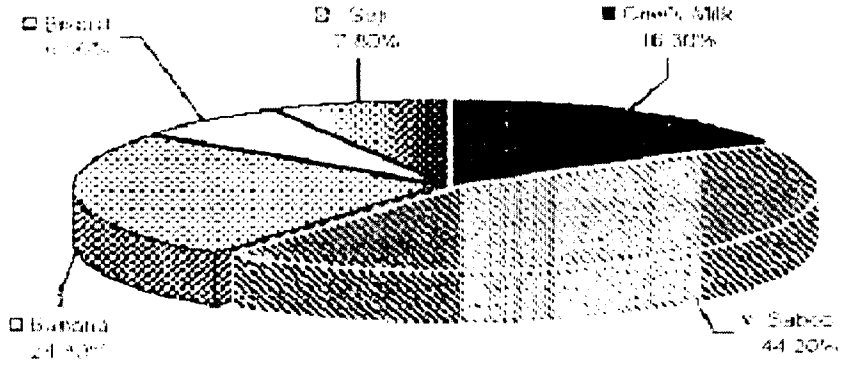

Figure 3: Percentage of infants mothers by type their weaning foods

Figure 3 present the distribution of infants' mothers by the types of weaning food at the start of weaning, and showed that the commonest weaning food item introduced and preferred by most of the mothers as weaning food was Saboo (44.2%), although now people are more aware about its nutritive value, followed by banana (24.8%) and cow's milk (16.3%).

Table 4: Distribution of mothers by reasons of early introduction of supplementary foods

Reasons	No. of Mothers	Percentage
Insufficient breast milk	90	69.7
For healthy growth of child	12	9.3
Baby's reluctance to breast milk	21	16.3
Following other's practice	06	4.7
Total	129	100

Table 4 shows that 69.7% introduced early feeding of supplementary food because of insufficient milk flow in their breasts. More them 16% mothers stated that their babies were reluctant to sucking breast milk.

Table 5: Association between mean lactation performance and corresponding lactose level in urine of first morning and random samples.

Range of Milk Intake Values (grams)	**Lactation Performance** (Milk Intake in grams in 8-study hour)	**Urinary Lactose (FMS)** (g/L)	**Urinary Lactose (RS)** (g/L)
≤ 150	129.9 ± 19.2	.074 ± .025	.085 ± .034
151 – 250	206.8 ± 26.3	.174 ± .063	.133 ± .052
251 – 350	290.2 ± 29.0	.243 ± .077	.186 ± .066
≥ 350	382.5 ± 25.0	.275 ± .082	.231 ± .074

The relationship between mean lactation performance and corresponding maternal First Morning and Random urinary lactose level is shown in Table 5. Mean urinary lactose level in both FMS and RS increased with increase in mean lactation performance indicating higher the urinary lactose excretion, higher was the milk production in the mother's breast. Since the control mothers were non-lactating, urinary lactose excretion was very negligible and as such the corresponding figures of FMS and RS for control group were not shown in the table.

Table 6: Percent distribution of mothers by maternal Body Mass Index (BMI) and Lactation performance

Maternal BMI level	Percentage of mothers	Lactation performance (milk intake in grams in 8-hour study period)
≤ 18.5	28.6	217.3 ± 72.9
18.6 – 19.9	34.1	239.0 ± 61.2
20.0 – 25.0	37.3	236.0 ± 55.9

Table 6 shows the lactation performance and percent distribution of mothers according to their Body Mass Index (BMI). About 29% mothers had chronic energy deficiency (BMI≤18.5) as against 37.3% were within the normal range (20.0 to25.0) of BMI showing corresponding lower and higher lactation performance. Of course, a better lactation performance was observed in mothers whose BMI ranged between 18.6 and 19.9 with a mean milk output of 239.0 ±61.2g in 8 hours.

Table 7: Lactation performance and percent distribution of mothers by maternal age

Maternal age (years)	Percentage of mothers	Lactation performance (milk intake in grams in 8-hour study period)
≤ 20	24.0	217.4 ± 67.8
21 - 25	38.0	230.6 ± 60.3
26 – 30	25.6	237.2 ± 67.0
31 – 35	10.1	236.4 ± 43.7
36 & above	2.3	257.1 ± 58.9
Total	100.0	

Table 7 shows that lactation performance of the mothers increased with the increase of their ages and highest lactation performance was observed among mothers aged 36 years and above.

Table 8 : Relationship of urinary lactose, L : C molar ration and serum albumin level with others variables

Variables	Correlation Coefficient (r)	Level of Significame
Lactation Performance and Urinary Lactose level in FMS	0.63	0.001
Lactation performance and L : C molar ratio in first morning samples (FMS)	0.74	0.001
Lactation Performance and Urinary Lactose level in FMS in random samples (RS)	0.51	0.001
Lactation Performance and Urinary Lactose level in FMS in random samples (RS)	0.64	0.001
Feeding frequency of breast feeds in 8 hours and Urinary Lactose level in first morning sample (FMS)	0.58	0.001
Feeding frequency of breast feeds in 8 hours and L : C molar ratio	0.56	0.01
Feeding time (minutes) in 8 hour and Urinary Lactose level in first morning samples (FMS)	0.42	0.001
Feeding time (minutes) in 8 hour and L : C molar ration in (FMS)	0.52	0.001
Feeding frequency of breast feeds in 8 hours and Urinary lactose level in random sample (RS)	0.51	0.001
Feeding frequency of breast feeds in 8 hours and L : C molar ratio in (RS)	0.53	0.001
Feeding time (minutes) in 8 hour study period and Urinary lactose level in RS	0.36	0.001
Feeding time in 8-hour study period and L: C molar ratio in RS	0.51	0.001
Lactation performance and maternal serum Albumin level	0.19	0.05
Lactation performance and Infant's weight / Height ratio	0.17	0.05

Table 8 shows that Lactation performance were significantly correlated with Unitary Lactose molar ratio in FMS & random samples respectively. Feeding frequency and feeding time were also significantly correlated with Unitary Lactose level in FMS & in RS and molar ratio respectively. It was also found that Lactation performance was significantly correlated with maternal serum albumin and infants weight / height ratio respectively.

Discussion

The present study showed that there was an increase in milk out put and lactose excretion in both First Morning and Random urine samples of mothers from 2 weeks of infant's aged up to 4th month. This trend of raising persisted up to 6th month with a slight fall at 5th month. From 7th month onwards both lactation performance and lactose excretion decreased. Peak milk flow in this study was between 4th to 6th months of infant's age.

This study revealed that higher the mother's milk out put, greater were their lactose excretion in urine. Secretary activity of mammary gland among the non-lactating mothers was at it's minimal and their urinary lactose excretion was too negligible. Lactation performance appears to be perceived over wide range of maternal nutritional status. The amount of milk out put by the women of poor nutritional status may be reduced, but to a limited extent[8, 9].

In 1928, Watkins[10] first reported elevated lactose level in urine of pregnant and lactating women. Recently this fact has been supported by other researchers. The lactose that is measured in the urine and blood of pregnant and lactating women has been claimed to arise from the mammary glands[11].

Bangladesh is a developing country and like most other developing countries in the world, breast feeding is a usual custom and routinely practiced here. In this study all mothers also opined in favour of breast-feeding and are thus practicing it. But their knowledge regarding successful initiation and maintenance of breast-feeding was poor and highly influenced by superstitions. This might be due to lack of active support of the existing health delivery system as well as social and religious influences. Even before 6 years ago in most hospitals there was no practice of breast feeding advocacy and counseling. Only 2% mothers would get proper advice on breast-feeding.[12]

About 86% mothers had lactation performance between 151 – 350 g/day. Test-weighing results as appeared in Table 3 showed that mean intake per day increased from 198.3 to 260.8 grams. Lactation performance was found to be directly related to number of feeding per day.

Commonest practice in Bangladesh is to breast feed on demand. On an average the study mothers breast fed more than 5 times in an 8-hour study period and their babies were not malnourished. So this practice of breast feeding is suitable for rural

Bangladesh, but education on ideal breast feeding practice will improve and maintain effective child rearing practice in rural Bangladesh.

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