DO EXCLUSIVELY BREAST FED INFANTS NEED FLUID SUPPLEMENTATION ?

H.P.S. Sachdev
J. Krishna
R.K. Puri

Exclusive breast feeding is generally believed to satisfy the caloric and nutrient needs for activity and growth of infants below four months of age. However, there is no consensus on whether exclusive breast feeding adequately maintains hydration of young infants in tropical summer months(1). Water and/or other fluid (tea, camomile or fennel infusion) supplementation is commonly advised by parents, paramedical staff, and even doctors. It is believed(2) that these fluids will relieve pain (*e.g.,* from colic, earache), prevent and treat colds and constipation, soothe fretfulness, and, especially, quench thirst (maintain water homoeostasis). This manuscript briefly outlines the prevalence and the scientific evidence in relation to this practice, especially in the context of the developing world.

A. KAP of Medical Functionaries

Information on this aspect is available from a recent survey(3) conducted on 70 doctors (20 senior residents and 50 junior residents) and 34 nurses in a Delhi hospital. All the respondents to the questionnaire were aware of the superiority of breast milk over bottle feeds. However, 97% of nurses and 63% of doctors ($p<0.0005$) believed that water supplementation was necessary during summer. Of those who advocated water supplementation, 6% of nurses and 23% of doctors suggested it should be given on demand. For those who suggested a specific intake, the median lower and upper suggested volumes were 180 ml and 240 ml for nurses and 95 ml and 145 ml for doctors (ranges 20-1080 ml and 10-3000 ml, respectively). The suggested frequencies ranged from1 to 24 times a day for nurses and 2 to 10 times a day for doctors. The diversity of response is probably a reflection of the lack of clear recommendations or consensus on this subject in standard medical text books, manuals for health workers, and child care books.

B. Prevalence and Amount of Supplementation

Studies of feeding practices in first year of life indicate that 98% of infants born in Africa, 96% of those born in Asia, and 90% of those born in South America are breast fed for some part of this period(2). The period of exclusive breast feeding, however, is usually short. Even in countries where infants are traditionally breast fed over a long period, such as, Indonesia, India, Kenya, Peru, and the Philippines, supplementary fluids are given already in the first few weeks of life. In Peru, although 99% of infants were breast fed in the first month of life, 83% of them received water or teas in addition to breast

From the Division of Clinical Epidemiology, Department of Pediatrics, Maulana Azad Medical College, New Delhi 110 002.

Reprint requests: Dr. H.P.S. Sachdev, Associate Professor, Division of Clinical Epidemiology, Department of Pediatrics, Maulana Azad Medical College, New Delhi 110 002.

milk(2). Similarly, the prevalence of this practice in young infants (<4 months age) in Delhi ranged from 70 to 80% in the hospital and community setting(3,4).

An estimate of the amount of supplementation in breast fed young infants(3) suggests that the water intake ranges from 7 to 16% of total fluid intake (95% confidence interval) with an average of 11%.

C. Need for Supplementation – Theoretical Considerations

The 'prime reason' cited for offering extra fluids in breast fed infants is the need to maintain water homoeostasis, particularly in a hot and dry climate. Theoretical considerations of fluid requirements during the first six months of life, however, indicate that water supplementation is not necessary in this context.

The average daily fluid requirement of a healthy infant ranges from 80-100 ml/kg in the first week of life to 140-160 ml/kg between 3 and 6 months, depending on the concentration of the feeds, energy consumption, activity, rate of growth, and environmental temperature and humidity. Consumption below the required level will lead to dehydration, with increases in serum and urine osmolality(2).

With the low concentration of solute load, namely, sodium, chloride, potassium, and nitrogen in the breast milk, only a relatively small amount of fluid intake is needed for excretion of resulting waste products. Almroth has made the following calculations using a model 4 months old male western infant(1). Based on a body weight of 6.3 kg, an energy intake of 103 kcal/kg, and a caloric concentration of human milk of 75 kcal/100 g, the daily intake of milk was estimated at 865 ml. This was approximately taken to be equal to the amount of water available. Given the average value of 89 ml/kg for evaporative losses and 10 ml/kg for fecal water losses, these would amount to 561 and 63 ml, respectively, thus leaving 241 ml of water for the renal handling of solutes. Given a nitrogen content of human milk of 1.48 mg/ml, the infant would receive 203 mg of nitrogen/kg body weight. At this level of nitrogen intake the urinary excretion of nitrogen is 110 mg/kg and the osmolar load of nitrogen calculated as mmol of urea would be 25 mOsmoles. Given an osmolar concentration of the electrolytes sodium, chloride and potassium of 31 mOsmoles/kg of water, they would add another 27 mOsmoles. Thus the total renal solute load would be 216 mOsm/kg of water. In view of the fact that most infants subjected to lower fluid intake can concentrate urine to over 1000 mOsmoles/kg of water, these calculations indicate that an exclusively breast fed infant in a hot climate, could, in theory manage well without additional water(1). If the above calculations are analyzed in the light of the theoretical background provided by Weil and Bailie(5) it is obvious that Almroth has been generous while estimating fluid losses.

Essentially similar conclusions emerge from calculations based on a model Indian infant weighing 5.5 kg at the age of 4 months(6). A moderately sweating exclusively breast fed infant would excrete urine with an average concentration of 153 mOsm/L and the corresponding figure for a severely sweating child would be 821 mOsm/L; both values being well within the range of maximal urinary concentrating capacity of a 4-month-old child.

D. Clinical Evidence

Six studies have attempted to check the

validity of these calculations employing different methodologies(1,3,7-10). These were conducted in settings with a high environmental temperature and varying degrees of humidity. In 4 reports(1,7,810), urinary specific gravity or osmolality was the only hydration parameter evaluated. The remaining 2 studies(3,9) also considered breast milk intakes and urine output; and in the former(3), a control group receiving water supplementation as per usual practice was also available for comparison. The essential features of these reports are summarized in *Table I.*

Amongst the various hydration parameters evaluated in these studies, change in body weight is the most sensitive. In the only report(3) which evaluated this parameter, there was no difference in weight change in the study (exclusively breast fed infants) and control (water supplemented breast fed infants) groups after adjustment for age, weight, length, room temperature, humidity and fluid intake.

Urine concentration, an important and fairly sensitive indicator of hydration status, was evaluated in all these reports. The immature kidney of a neonate can

TABLE I—*Summary of the Available Trials*

Parameters	Studies					
	Almroth	Armelini	Goldberg	Brown	Almroth	Sachdev
Reference	1	7	8	9	10	3
Year	1978	1979	1983	1986	1990	1991
Place	Jamaica	Argentina	Israel	Peru	India	India
Sample size	16	8	15	40	31	45
Age (mo)	<1-4	<1-2	1-5	<1-6	1-5	1-4
No. of urine samples	48	24	15†	40#	63	23*#
Temperature Celsius	24-28	20-39	32-37	24-30	27-42	34-41
% Relative humidity	62-90	60-80	13-41	45-96	10-60	9-75
Urine osm. (mOsm/L)	103-468!	105-199	55-320	30-544!	66-1234!	99-703
Controls	No	No	No	No	No	Yes*
Milk & urine volume	No	No	No	Yes	No	Yes

† - Modified from References 2 and 6.

@ - Single sample per infant collected between 10h00 and 16h00.

- All urine discharges of the day or study period were analyzed.

! - Urine osmolarity was approximated from the urine specific gravity.

* - A control group receiving water supplementation as per usual practice was also evaluated (n =22). The depicted hydration parameters are only for the study group (exclusively breast fed infants).

achieve a urine concentration of 700 mOsm/L, and healthy infants can attain a concentration of up to 1200 mOsm/L by the age of 3 months(11). Out of more than 213 urine samples that were examined, over 90% had an osmolarity that was well below these levels, indicating a well hydrated state. The urine osmolarity ranged between 700 to 1200 mOsm/L in 12 samples. Only 2 samples had values in excess of 1200 (<1234) mOsm/L; however, these infants were considered to be in adequate water balance(10). These observations support the theoretical calculations; osmolarity values were well within the normal concentrating capacity of the kidney even under extremely hot and dry conditions(2).

Other additional hydration parameters (clinical evidence, urine output, serum osmolarity and rectal temperature) evaluated in some studies, reaffirm the conclusion that waster or fluid supplementation is not required to maintain water homoeostasis in exclusively breast fed infants.

E. Risks Associated with Supplementation

Recent evidence indicates that there are important potential hazards associated with water or fluid supplementation in the exclusively breast fed young infant.

An important risk is the possibility of contracting diarrhea due to frequent contamination of water(10) or other supplements with enteropathogens, particularly in the context of the developing world during summer months. The importance of breast feeding in the prevention of diarrhea is well documented; the protection being the greatest in exclusively breast fed infants(12). Recent research has demonstrated that giving young infants supplementary fluids such as water and/teas in addition to breast milk is associated with a significant increase in the risk of diarrheal disease(2). In a study conducted in a poor urban community in Lima, Peru, the incidence and prevalence rates of diarrhea in infants younger than 6 months were significantly higher among those who received water and teas in addition to breast milk than among those who were exclusively breast fed. The diarrhea prevalence rates doubled with the addition of these supplementary fluids(13). A confounder controlled case control study of infant mortality in Brazil showed that infants who received water, tea, or juice in addition to breast milk were at increased risk of diarrheal death. Each additional feed with these fluids substantially increased the risk of death(14).

The importance of infant sucking-stimulation for the maximum production of milk is well described. A decline in maternal plasma prolactin concentration has also been noted with the introduction of supplementary foods(15). By artificially satisfying the infant's hunger or thirst with fluid supplementation, the mothers could conceivably reduce their milk production or the milk intake of their infants. A recent controlled study(3) in one to four month old infants, documented a significantly lower breast milk intake in water supplemented infants after adjustment for age, weight, length, room temperature, and humidity (274 *vs* 210 ml; mean difference 64 ml and 95% confidence interval of adjusted difference 27-102 ml). In the setting of a developing country, the caloric loss associated with decreased breast milk intake could prove an important nutritional handicap.

Young infants who receive supplemental fluids are more likely to be breast fed for shorter periods than if they are exclu-

sively breast fed. In Brazil, infants who were offered water or teas in addition to breast milk in the first days of life were twice as likely to stop breast feeding before the age of 3 months as those who were exclusively breast fed(16).

F. Conclusions

Supplementation in the form of water and teas in early infancy is a common practice. It is associated with important risks including increased chances of diarrheal morbidity and mortality, decreased milk intake and premature termination of breast feeding. Theoretical and clinical evidence indicates that exclusively breast fed healthy infants do not need supplemental fluids to maintain water homoeostasis. Their use should, therefore, be actively discouraged, and *exclusive* breast feeding should be promoted as the ideal feeding practice during the first 4 to 6 months of life. There is an urgent need for proper education of the general public and of paramedical and medical personnel on this subject.

REFERENCES

1. Almroth SG. Water requirements of breast fed infants in a hot climate. Am J Clin Nutr 1978, 31: 1154-1157.
2. World Health Organization. Programme for Control of Diarrheal Diseases—Update. Breast Feeding and the Use of Water and Teas, 1991, 9: pp 1-4.
3. Sachdev HPS, Krishna J, Puri RK, Satyanarayana L, Kumar S. Water supplementation in exclusively breast fed infants during summer in the tropics. Lancet 1991, 1: 929-933.
4. Sachdev HPS. Prevalence of water supplementation in young infants (Unpublished observations).
5. Weil WB, Bailie MD. Fluid and Electrolyte Metabolism in Infants and Children: A Unified Approach. New York, Grune and Stratton, 1977, pp 38-48.
6. Krishna J. Comparison of hydration status of breast fed infants with and without water supplementation in a warm climate. Thesis submitted to the University of Delhi for M.D. (Pediatrics), 1990.
7. Armelini PA, Gonzalez CF. Breast feeding and fluid intake in a hot climate. Clin Pediatr 1979, 18: 425-426.
8. Goldberg NM, Adams E. Supplementary water for breast fed babies in a hot and dry climate – not really a necessity. Arch Dis Child 183, 58: 73-74.
9. Brown KH, de Kanashiro HC, del Aguila R, Guillermo LR, Black RE. Milk consumption and hydration status of exclusively breast fed infants in a warm climate. J Pediatr 1986, 108: 677-680.
10. Almroth S, Bidinger PD. No need for water supplementation for exclusively breast fed infants under hot and arid conditions. Trans R Soc Trop Med Hyg 1990, 84: 602-604.
11. Guignard JP. Neonatal nephrology. *In:* Pediatric nephrology, 2nd edn. Eds Holliday MA, Barrat TM, Vernier RL. Los Angeles, Williams and Wilkins, 1987, pp 921-944.
12. Feachem RG, Koblinsky MA. Interventions for the control of diarrheal diseases among young children. Bull WHO 1984, 62: 467-476.
13. Brown KH, Black RE, de Romana GL, de Kanashiro HC. Infant feeding practices and their relationship with diarrheal and other diseases in Huascar (Lima), Peru. Pediatrics 1989, 83: 31-40.
14. Victora CG, Smith PG, Vaughan JP, *et al.* Infant feeding and deaths due to diarrhea–A case control study. Am J Epidemiol 1989, 129: 1032-1041.

15. Howie PW, Mc Neilly AS, Houston MJ, Cook A, Boyle H. Effect of supplementary food on suckling patterns and ovarian activation during lactation. Br Med J 1981, 283: 757-759.

16. Martines JC, Ashworth A, Kirkwood B. Breast feeding among the urban poor in Southern Brazil: Reasons for termination in the first six months of life. Bull WHO 1989, 67: 151-161.