Short Communication

Prevalence and Risk Factors of Vitamin A Deficiency in Children and Women of Childbearing Age in a Southern Indian Tribal Population: A Cross-Sectional Study

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Abstract

Background: Night blindness and keratomalacia continue to be a problem among the tribal children and pregnant women residing in Jawadhi hills. **Objectives:** The objective of the study is to determine the prevalence and risk factors of Vitamin A deficiency (VAD) among children aged 1–8 years and women of reproductive age in a southern Indian tribal population. **Materials and Methods:** A cross-sectional study was done among children aged 1–8 years and women aged 15–45 years residing in Jawadhi hills. Participants were randomly selected by cluster sampling. Their sociodemographic characteristics and frequency of consumption of Vitamin A rich food were collected through a structured questionnaire. Anthropometric measures and serum retinol levels, using high-performance liquid chromatography, were estimated for all participants. **Results:** A total of 166 children and 211 women participated in this study. The prevalence of VAD among the children (1–8 years) was 10.2% (95% confidence interval [CI] 5.5%–14.9%) and among women of the reproductive age group was 3.8% (95% CI: 1.2%–6.4%). Dietary intake was not associated with serum retinol levels. Low educational status of the head of the household (adjusted odds ratio [aOR] = 8.9) and pregnancy (aOR = 11.6) was significantly associated with an increased risk of VAD among children and women, respectively. **Conclusions:** The prevalence of VAD among children is a moderate public health problem. Strategies must focus on pregnant women and children from families with more than four children.

Keywords: Nutritional status, serum retinol, tribal, Vitamin A

Introduction

Vitamin A deficiency (VAD) causes night blindness, xerophthalmia, and preventable childhood morbidity.[1] A survey conducted by the National Nutrition Monitoring Bureau (NNMB) reported a prevalence of 61% of subclinical VAD at the national level; 49% in Tamil Nadu, and 74% among the tribal population.[2] Between 2009 and 2012, four children aged between 4 and 12 from Jawadhi hills were seen in the outpatient department of a tertiary care center for ophthalmology with keratomalacia.

Materials and Methods

A cross-sectional study was conducted prospectively among the residents of Jawadhi hills between December 2015 and February 2016. Guidelines laid down in the Declaration of Helsinki were followed, and the study protocol was approved by the Review Board and Ethics Committee of the Institute (IRB Min No. 9635 dated 23/09/2015) of Christian Medical College, Vellore. Written informed consent was obtained from the study participants and parental consent in case of children.

Jawadhi hills is located on the borders of Vellore and Tiruvannamalai districts of Tamil Nadu and is home to 80,000 people, mostly belonging to the Malayali tribe.[3] Previous surveys show that they are mainly agricultural laborers, 46% have never attended school, infant mortality rate (IMR) is 70/1000 live births, complete immunization rate among

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under-five children is 20%, and 40% of under-five children are stunted.[4] Between 2009 and 2012, four children aged between 4 and 12 years from Jawadhi hills were seen in the outpatient department of a tertiary care center for ophthalmology with keratomalacia.

A documented prevalence of 25% in women and 61.7% in children, respectively, from studies done elsewhere and a design effect of 1.5 was used to calculate the sample size which was found to be 165 children and 200 women.[5,6] Fifteen villages were chosen by purposive sampling, and in each village, through medical camps, participants were selected randomly. A total of 211 women of the reproductive age group and 166 children between the ages of 1 and 8 were selected.

Data were collected using an interviewer-administered structured questionnaire. Sociodemographic characteristics, socioeconomic status, frequency of consumption of Vitamin A rich food, history of Vitamin A supplementation, and the obstetric scores of the participants were recorded. The local term for night blindness "maalaikannu" was used to elicit the history of night blindness in all participants. Parents of toddlers were asked for symptoms, suggesting that the child may have poor vision in dim light. Anthropometric measurements were made using a stadiometer and a bathroom weighing scale. For all children under the age of 5, the Z-scores for their weight for age, height for age, and weight for height were calculated using the WHO Anthro for personal computers, version 3.2.2, 2011: Software for assessing the growth and development of the world's children. Geneva: WHO, 2010.[7] The body mass index (BMI) was calculated and classified using the Asian classification for all the adults.[8]

Serum retinol levels were measured for all participants. Although an unreliable indicator of assessing the Vitamin A status of an individual, this reflects the severity of VAD as a public health problem and has been found to be more accurate than other clinical methods. Two milliliters of whole blood were collected in lithium heparin tubes, labeled, covered with aluminum foil, and transported for centrifugation. Serum retinol levels were quantified by high-performance liquid chromatography according to the method described by Postaire *et al*. Participants with serum retinol levels below 20 μg/dL were classified as deficient in Vitamin A.[9,10]

The data were entered using EpiData v3.1 (Odense, Denmark) and analyzed using SPSS Statistics for Windows, Version 17.0. Chicago, Illinois, USA: SPSS Inc. Percentages were used to describe categorical variables. Continuous variables were described using measures of central tendency and dispersion. The public health significance of the prevalence of VAD was classified as follows: mild (2%–9% prevalence), moderate (10%–19% prevalence), and severe (≥20% prevalence).[11] Chi-square test and odds ratio were calculated to measure the association between VAD and the risk factors such as sex, level of education of the head of the household, land ownership, family size, diet, anthropometric measurements, and being pregnant. Finally, a binary logistic regression was used to adjust for confounders.

Results

A total of 166 children aged 1–8 years were included in the study, with an almost equal proportion of boys and girls. The mean age of the children was 4.3 years (standard deviation [SD] = 1.8). Most of them (71.1%) lived in nuclear families, 57.8% lived in kutcha houses, and 96.4% belonged to the lower class by BG Prasad scale. None of the 166 children or their parents reported difficulty in seeing or identifying objects in dim light. Of the 91 under-five children, 39.6% were underweight, 44% were stunted, and 27.5% were wasted.

A total of 211 women aged between 15 and 45 years participated in the study. Their mean age was 29.6 years (SD = 6.9). Most of the participants (71.1%) lived in nuclear families, 48.3% lived kutcha houses, and 86.8% belonged to the lower class. Among the participants, 88.6% were married and eight were pregnant at the time of the study. Based on the WHO classification of BMI for Asians, 31.9% were undernourished, 53.3% were normal, and the remaining 14.8% were overweight or obese.

The prevalence of VAD among the children was 10.2% (95% confidence interval [CI]: 5.5%–14.9%) and among women of the reproductive age group was 3.8% (95% CI: 1.2%–6.4%). None of the study participants had serum retinol levels of < 10 μg/dl. Weekly consumption of at least 5 of the 9 Vitamin A rich food was reported among 17.4% of the children. The consumption of at least one Vitamin A rich food item three times a week was reported among 57.8% of the children and 39.3% of the women. None of the participants had received any form of Vitamin A supplements in the 6 months before the study.

During the bivariable analysis for the children, it was found that having four or more children in the family (odds ratio [OR]: 3.46; 95% CI: 1.08–11.1), level of education of the head of the household (OR: 10.24; 95% CI: 2.26–46.38), and land ownership (OR: 9.1 95%; CI: 1.17–70.5) was significantly associated with VAD [Table 1]. Gender of the child, age, type of housing, frequency of consumption of Vitamin A rich foods, and anthropometric measures were not associated with low serum retinol levels. A multivariable analysis model with the educational status of the head of the household, land ownership, gender of the child, and number of children in the family had a −2-log likelihood of 83.4 and Nagelkerke R square of 0.30. An educational status of less than middle school in the head of the household remained significantly associated with VAD (adjusted OR [aOR] 8.9). Girls and children from families with less than one acre of land showed a trend toward being associated with VAD [Table 1].

In the bivariable analysis done for the women of the reproductive age group, parity, socioeconomic status, type of housing, family type, frequency of consuming Vitamin A rich food items, and BMI were not found to be associated with VAD. None of those who had symptoms of night blindness were found to have low retinol levels. After adjusting for confounders, pregnancy remained significantly associated with VAD (aOR: 11.6; 95% CI: 1.9–73.2) [Table 2].

Discussion

The prevalence of VAD among the tribal children was 10.2% (95% CI: 5.5%–14.9%) and among women of the reproductive age group was 3.8% (95% CI: 1.2%–6.4%). There was strong evidence of an association between the outcome of vitamin A deficiency and exposures such as the level of education of the head of the household and pregnancy.

The prevalence is lower than those reported from other states and the 49% reported in the NNMB survey conducted in 2001 and may be due to methodological differences or part of a long-term trend.[5,6] The burden of VAD among the children can be classified as one of the moderate public health importances in the light of the other ecological indicators such as the high IMR and high prevalence of stunting.[11] Pregnancy was associated with a higher risk of VAD which is similar to the findings made by Katz *et al*.[12]

Vitamin A supplementation programs were launched in India in the 1970s to decrease under-five mortality and nutritional blindness, and the relevance of a more targeted approach is being discussed.[13] The results of this study are important as it reveals that VAD continues to be a problem among preschool children, children up to 8 years of age, and pregnant women. Research addressing the ways to tackle VAD in all these subgroups is needed.

Conclusions and Recommendations

VAD is a public health problem in this area not just among the preschool children but among children up to the age of 8 years and pregnant women. Further studies looking at possible interventions are needed.

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Table 1: Risk factors for Vitamin A deficiency among children (*n*=165)

Factor	Subcategories	Proportion with VAD (%)	Crude OR (95% CI)	aOR (95% CI)
Educational status of the head of the household*	Nil or primary education	19.2	10.24 (2.26-46.38)	8.9 (1.9-42.4)
	Middle school and above	2.3		
Sex of the child*	Female	14.3	2.5 (0.86-7.6)	3.05 (0.94-9.9)
	Male	8.1		
Height for age	Stunted (HAZ<−2SD)	6.3	0.53 (0.13-2.1)	
	Normal (HAZ >−2)	11.3		
Number of children in the family*	≥4	23.8	3.46 (1.08-11.1)	2.7 (0.73-10.13)
	≤3	8.3		
SES (BG Prasad scale)	Low class	10.6	Could not be calculated	
	Middle class	0		
Land owned*	<1 acre	14.4	9.1 (1.17-70.5)	8.08 (0.99-66.05)
	1 acre and more	1.8		

*Variables in the model. VAD: Vitamin A deficiency, CI: Confidence interval, SES: Socioeconomic status, OR: Odds ratio, aOR: Adjusted odds ratio

Table 2: Risk factors for Vitamin A deficiency among women of the reproductive age group (*n*=211)

Factor	Subcategories	Number with VAD (%)	Crude OR (95% CI)	aOR (95% CI)
Educational status of the head of the household*	Nil or primary education	4 (3.1)	0.65 (0.16-2.6)	0.68 (0.16-2.9)
	Middle school and above	4 (4.8)		
Currently pregnant*	Yes	2 (25)	10.9 (1.8-65.8)	11.6 (1.9-73.2)
	No	6 (3)		
BMI	<18.5	2 (3.0)	0.7 (0.14-3.6)	
	≥18.5	6 (4.2)		
Number of children in the family*	≥4	1 (5.6)	1.5 (0.18-13.4)	2.2 (0.24-20.40)
	≤3	7 (3.6)		
SES (BG Prasad scale)	Low class	8 (4.1)	Could not be calculated	
	Middle class	0 (0)		
Frequency of consumption of Vitamin A rich foods	>3 times a week	2 (2.4)	0.5 (0.1-2.6)	
	3 or<3 times a week	6 (4.7)		
Land owned	<1 acre	8 (5.8)	Could not be calculated	
	1 acre and more	0 (0)		

*Variables in the model. BMI: Body mass index, VAD: Vitamin A deficiency, CI: Confidence interval, SES: Socioeconomic status, OR: Odds ratio, aOR: Adjusted odds ratio

Conflicts of interest

There are no conflicts of interest.

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