NUTRITION RESEARCH, Vol. 4, pp. 923-927, 1984
0271-5317/84 $3.00 + .00 Printed in the USA.

RECOMMENDED ZINC INTAKE FOR THE FIRST SIX MONTHS OF LIFE

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ABSTRACT

This paper suggests that recommended zinc intake for the 0-6 months age group is grossly overestimated and impossible to achieve by wholly breast-fed infants. This discrepancy may be explained by the high zinc concentrations in human milk considered by the National Research Council to establish the present RDA. An alternative approach based on absorbed amounts of zinc required is proposed. This method appears to be closer to the real needs of young infants; thus, for the first three months, 0.64 mg/day and for the second three months, 0.90 mg/day would be required to meet the proposed absorbed zinc needs.

KEY WORDS: Zinc, Nutrient Requirements, Infants.

INTRODUCTION

Zinc is known to be essential in human and animal nutrition and is a component of several enzymes involved in important steps of nucleic acid and protein synthesis (1,2). Rapidly growing young infants are more vulnerable to zinc deficiency since growth is associated with high rates of nucleic acids and protein turnover. Knowledge of how to set the Recommended Dietary Allowances (RDA) for this age group becomes of critical importance, especially in the evaluation of dietary data and in the formulation of infant foods.

The value suggested by the National Research Council in 1980 considered human milk as the reference standard. NRC considered a zinc concentration in human milk ranging from 2 to 5 mg/l, resulting in a daily supply of 2 mg or more per day of zinc with a high availability. In consequence, the recommendation was set at 3 mg/day (3).

However, further studies on the chemical composition of mature human milk show values much lower than those considered by NRC. Table 1 presents values taken from different countries at various stages of lactation (4-9). During the first 3 months, values range from 1.1 to 2.65 mg/l with a mean average of 1.92 mg/l. In the second 3 months, values are significantly lower, ranging from 0.49 to 0.95 mg/l with a mean average of 0.78 mg/l. In contrast, values higher than 3 mg/l are commonly seen in colostrum or during the first three weeks of lactation, but not later (6).

Data on milk output in well-nourished populations show wide variations. Values reported in the literature and compiled by Jelliffe in an extensive review, give a mean average of 638, 685 and 719 mg/day in the first, second and third months, respectively, in Swedish and American women (10). If these volumes and the zinc content by stage of lactation are used to calculate daily zinc supply, values range from 1.10 to 1.56 mg/day (mean, 1.3 mg/day). If the classical 850 ml/day of milk production is used instead, the result is 1.6 mg/day and not "2 mg or more". This discrepancy is much more evident for the second 3 months, in which daily supply is only 0.6 mg/day (considering 771 ml/day of milk output) or 0.66 mg/day (considering 850 ml/day).

TABLE 1
Zinc Content in Human Milk (mg/l)
at Various Stages of Lactation in Different Countries

Stage of Lactation	USA (4)	Chile (5)	Finland (6)	USA (7)	USA (8)	Finland (9)	Mean Zinc mg/l	Mean Daily Milk Volume* (ml)	Total Zinc Supply mg/day
4	2.2	2.65	2.5				2.45	638	1.56
8	2.2	1.66	1.3	2.04	1.63	1.89	1.79	685	1.23
12	1.9	1.60	1.1				1.53	719	1.10
14-16			0.95						
20-22			0.75				0.78	771	0.60
23-25			0.49	0.93					

* Derived from data compiled by Jelliffe (10).

This analysis suggests that the zinc content of human milk used by NRC to establish the recommendation was too high and consequently, the RDA may overestimate zinc needs.

While some observations indicate that the RDA might overestimate needs, others suggest the inverse. Hambidge reported that six-month old babies fed a cow milk formula containing 5.8 mg/l of zinc (which meets or exceeds the RDA of 3 mg/day) had lower serum zinc levels than the breast-fed group (11). Perhaps the source of these discrepancies is the use of a single RDA value for the first 6 months of life, a period when many important physiological changes occur. It seems more reasonable to consider a value for the first and another for the second 3 months. In addition, the evaluation of zinc adequacy should consider the amount absorbed in order to correct intake for the differences in zinc bioavailability. This is the criterion proposed by the WHO Expert Committee in its report (12); they recommend for the 0-4 month period, an absorbed zinc of 1.25 mg/day be obtained using a factorial approach. This value, however, seems to be too high, since if we perform a similar analysis as done in relation to the NRC/RDA, we conclude that human milk cannot reach the absorbed zinc value suggested by WHO. This recommendation could be met only if zinc absorption is 96% or greater, considering the 1.3 mg/day supplied by breast milk during the first 3 months.

Solomons, in a recent review (and apparently based on values reported by the Expert Panel of the American Medical Association on trace element preparations for parenteral use) indicates the amounts of parenteral zinc required to maintain normal balance in healthy individuals. For full-term infants during the first year of life, the quantity suggested is 100 μg/Kg

BW/day (13,14). It is not clear, however, if this value was obtained considering zinc sweat losses, which have been suggested to make an important contribution to the requirement (12). Nevertheless, Jacob and co-workers studying sweat zinc lost by adults living in a comfortable environment (measured through total body sweat collection), indicate that the zinc lost in this way represents 3.9% of the dietary intake. Similar results were reported by Harrison et al, who found that sweat zinc loss represents only 2% of the total zinc intake in preadolescents (15, 16). Therefore, if the 100 μg/Kg figure does not consider the sweat zinc lost, the error introduced is probably minimal.

As an attempt to provide a more realistic approach to setting zinc recommendations for the first semester, the following methodology is proposed:

Considering an absorbed zinc need of 100 μg/Kg and using the 50th percentile of WHO growth charts (17), it is possible to calculate the total amount required (Table 2). Thus, a tentative recommendation would be 0.64 mg/day for the first 3 months and 0.90 mg/day for the second 3 months, respectively, as absorbed zinc.

TABLE 2
Total Recommended Daily Absorbed Zinc Allowances During the First Six Months of Life (mg/day)

Month	Girls Requirement*	Girls RDAA**	Boys Requirement*	Boys RDAA**	Both Sexes RDAA**
1	0.40		0.43		
2	0.47	0.61	0.52	0.67	0.64
3	0.54		0.60		
4	0.60		0.67		
5	0.67	0.86	0.73	0.94	0.90
6	0.72		0.78		

* Based on mean weight for given age x 100 μg/Kg/day absorbed zinc need.
** RDAA = Recommended daily absorbed allowances for zinc based on mean requirement plus 30% (assuming a 15% coefficient variation in requirement).

Zinc in human milk is absorbed at rates from 41 to 59% in studies in humans and animals (18, 19). If these values are applied to zinc supply data during the first 3 months to check if they meet the proposed theoretical recommendation, we observe that 1.3 mg of zinc supplied daily represents 83 to 120% of this RDAA. This lends support to the above mentioned recommendation. During the second 3 months, this approach leads to less conclusive results. A daily intake of 0.6 mg/day appears to be clearly inadequate. However, Hambidge has found in breast-fed infants aged 6 months, serum and hair levels similar to those of young adults, suggesting an adequate zinc intake derived from human milk (11).

In summary, this paper indicates that traditionally considered zinc content values in human milk are too high, and that recommendations for zinc intake during the first 6 months are also overestimated. The present intake recommendations for zinc are impossible to achieve by exclusively breast-fed infants during the first 6 months of life. Therefore, it is necessary to re-evaluate the criteria and considerations used in their formulations. A more realistic approach is proposed which recommends amounts to be absorbed rather than ingested. In consequence, more information on bioavailability of zinc in different infant foods is badly needed.

ACKNOWLEDGEMENTS

The author would like to thank Dr. Ricardo Uauy for reviewing the manuscript, and Mrs. Ximena Pino for secretarial help.

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Accepted for publication July 16, 1984