ORIGINAL ARTICLE

Maternal recall of exclusive breast feeding duration

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Background: Both the pattern and duration of breast feeding are important determinants of health outcomes. In vertical HIV transmission research, reliable documentation of early breast feeding practices is important in order to correctly attribute postnatal transmission to feeding pattern.
Aims: To validate methods of collecting data on the duration of exclusive breast feeding (EBF) in an area of South Africa with a high HIV prevalence rate.
Methods: A total of 130 mothers were interviewed weekly, postnatally. At every interview a 48 hour and a seven day recall breast feeding history were taken. A subset of 70 mothers also received two intermediate visits per week during which additional 48 hour, non-overlapping, recall interviews were conducted. Ninety three infants were revisited at 6–9 months of age when mothers' recall of EBF duration from birth was documented. The different methods of recalling EBF status were compared against an a priori "best comparison" in each case.
Results: Reported breast feeding practices over the previous 48 hours did not reflect EBF practices since birth (specificity 65–89%; positive predictive value 31–48%). Six month EBF duration recall was equally poor (sensitivity at 2 weeks 79%; specificity 40%). Seven day recall accurately reflected EBF practices compared with thrice weekly recall over the same time period (sensitivity 96%, specificity 94%).
Conclusions: 48 hour EBF status does not accurately reflect feeding practices since birth. Long term recall data on EBF are even more inaccurate. We recommend that data on duration of EBF be collected prospectively at intervals of no longer than one week.

Collecting breast feeding data is fraught with difficulties. Data collected retrospectively from cross sectional surveys or longitudinal studies with long time intervals between interviews may be biased by maternal recall.[1–3] Current breast feeding status based on a previous 24 hour history may not accurately reflect the feeding pattern since birth.[4–6] Infants are often grouped by imprecise criteria depending on whether they have "ever" or "never" received breast milk, and rarely by the pattern of breast feeding which can be exclusively breast fed (EBF), predominantly breast fed, and partially breast fed.[7–9] In addition, since many researchers do not use standardised definitions for breast feeding patterns (table 1), comparability of results between studies is impaired.

An important illustration of the need for accurate breast feeding practices data is in HIV transmission research. The HIV pandemic has raised dilemmas about infant feeding recommendations[10] and highlighted the importance of accurate and consistent documentation of early infant feeding practices, in order to correctly estimate the risks of breast feeding in mother to child transmission (MTCT) of HIV.[11] While many studies have documented postnatal transmission of HIV in breast feeding populations, few have attempted to describe feeding practices in detail.[12–16] There is some evidence that EBF may carry minimal additional risk of postnatal MTCT of HIV compared to exclusive replacement feeding, but a significantly lower risk than mixed feeding.[17] In order to make the distinction between EBF and other patterns of breast feeding it is important to document the frequency, volume, and description of all other fluids and feeds given, including non-prescribed medications. Inaccurate data may falsely attribute postnatal transmission to a particular feeding pattern (for example, EBF), when, in reality, the mother has been mixed feeding. In addition, it is unknown whether mixed

Abbreviations: EBF, exclusive breast feeding or exclusively breast fed; MTCT, mother to child transmission

Table 1 Definitions of breast feeding patterns

Breast feeding pattern	Definition
Exclusive breast feeding (EBF)	Means giving the infant no other food or drink, not even water, apart from breast milk (including expressed breast milk), with the exception of drops or syrups consisting of vitamins, mineral supplements, or prescribed medicines[24]
Predominant breast feeding	The infant's predominant source of nourishment is breast milk. However, the infant may also have received water or water based drinks (sweetened or flavoured water, teas, infusions, etc); fruit juice; oral rehydration salts (ORS); drop and syrup form vitamins, minerals, and medicines; and folk fluids (liquids used for non-nutritional purposes; for example, oil for constipation or tea for relief of colic). With the exception of fruit juice and sugar-water, no food based fluid is allowed under this definition[24]
Partial breast feeding	Means giving a baby some breast feeds, and some artificial feeds, either milk or cereal, or other food[25]
Mixed breast feeding*	Means giving a baby some breast milk and also any other fluid or feeds, even a teaspoon of water (that is, includes predominant and partial breast feeding)

*This definition is not a standard WHO definition but has come into common usage in HIV transmission research. Our definition, above, was used for the purposes of this study.

feeding with different fluids (for example, water or dilute porridge) carries the same risks for MTCT of HIV, whether these risks vary with the degree of mixing, and whether they are constant postnatally. The World Health Organisation (WHO) recently published an assessment tool to improve standardisation of collecting infant feeding practices and breast health data in the context of HIV transmission research.[18] This tool was based on the experience of several field studies including the one reported here.

Our prospective longitudinal study was conducted in an area of rural South Africa with an extremely high prevalence of HIV, with the aim of comparing different methods of collecting breast feeding data. We hypothesised that seven day recall of breast feeding practices reliably reflects feeding practices over the preceding week and is as accurate as a series of 48 hour recall histories taken over the same time period.

POPULATION AND METHODS

This was a longitudinal observational study conducted in the rural health district of Hlabisa, situated in northern KwaZulu Natal, South Africa. The resident population of 220 000 people is Zulu speaking and predominantly rural, although there is one township in the southern part of the district. The health infrastructure consists of a community hospital, run by medical staff and nurses, and 13 government clinics run by nurses, who provide primary level health care. The majority of pregnant women deliver their infants at one of the clinics or the district hospital, which was declared Baby-Friendly in 1999.[19] National anonymous antenatal surveillance showed that 36% of women attending antenatal services in rural KwaZulu Natal in the year 2000 were HIV infected.[20]

Three clinics were selected for the study in order to represent the socioeconomic heterogeneity of the area: clinic 1 in the township where most homes have piped water, waterborne sanitation, and where most persons have regular employment; clinic 2 in a rural area accessed by a tar road; and clinic 3 in a deep rural area accessible only by a dirt road. Most women in these rural areas obtain their water from rivers or ponds. Households are supported by incomes from migrant labour, old age pensions, and subsistence farming.

Enrolment into the study was from September 1999 to February 2000. Women attending antenatal clinics were eligible for the study if they were at least 30 weeks gestation, lived in the catchment area of one of the three clinics included in the survey, and did not intend to move out of the area in the four months post-delivery. Consecutive pregnant women were approached and none declined to participate. All women were visited, at home, between two and four days post-delivery, and then at weekly intervals until 16 weeks post-delivery. In addition to the weekly visits, a subset of women received two intermediate visits during the week (that is, a total of three visits per week). These women were randomly selected at delivery using a computer generated random number system which allocated odd or even numbers. All data were collected via structured questionnaires and administered by trained field workers. In this study we used the available standardised WHO definitions (table 1).

Eight female field workers, who had completed high school but had no tertiary education, were recruited from the local area. Selection criteria included communication skills, aptitude to problem solving, ability to assimilate new information, and literacy and numeracy skills. They received three weeks of formal training in interview technique, completion of questionnaires, and feeding definitions, with formal tests to ensure competency.

At the weekly interviews, a 48 hour recall history and then a seven day recall history were obtained from each mother. The subgroup of mothers who received two additional visits per week had additional 48 hour, non-overlapping, recall interviews. Follow up was to 16 weeks post-delivery. Women were asked what they had given their infant to eat/drink over the period of time examined (that is, 48 hours or seven days). Anything other than breast milk was documented using a structured questionnaire with a list of commonly given foods/fluids and space for other items not listed. The field workers probed the mother using the list of commonly given foods/fluids, in case mothers did not realise the importance of mentioning fluids such as water. If nothing else had been given the infant was recorded as being exclusively breast fed. Anything other than breast milk given was documented and the infant was coded as not exclusively breast feeding for that recall period.

One extra visit was carried out when the infant was between 6 and 9 months of age, during which the mothers' recall of duration of EBF from birth was documented. Mothers were asked when (if ever) they first introduced water, when (if ever) they first introduced non-human milk, and when (if ever) they first introduced (semi)-solids to their infant's diet. Whichever was introduced first was taken as the time when exclusive breast feeding was discontinued. The EBF recall histories of twins were considered separately to take into account their possible different feeding patterns.

All mothers were also asked to keep simple diaries in which they marked days of non-EBF. The diaries consisted of a square to represent each weekday. The women made a mark in the appropriate square if they gave anything in addition to breast milk on that day. If the square remained empty it was assumed that the baby had been EBF for that day. Neither the mothers nor field workers looked at the diaries at the time when the structured questionnaires were being completed. The diaries were collected and brought back to the centre weekly, with the questionnaires, and were only looked at by the data capturers.

As a quality control measure, 5% of questionnaires were repeated by a different field worker on the same day as the original interview. Discrepancies were reconciled by a senior member of the study team, with a revisit to the home if necessary. Questionnaires were brought to the centre daily and data entered into an MS Access database; 10% of questionnaires were double entered.

In order to validate the various approaches to assess duration of EBF, we investigated the following key questions:

- *Is 48 hour EBF status (= "current EBF feeding status") representative of the entire preceding feeding history?*

The 48 hour recall EBF status at 2, 4, 6, 8, and 16 weeks was compared with the cumulative EBF history from birth, determined from consecutive seven day recall histories. An infant was removed from the EBF category as soon as something other than breast milk was introduced to the diet.

- *Do maternal recall interviews at 6–9 months post-delivery provide accurate information on EBF duration and what are the determinants of recall accuracy?*

The duration of EBF recalled by mothers, revisited between six and nine months post-delivery, was compared with the cumulative data from birth, obtained from seven day recall at the weekly visits. Mothers were asked at this 6–9 month visit to recall for how long their infant had received EBF. From this, the recalled EBF status when the infant was 2, 4, 6, 8, and 16 weeks was categorised. From the cumulative longitudinal data we knew the week at which the infant was no longer receiving EBF. We allowed a one week range on either side of this time point and compared this with the duration of EBF recalled by the mother at 6–9 months. Multiple logistical regression analyses were carried out to look at determinants of accurate recall of EBF to within one week. We considered the following socioeconomic determinants: maternal education, ownership of fridge, types of water, fuel and sanitation used, and clinic catchment area. Other possible determinants of breast feeding recall accuracy included: parity, gravidity, age, people who

Table 2 Characteristics of mothers and infants participating in a longitudinal breast feeding study in rural KwaZulu Natal

Maternal characteristics (n=130)	
Clinic 1	n=36
Clinic 2	n=55
Clinic 3	n=39
Age at delivery (mean)	26 years (SD 7)
Parity (median)	2.0 (range 1–10)
Education	
Completion of final year of school	30% (n=39)
Completion of some schooling	54% (n=70)
No schooling	10% (n=13)
Unknown	6% (n=8)
Main water supply	
Piped water	48% (n=62)
Well water	15% (n=19)
River water	36% (n=47)
Other	1% (n=2)
Main fuel supply	
Electricity	38% (n=49)
Paraffin	25% (n=33)
Wood	26% (n=34)
Other	11% (n=14)
Toilet facilities	
Flush toilet	11% (n=14)
Pit latrine	74% (n=96)
No toilet facilities	15% (n=20)
Delivery (n=130)	
Home delivery	14% (n=18)
Caesarean section	12% (n=16)
Breast health problems reported during first 48 hours post-partum	31% (n=41)
Breast health problems reported after first 48 hours post-partum	19% (n=25)
Infant characteristics (n=134)	
Infant female	50% (n=67)
Mean birth weight	3.3 kg (SD 0.45)

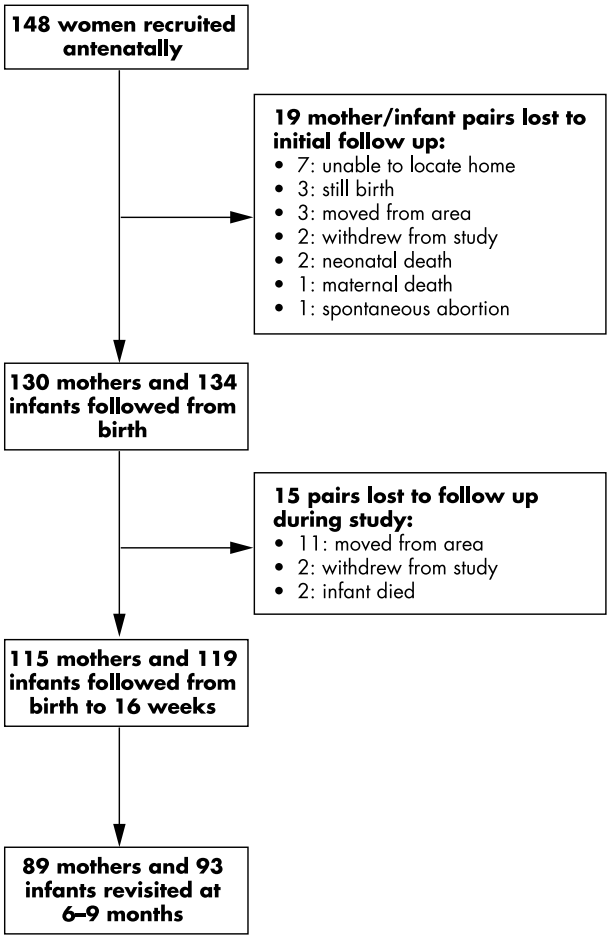

Figure 1 Cohort profile: longitudinal breast feeding study.

influenced feeding practices and helped with breast feeding, history of breast health problems, the infant's sex and birth weight, and the elapsed time since the mother had stopped EBF.

Additional questions investigated were:

- *Is 48 hour EBF recall representative of the previous seven day EBF recall?*

The 48 hour EBF recall data obtained at the weekly visit were compared with the seven day EBF recall data obtained at the same weekly visit from all mothers.

- *Do feeding practices, as recorded in maternal diaries, accurately represent recent breast feeding history?*

The number of women reporting EBF in their diaries over the previous seven days was compared with both the seven day recall data (collected from all mothers) and the thrice weekly recall (collected from the subset of mothers).

- *How accurate is seven day recall compared to a series of 48 hour recalls?*

Seven day EBF recall was compared with 48 hour recall collected thrice weekly (twice from the intermediate visits and once from the weekly visit) from the subset of women. The number of women who said they had EBF over the previous seven days was compared with the number of women who said they had EBF at each of the thrice weekly visits. A woman was only counted to have EBF from the thrice weekly data if she reported EBF on each of the three occasions.

For each validation we computed the sensitivity, specificity, positive predictive value, and negative predictive value of the index method against the corresponding "best comparison". Analyses were performed using the SPSS and STATA statistical packages: SPSS version 8.0 (SPSS Inc., Chicago, IL); STATA version 5.0.

At the time of this study routine HIV counselling and testing were not offered to pregnant women in the district. Ethical approval for the study was obtained from the Ethics Committee of the University of Natal, Durban. Written informed consent was obtained from all women.

RESULTS

One hundred and forty nine women were recruited antenatally (fig 1). Nineteen mother/infant pairs were lost to initial follow up. One hundred and thirty mothers and 134 infants (including four sets of twins) were followed weekly from birth; of these, 119 infants were followed for all 16 weeks of the study. The results of the remaining 15 mother/infant pairs were included in the data analysis for the period they were in the study. Table 2 presents a description of the characteristics of mothers and infants. Seventy mothers and 71 infants also received the two intermediate visits per week. Eighty nine mothers and 93 infants were traced and revisited when the infants were between 6 and 9 months of age. An EBF recall history was obtained on 81 infants; mothers could not recall a feeding history for the other 12 infants.

Breast feeding patterns, which have been reported elsewhere,[21] were similar in all three areas, and the feeding data of the cohort were, therefore, analysed collectively. In summary, all mothers initiated breast feeding (n = 130). Forty six per cent (n = 61) of infants received other fluids or feeds in addition to breast milk in the first 48 hours of life, and were therefore classified as mixed feeders. Most infants had

Table 3 Comparison of methods of determining EBF versus non-EBF; 48 hour recall, diary, and weekly recall compared against a specified "best comparison"

EBF recall	"Best comparison"	No. of records compared	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
48 hour recall ("current EBF status") at:						
2 weeks	Cumulative feeding history since birth	94	100	65	48	100
4 weeks	Cumulative feeding history since birth	89	100	74	47	100
6 weeks	Cumulative feeding history since birth	96	100	77	33	100
8 weeks	Cumulative feeding history since birth	95	100	79	31	100
16 weeks	Cumulative feeding history since birth	88	100	89	47	100
Recall at 6–9 months for EBF status at:						
2 weeks	Cumulative feeding history since birth	81	79	40	52	70
4 weeks	Cumulative feeding history since birth	81	76	46	41	79
6 weeks	Cumulative feeding history since birth	81	86	70	36	96
8 weeks	Cumulative feeding history since birth	81	80	70	26	96
16 weeks	Cumulative feeding history since birth	81	100	82	30	100
48 hour recall*	Weekly recall	1051	100	96	92	100
Diary	Thrice weekly recall†	436	96	88	73	98
Diary	Weekly recall	1199	94	86	74	97
Weekly recall	Thrice weekly recall†	546	96	94	86	98

Sensitivity is the ability of the methods to correctly identify infants who are EBF; specificity is the ability of the methods to correctly identify those who are not EBF.
*Interview carried out at same time as weekly interview on each woman.
†Subsample of women.

dropped out of the EBF category by 2 weeks of age. Only 17% (n = 23) of infants were EBF to 2 weeks, 10% (n = 14) to 6 weeks, and 6% (n = 8) to 16 weeks of age.

Table 3 shows the different methods of recalling EBF status against a "best comparison" in each case. The number of complete records available for each comparison is documented, in addition to the sensitivity, specificity, and positive and negative predictive values. The meaning of sensitivity in this analysis is the ability of the methods to correctly identify infants who are EBF, while the specificity is the ability of the methods to correctly identify those who are not EBF. The data on 48 hour recall at the different time points ("current EBF feeding status") showed low specificities and poor positive predictive values for the entire EBF history. In other words, some infants were classified as EBF from the 48 hour recall, when in fact the entire feeding history indicated that they had received fluids/feeds other than breast milk at some time. More specifically, using our 48 hour assessment method, one would conclude that 31% of infants were EBF at 6 weeks, whereas if cumulative assessments are taken into account this estimate is only 10%. High positive and negative predictive values were obtained when 48 hour recall was compared to weekly recall obtained at the same interview, showing that recall over 48 hours predicted reliably the breast feeding history over the preceding week. High sensitivities and specificities were obtained when weekly histories were validated against thrice weekly recall. In other words, seven day recall accurately identified those infants who had been EBF and those who had not been EBF over the preceding week, when compared to the three 48 hour interviews over the same time period. Diaries also showed high sensitivities and negative predictive values compared to both weekly and thrice weekly interview recall. Diaries accurately recorded infants who were EBF (sensitivity) but were not so reliable at identifying infants who were not EBF (specificity).

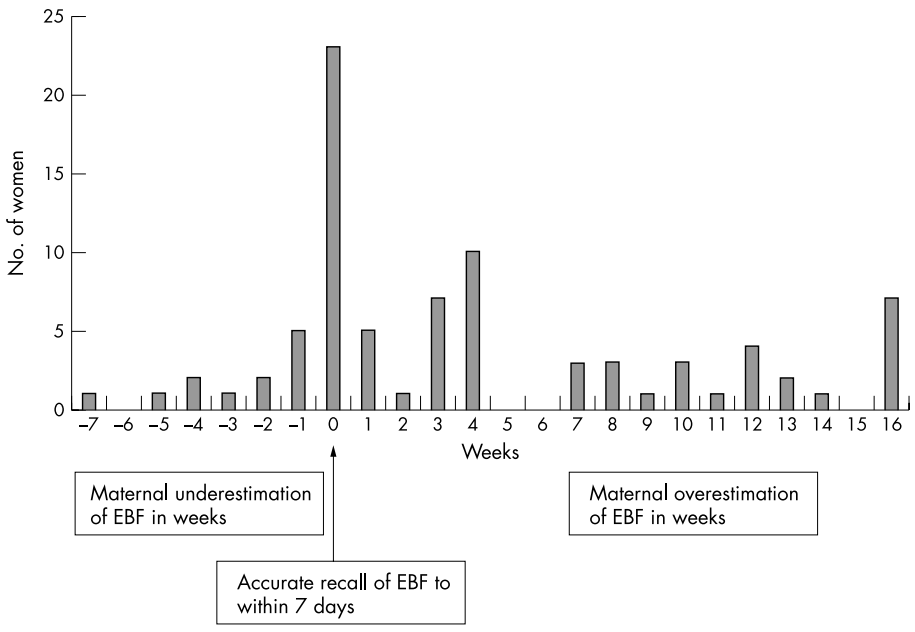

Figure 2 Maternal recall of duration of EBF by mothers interviewed 6–9 months post-delivery compared to the longitudinal data collected at weekly intervals.

Recall at 6–9 months post-delivery was poor, particularly for the early weeks of infant life (table 2). The few mothers who had maintained EBF for the study duration, however, recalled this accurately. Multivariate analyses revealed no other significant determinants of accurate recall of EBF to within one week. Specifically, educational level achieved, economic advantage (indicated by water and fuel supply and ownership of a fridge), and a history of breast health problems did not significantly influence long term recall. Figure 2 shows the difference between the length of EBF, in weeks, recalled by the mother when she was revisited between six and nine months post-delivery and the length of EBF collected from the weekly interviews. The mean age of the infants when the mother was interviewed was 31 weeks (standard deviation 4.8 weeks; range 22–47 weeks). Thirteen per cent (n = 12) of mothers could not remember when they gave something other than breast milk to their infant, so infant breast feeding data are only available for 81 mother-infant pairs. Among those who did remember, 72% (n = 58) inaccurately recalled the length of time, to within one week, that their infants received EBF: 57% (n = 46) overestimated the duration of EBF (mean 7.6 weeks); 15% (n = 12) underestimated the duration of EBF (mean 2.7 weeks).

DISCUSSION

This study compared different recall methods of (duration of) EBF in the same cohort of women in which the WHO definitions of early infant feeding were consistently applied. If an infant ever received a fluid or feed other than breast milk they were immediately removed from the EBF category, and we classified them as mixed feeders from that time. We feel this is crucial when documenting breast feeding patterns in relation to MTCT of HIV. If researchers discount small deviations from EBF (for example, 10 ml of glucose water after delivery) and use their personal judgement to change definitions of feeding patterns as studies continue, then comparisons between studies become difficult and confused. More specifically, studies may underestimate a benefit of EBF if small deviations from EBF do, indeed, increase the risk of HIV transmission and these have not been documented.

"Current status" dietary assessments, most commonly obtained from a 24 hour recall, but in our study from a 48 hour recall, are not intended to capture lifelong feeding histories. In our study 48 hour recall does not accurately reflect EBF history since birth. Clearly, the "current EBF status" showed 100% sensitivity for those mothers who were exclusively breast feeding at the given time points. However, mothers who had exclusively breast fed over the previous 48 hours had not necessarily exclusively breast fed consistently since birth as reflected by the lower specificities (65% at 2 weeks, 74% at 4 weeks, and 77% at 6 weeks of infant age). Studies have reported the phenomenon of infants moving in and out of feeding categories,[4 22] changing from mixed feeding at some time points to EBF at other times. In our study area salaries are paid monthly and it is not unusual for families to run out of money at the end of the month. A mixed fed baby might, therefore, be exclusively breast fed at the end of the month if there is no commercial formula milk left in the household because of inadequate finances. In addition, sick infants are often exclusively breast fed, which would be reflected in the "current EBF status" but does not necessarily reflect the entire breast feeding history. Using these methods in studies examining mother to child transmission of HIV may lead to substantial misclassification of lifelong feeding patterns and confuse and obscure relations between breast feeding patterns and the risk of postnatal transmission of HIV. We therefore recommend that "current EBF status" is inadequate when attributing feeding practices to the acquisition of HIV from birth.

When we interviewed mothers between six and nine months post-delivery, we found that recall of feeding practices from birth to 16 weeks was inaccurate. It has previously been documented that mothers overestimate the duration of breast feeding.[23] In this study we show that mothers also overestimate the duration of exclusive breast feeding. We therefore recommend that studies intending to correlate postnatal transmission and feeding practices need to collect prospective, longitudinal data rather than rely on cross sectional surveys. Cross sectional surveys may be more appropriate for describing population trends rather than individual practice.

When the 48 hour EBF recall was compared with the seven day EBF recall obtained at the same visit for each mother, the recall of EBF practices over the previous 48 hours showed high positive and negative predictive values compared to their recall of events over the preceding seven days (positive predictive value of 92% and negative predictive value of 100%). We conclude that 48 hour recall methods can accurately capture EBF patterns over the preceding week (although some overestimation will still occur) and are suitable for cross sectional surveys of current feeding practices. One of the shortcomings of this study is that we did not look at 24 hour recall to assess "current status" of breast feeding, and cannot, therefore, comment whether 24 hour and 48 hour recall are equivalent.

The seven day recall of EBF practices showed both a high sensitivity and specificity compared to the thrice weekly recordings (sensitivity of 96%; specificity of 94%). Weekly recall reliably reflects the feeding pattern over the preceding seven days.

Mothers found the simple diaries easy to use. The sensitivity was high when compared with both the weekly and thrice weekly recall obtained from the structured interviews. However, it was not 100% sensitive—that is, while some diaries reported EBF, the information from the interviews reported mixed feeding over the same time period. This was most likely a result of diary design. No mark on any day of the diary indicated a week of EBF. Therefore, if a mother forgot to fill in her diary it was assumed, sometimes falsely, that her infant had received EBF for that week. Nevertheless, we suggest that simple diaries, when designed and used appropriately, are a useful adjuvant to data collection exercises in the field and can be used to corroborate data from longitudinal studies based on weekly visits.

In conclusion "current EBF status", based on 48 hour EBF recall, does not accurately represent the feeding pattern since birth, and long term EBF recall tends to overestimate the duration of EBF. We concur with the recent WHO document[18] that feeding data should, ideally, be collected by prospective longitudinal studies in order to assemble a lifetime feeding history. Based on the data from our study we recommend seven day recall methods for prospective studies. However, given the accuracy of the seven day recall period it would be useful, in future studies, to compare this with other methods, for example two weekly recall. We recommend that investigators use the standardised WHO definitions of breast feeding (table 1), and that they adhere strictly to these during the period of research, recording any deviation in terms of frequency and volume of other fluids or feeds given. Studies reporting on MTCT of HIV can then be compared and the crucial issue of whether EBF is safe for infants of HIV infected women can be answered consistently and accurately.

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ARCHIVIST

Passive smoking and children's teeth

The prevalence of dental caries in children in the United States has fallen greatly in the last 50 years probably because of the use of toothpastes and increased fluoride in drinking water. Nevertheless the treatment of paediatric dental caries is still estimated to cost US$4.5 billion in the USA each year. Children living in poverty are at particular risk. Now data from the Third National Health and Nutrition Examination Survey (NHANES III) of 1988–94 (CA Aligne and colleagues. *Journal of the American Medical Association* 2003;**289**:1258–64) have confirmed that passive smoking is a risk factor for dental caries in children.

A total of 3531 children aged 4–11 years had both dental examinations and measurement of serum cotinine concentrations (passive smoking defined as serum cotinine 0.2–10 ng/mL). Over half (53%) of the children had serum cotinine concentrations in this range. Almost half (47%) had caries in primary teeth and over a quarter (26%) had caries in permanent teeth. Dental caries in primary teeth, but not in permanent teeth, was significantly associated with passive smoking. After adjustment for confounding variables such as age, sex, parental income, and parental education, passive smoking was associated with significant increases of 80% in the number of children with decayed (unfilled) primary teeth and 40% in the number of children with fillings in primary teeth. The estimated population attributable risk from passive smoking was 27% for decayed primary teeth and 14% for fillings.

Passive smoking is an important risk factor for caries in primary teeth.