

Vitamin A in breast milk

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Introduction

Vitamin A deficiency is a major public health problem in developing countries, outnumbering all other causes of blindness in children¹. It is estimated that 7% of all children under the age of five years are vitamin A deficient², and countless other children are vitamin A depleted, a condition associated with decreased resistance to infectious diseases and increased mortality^{3,4}.

The vitamin A status of most new-born infants is marginal, and those who are born early and/or whose mothers have inadequate vitamin A intakes appear to be at particular risk^{5,6}. Although the vitamin A concentration in human milk is dependent on the mother's vitamin A status, even in regions where vitamin A deficiency is endemic, breastfed infants are less likely to develop vitamin A deficiency than infants who are not breastfed^{7,10}. The protective effect appears to continue after breast feeding is discontinued, presumably because some of the vitamin A provided by human milk is stored in the infant's liver¹¹.

To facilitate the integration of breast feeding promotion activities with vitamin A deficiency prevention programs, the world literature on vitamin A and breastfeeding during the last 40 years was reviewed^{12,13}. The vitamin A status of lactating women, the effect of maternal vitamin A status on the vitamin A content of human milk, and the adequacy of breast milk as a source of vitamin A are summarised. The impact of maternal vitamin A supplementation on the vitamin A content of human milk, and on the health of breast feeding women and their infants are also summarised^{12,13}.

Method and finding

Assuming nutritional deprivation to be more likely in countries with higher child mortality levels, data from countries with under 5 child mortality levels of 21 or greater (developing) are compared to that from countries with under 5 child mortality levels of 20 or less (developed). All reports of vitamin A activity were translated into retinol equivalents (RE) to allow comparison among studies. Reported values for vitamin A in human milk were divided by the time after delivery during which the samples were obtained (1-6, 7-13, or 14-21 days; 1-2, 3-4, 5-6, 7-12, 13-24, or more than 24 months). The studies were further divided by whether the birth was term or preterm (defined as less than 37 weeks gestations).

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The average daily dietary intake of vitamin A by unsupplemented lactating women in developing countries (660 RE/day) is less than half that of women in developed countries (1540 RE/day). This is lower than the 850 RE/day recommended safe level for lactating women, but well above the basal requirements of 450 RE/day suggested by the Food and Agriculture Organisation (FAO) and the World Health Organisation (WHO). The average serum levels of retinol and retinol-binding protein (RBP) in unsupplemented lactating women from developing countries are approximately 70% of the levels in unsupplemented lactating women in developed countries. The lower serum levels of retinol and retinol-binding protein may reflect chronic poor dietary intake in developing countries¹⁴. Despite these large differences, both average serum retinol and RBP levels in developing and developed countries are in the range considered adequate.

There are considerable differences in the vitamin A activity (retinol plus beta-carotene) of the milk of unsupplemented mothers in developed countries and developing countries. During the first six months of lactation, the retinol content of mature milk from mothers delivering at term average 660 RE/liter in developed countries and 330 RE/liter in developing countries^{12,13}.

Because human milk changes to meet the changing needs of the growing infant, colostrum and transitional milk are particularly rich in vitamin A to complement the low liver

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Table 1. Retinol and carotene in term milk of unsupplemented mothers in developed countries according to time after delivery						
Time after delivery	Average daily intake of vitamin A by breastfed infants (RE / liter)			Weighted average daily breast milk intake (liter/day) [b]	Vitamin A concentration (RE/liter) [a]	
	Retinol	Carotene	Retinol and carotene		Retinol (RE/day)	Retinol plus carotene (RE/day)
1-6 days	1524 [161]*	130 [170]	1654	.43 [47]	655	711
7-21 days	1023 [117]	25 [64]	1048	.61 [60]	624	639
1-2 months	683 [284]	33 [82]	716	.71 [59]	485	508
3-4 months	640 [242]	54 [34]	694	.72 [22]	461	500
5-6 months	745 [151]	35 [12]	780	.81 [34]	603	632
7-12 months [c]	NA	NA	NA	.63 [74]	NA	NA

[a] Weighted averages are based on values in Newman (1993) Reference 12. Total number of samples for each average is in square brackets.
[b] Total number of samples for each time period is in square brackets.
[c] There was no information on the vitamin A content of human milk from developed countries after six months postpartum.
NA = not available.

Table 2. Retinol and carotene in term milk of unsupplemented mothers in developing countries according to time after delivery						
Time after delivery	Vitamin A concentration (RE/liter) [a]			Weighted average daily breast milk intake (liter/day) [b]	Average daily intake of vitamin A by breastfed infants	
	Retinol	Carotene	Retinol and carotene		Retinol (RE/day)	Retinol plus carotene (RE/day)
1-6 days	1193 [129]	50 [129]	1243	.43 [47]	513	534
7-21 days	866 [182]	NA	866	.61 [60]	528	528
1-2 months	495 [347]	46 [17]	541	.71 [59]	351	384
3-4 months	480 [328]	41 [19]	521	.72 [22]	346	375
5-6 months	459 [221]	43 [25]	502	.81 [34]	372	407
7-12 months	347 [254]	35 [20]	382	.63 [74]	219	241
13-24 months	278 [237]	31 [22]	309	.52	144	161
> 24 months	130 [45]	NA	130	.30	39	39

[a] Weighted averages are based on values in Newman (1993) Reference 12. Total number of samples for each average is in square brackets.
[b] Total number of samples for each time period is in square brackets.
NA = not available.

reserves of new-born infants^{12,13}. The vitamin A concentration in breast milk during the first two weeks of lactation is nearly double that at one month (see Tables 1 and 2)¹²⁻¹⁷. Preterm milk is even higher in vitamin A concentration than term milk during the first several months, which is significant considering the particularly low vitamin A liver reserves of most preterm infants (see Table 3)^{14,18-20}.

Discussion

The FAO and WHO recommended a minimum of 180 RE/day for infants to meet basal needs. To allow normal liver storage of vitamin A, however, 350 to 375 RE/day is preferable throughout the first year of life, and 400 RE/day during the second and third year of life. Thus, under

Table 3. Retinol and carotene in preterm milk of unsupplemented mothers in developed countries according to time after delivery [a]						
Time after delivery	Vitamin A concentration (RE/liter) [b]			Weighted average daily breast milk intake (liter/day)	Average daily intake of vitamin A by breastfed infants	
	Retinol	Carotene	Retinol and carotene		Retinol (RE/day)	Retinol plus carotene (RE/day)
1-6 days	1671 [44]	188 [44]	1859	.11 [c]	184	204
7-13 days	1707 [37]	89 [8]	1796	.29d	495	521
14-21 days	1355 [70]	65 [28]	1420	.38d [39]	515	540
1-2 months	1215 [140]	41 [40]	1256	.42[d] [52]	510	528
> 3 months	NA	NA	NA	NA	NA	NA

[a] There were no published studies reporting the vitamin A content of preterm milk from developing countries.
 [b] Weighted averages are based on values in Newman (1993) Reference 12. Total number of samples for each average is in square brackets.
 [c] Averaged intake recommended for 1501-1800 gm infant for days 1-6.
 [d] For explanation, see Newman (1993) Reference 12.
 NA = not available.

conditions of relatively good maternal health and nutritional status in developed countries, mature human milk alone provides considerably more vitamin A than necessary to allow liver storage for at least the first six months of life, and probably for at least the first year; however, due to the lack of data on the vitamin A content of human milk in developed countries after six months postpartum, this cannot be known with certainty.

Even in presumably more poorly-nourished populations in developing countries, human milk alone provides sufficient vitamin A activity (retinol plus carotene) to prevent clinical deficiency throughout the first 12 months of life. However, the average amount of vitamin A in human milk in developing countries is not sufficient to allow liver storage after about six months of lactation, even when both retinol and carotene are counted. Some low-income populations may provide insufficient vitamin A to the infant in breast milk earlier than that time, and other populations later. Breast milk continues to be one of the most important sources of vitamin A in the infant's diet in developing countries throughout the second year, supplying a daily average of approximately 140 RE of retinol or 160 RE of retinol plus carotene from 13 through 24 months.

Despite the relatively lower levels of vitamin A in the milk of mothers from developing countries, breast milk is still the major source of vitamin A in diets of their infants and young children. Thus, it is important to improve maternal vitamin

A status in order to increase the vitamin A content of their milk. Lactating women suspected of having low vitamin A stores and/or those unable or unwilling to increase their dietary intake of vitamin A would be expected to benefit from vitamin A supplementation. Since the concentration of vitamin A in human milk is dependent on maternal vitamin A status, their infants would also be expected to benefit and potential toxicity from high-dose supplements given directly to the infant could be avoided.

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Conclusion

Improving the vitamin A status of lactating women, promoting the use of colostrum, encouraging exclusive breast feeding for four to six months of life, and the addition of appropriate vitamin A-rich weaning foods after that time while breast feeding continues, are important strategies for improving the vitamin A status of infants and young children. Because of the precarious vitamin A status of preterm and small-for-gestational-age infants, their mothers should receive particular support to enable them to provide their own milk to their infants. Breastfeeding throughout the

infant's first two years of life, with the addition of vitamin A rich foods to the infant's diet by six months of life, is particularly important in developing countries where vitamin A deficiency is a recognised public health problem. Health care workers, traditional birth attendants, community leaders, and the public need to be educated about this, so that breast feeding will be promoted.

“ ... the average amount of vitamin A in human milk in developing countries is not sufficient to allow liver storage after about six months of lactation... ”

References

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“ Some national medical officers of preventative health services in the Pacific have only managed to prevent appropriate health development ”

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