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Research Article

PREVALENCE OF VITAMIN A DEFICIENCY DISORDER AMONG CHILDREN AGED 1-5 YEARS

Savita Kumari

*Lecturer, Faculty of Physiotherapy and Diagnostic, and Department of Medical

Laboratory Technology, Jyoti Vidhyapeeth Women's University, Jaipur

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ABSTRACT

Randomized controlled trial data of vitamin A interventions and survival were used to estimate the risk of mortality associated with vitamin A deficiency. The published relative risks were adjusted for the estimated prevalence of deficiency at study baseline. Summary relative risks were calculated from meta-analyses (for measles, diarrhoea, and other infectious disease causes of child mortality) or from single studies (malaria mortality among children and all-cause maternal mortality). The estimated relative risks associated with vitamin A deficiency in children were 1.86 (95% CI 1.32–2.59) for measles mortality, 2.15 (95% CI 1.83–2.58) for diarrhoea mortality, 1.78 (95% CI 1.43–2.19) for malaria mortality, 1.13 (95% CI 1.01–1.32) for other infectious disease mortality and 4.51 (95% CI 2.91–6.94) for all-cause maternal mortality.

Vitamin A deficiency is a common form of micronutrient malnutrition affecting 21.1% of preschool-age children and 5.6% of pregnant women worldwide. The available evidence suggests that nearly 800000 deaths worldwide can be attributed to vitamin A deficiency among women and children.

Key words: Vitamin A, UNICEF, Serum, Retinol.

1. INTRODUCTION:

A deficiency and to calculate the associated burden of disease for different regions of the world. Vitamin A is an essential nutrient required for maintaining immune function, eye health, vision, growth and survival in human beings. Over the years, numerous studies have been conducted to identify the biological functions of vitamin A, the health consequences associated with deficiency, and the mechanisms that explain these relationships.

According to World Bank estimates, vitamin A supplementation for preschool-age children is one of the most cost-effective child survival interventions (World Bank 1993). National level public health programmes to prevent and treat vitamin A deficiency are currently being implemented in countries in Asia, Africa and elsewhere. International donors and agencies including the Canadian International Development Agency (CIDA), United Nations Children's Fund (UNICEF), the United States Agency for International Development (USAID), the World Health Organization (WHO) and others have actively supported both national and global level initiatives to raise awareness about the problem of vitamin A deficiency and to promote efforts to implement effective and affordable solutions (Mason et al. 2001).

2. VITAMIN A DEFICIENCY:

In more recent years, various vitamin and mineral deficiencies, including vitamin A, iron, iodine and zinc have been recognized as discrete types of malnutrition that adversely affect human health and contribute to disease and mortality. Some of these nutrients affect closely related biological systems; for example both vitamin A and zinc play important roles in maintaining different aspects of immune function (Shankar 2001) and both vitamin A and iron affect haemoglobin metabolism (Semba and Bloem 2002). Ecological-level studies have demonstrated that the prevalence of these micronutrient deficiencies are high in many of the same countries, thus many individuals may suffer from multiple micronutrient deficiencies at the same time. However, relatively few data are

*Corresponding author: Savita Kumari

currently available for quantifying either the joint distribution of multiple deficiencies or the impact that multiple micronutrient deficiencies have on specific health outcomes.[1]

vitamin A deficiency is far more common, but the assessment of vitamin A deficiency that does not result in relatively easily observable eye signs is also more problematic. One way to identify milder forms of vitamin A deficiency is to collect blood samples and measure the concentration of circulating serum retinol in an individual.[2]

3. DEFINITIONS FOR CHILDREN (1–5 YEARS)

Globally, the most reliable population-based survey data provide estimates of vitamin A deficiency among children aged <5 years, primarily because this is the most well-established high-risk age group for this nutritional risk factor. In the CRA project prevalence estimates have been developed only for the 1–5-year age group, although there is some evidence that slightly older children also suffer from vitamin A deficiencyand its adverse health consequences.[3]prevalence data for vitamin A deficiency among preschool-age children,a definition of vitamin A deficiency related to low serum retinol concentrationsamong children in the 1–5-year age range emerged as themost appropriate choice for use in the CRA project:

- Vitamin A deficient: serum retinol concentration <0.70mmol/l.
- Vitamin A sufficient: serum retinol concentration ≥0.70mmol/l.

4. PREVALENCE ESTIMATES FOR CHILDREN

The 1995 WHO report Global prevalence of vitamin A deficiency included prevalence estimates of vitamin A deficiency among preschoolage children for two classes of indicators: (i) clinical eye signs of disease (xerophthalmia); and (ii) low serum retinol concentrations. However, data were reported only for the individual countries that met the definiAmy L. Rice et al. 215 tion of a significant public health problem, which was defined as a population prevalence of low serum retinol (1%, of Bitot's spots (X1B) >0.5%, of corneal xerosis and/or ulceration (X2, X3A, X3B) >0.01%, or of xerophthalmiarelated corneal scars (XS) >0.05% (WHO 1995).[4]

5. MATERIALS & METHOD:

5.1 Methods for identifying relevant studies and review materials:

The following sources were initially consulted to identify relevant materials for this chapter: Medline database; published books about vitamin A, international health, and nutrition; International Vitamin A Consultative Group (IVACG) statements; meeting reports; abstracts and conference proceedings; and other non-peer reviewed literature sources related to vitamin A programme implementation and cost-effectiveness analyses. The Medline database was searched for literature published between 1966 and 2017 in English or with an English language abstract.[5] Combinations of the following keywords were used: vitamin A, vitamin A deficiency, blindness, mortality, acute respiratory infection, pneumonia, diarrhoea, measles, malaria, stillbirth, fetal loss, miscarriage, low birth weight, women. Abstracts of articles concerning the relationship between vitamin A deficiency in humans, intervention trials, and the health outcomes of interest were reviewed and copies of relevant articles were obtained.[6] Additional publications and reference materials were identified from the citation lists in those sources and through discussions with investigators working in the field.[7]

5.2 Inclusion criteria for individual studies:

The individual studies and reports presented in this chapter were restricted to the results of controlled intervention trials because these findings provide strong evidence for a causal relationship and the data 220 Comparative Quantification of Health Risks can be used to quantify the risk associated with either documented or suspected vitamin A deficiency (Rothman and Greenland 1998).

5.3Estimating risk factor levels:

The prevalence of vitamin A deficiency (defined as serum retinol concentrations<0.70mmol/l) among children aged 1–5 years and pregnant was estimated for each of the 14 subregions. This process involved several steps.[8]

5.3 Data sources:

A wide variety of data sources related to vitamin A deficiency were reviewed in order to obtain the

most current information possible. These included: (i) the 2015 comprehensive survey report compiled by the WHO Micronutrient Deficiency Information System (MDIS) (WHO 2015); (ii) a 2017 update from the MDIS group at WHO that included national survey data published after 1995.[9]

5.4 Indicators:

The 2015 West report presents prevalence data for xerophthalmia rates and serum retinol concentrations <0.70mmol/l among children and fornight blindness rates. In preschool-age children the prevalence of serum retinol concentrations <0.70mmol/l was directly estimated from survey data wheneverpossible. When such data were unavailable, the prevalence was assigneda value equivalent to the population prevalence of abnormal CIC results.Survey data referring to children in a narrower age than 1–5 years orsurveys that included data that extended slightly beyond the fifth yearof life were used as the prevalence estimate for children aged 1–5 years.[10]

5.5 Data Extrapolation:

Separate algorithms were developed for the different subregions of the world to estimate the country-specific prevalence estimates for serum retinol concentrations <0.70mmol/l among children.[11] Prevalence estimates among preschool-age children were also adjusted downwards in countries where the survey data preceded coverage reports from recent vitamin A supplementation programmes that reported coverage rates >75%[12,13].

6. RESULT AND DISCUSSION:

The subregional and global prevalence rates of serum retinol concentrations <0.70mmol/l among children aged 1–5 years are shown in Table 1 The prevalence estimates from the smaller number of countries that contributed to the 2017 West report are compared to the global estimates generated for the CRA project.[14,15] The results indicate that globally, approximately 21% of all children have serum retinol concentrations <0.70mmol/l. The highest prevalence rates and the largest number of affected children live in the South-East Asian and African Regions. The estimated number of affected children is similar to what was reported by the Micronutrient Initiative, UNICEF.[16]

Table 1: Distribution of 191 WHO Member States by population group for which the prevalence of serum retinol concentrations <0.70 mmol/l was estimated by subregion and type of data used to generate subregional prevalence estimates

Subregion	Total	National level data	Sub-national level data	Imputed prevalence estimates >0	No available survey data, assigned 0% prevalence estimate
AFR-D	26	5	7	14	0
AFR-E	20	10	7	3	0
AMR-A	3	0	0	0	3
AMR-B	26	9	2	0	15
AMR-D	6	4	1	1	0
EMR-B	13	1	1	0	11
EMR-D	9	2	3	4	0
EUR-A	26	0	0	0	26
EUR-B	16	1	0	0	15
EUR-C	9	0	0	0	9
SEAR-B	3	2	1	0	0
SEAR-D	7	3	0	3	1
WPR-A	5	0	0	0	5
WPR-B	22	5	2	9	6
World	191	42	24	34	91

6.1 Risk factor:

For the purpose of the CRA project, relative risk estimates for child and maternal health outcomes used vitamin A intervention trial data as the starting point. However, the relative risk estimates were adjusted to take into account the fact that many, but not all, of the study partici-pants had low serum retinol concentrations at the beginning of the inter-vention trials.[17] The following section describes how the adjustment process was conducted. The same process was applied to data for both the child and maternal health outcomes.

The adjusted relative risks were calculated using a four-step process.

1. A quantitative estimate of the protective effect that a vitamin A inter-vention had in preventing an adverse health outcome was found in the published literature.

2. The prevalence of serum retinol concentrations <0.70 mmol/l was esti-mated among the study population at baseline.[18]

3. An adjusted relative risk was calculated by constructing a hypotheti-cal population of 100000 individuals and dividing them into two strata using a serum retinol concentration cut-off of <0.70 mmol/l and the prevalence estimate obtained in the second step. The relative risk of an adverse outcome was then calculated for both strata separately by setting the background incidence rate of the adverse outcome to be equivalent among the following groups: (i) the vitamin A inter-vention group in the entire study population; (ii) the vitamin A intervention and control groups in the strata with serum retinol concentrations ≥0.70 mmol/l;[19] and (iii) the vitamin A intervention group in the stratum with serum retinol concentrations <0.70 mmol/l. The rel-ative risk for children in the stratum with serum retinol concentra-tions ≥0.70 mmol/l represents the effect of the vitamin A intervention among children who were not deficient before the trial began.[20] In this stratum the relative risk is 1.0 because those children were not expected to benefit (in terms of reducing all-cause mortality) from the intervention. The relative risk for children in the other stratum is lower than the overall trial estimate (representing a greater protective effect) because those children were deficient when the trial began and all of the observed benefit (in terms of reducing all-cause mortality) associated with the vitamin A intervention was presumably observed among this subgroup of children.[21,22]

7. SUMMARY & DISCUSSION:

Expected Changes In The Prevalence of Vitamin A Deficiency: Based on the trends observed over the past 20 years, and more specifi-cally on changes over the past 5–10 years, there is reason for optimism and the expectation that the global prevalence of vitamin A deficiency (defined as serum retinol concentrations <0.70 mmol/l) will decrease in the years leading up to 2030.Numerous factors contribute to the current situation. In recent years a favourable global policy environment has been created and global part-nerships have emerged to help guide activities aimed at the control and prevention of vitamin A deficiency. Various groups have contributed to the positive policy environment including IVACG, international organi-zations, bilateral agencies and individual country governments around the world.

Although these groups initially focused their attention almost exclu-sively on the more obvious problem of vitamin A deficiency among children, the situation is now changing. Policy-makers and programme managers are increasingly expanding their efforts in recognition of the fact that vitamin A deficiency is also prevalent among women of repro-ductive age and has potentially severe health consequences for them as well.

Many countries have already initiated national supplementation pro-grammes for children (most commonly using community-based health services as a routine delivery channel or special vitamin A distribution initiatives combined with national immunization days or child health days or weeks) in an effort to prevent severe vitamin A deficiency among this age group. Although child-based supplementation programmes do not necessarily directly address the problem of vitamin A deficiency among women, other more general approaches may, if the accompany-ing health messages are modified to specifically encourage women as participants and programme beneficiaries. These include widespread food fortification initiatives, efforts to improve the availability of vitamin A rich foods through agricultural programmes, nutrition education pro-grammes, etc.

8. CONCLUSION:

Vitamin A deficiency remains a major public health problem among preschool-age children throughout the world. Globally, 21%, or over 127 million children aged <5 years are vitamin A deficient. Twenty per cent to 24% of early childhood deaths due to measles, diarrhoea and malaria are attributable to vitamin A deficiency, plus an additional 3% of deaths due to other infectious causes, accounting for 647000 deaths of preschool-age children each year. Vitamin A deficiency appears to espe-cially put children at risk of mortality due to diarrhoea, which accounts for 50% of all childhood deaths attributable to vitamin A deficiency.

Vitamin A deficiency affects vulnerable populations throughout critical stages of life, as revealed by these estimates of disease burden in young children and pregnant women. Successful efforts to control and reduce vitamin A deficiency have the potential to improve the health and well-being of women and children around the world and to reduce the global burden of disease associated with this nutritional risk factor.

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