Published in final edited form as:

Ophthalmic Epidemiol. 2009 ; 16(3): 193–197. doi:10.1080/09286580902863080.

Risk factors for maternal night blindness in rural South India

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Abstract

Purpose—This study aimed to identify risk factors associated with maternal night blindness in rural South India.

Methods—At delivery, women enrolled in a population-based trial of newborn vitamin A supplementation were asked whether they were night blind at any time during the pregnancy. Multivariate logistic regression was used to identify socioeconomic, demographic, and pregnancy related factors associated with maternal night blindness.

Results—Women reported night blindness in 687 (5.2%) of 13,171 pregnancies. In a multivariate model, having a concrete roof (Odds Ratio (OR): 0.60, 95% Confidence Interval (CI): 0.47, 0.78), religion other than Hindu (OR: 0.46, 95% CI: 0.27, 0.76), maternal literacy (OR: 0.58, 95% CI: 0.49, 0.69), and maternal age from 25 to 29 years (OR: 0.68, 95% CI: 0.50, 0.93) were associated with a lower risk of night blindness in pregnancy. The odds of night blindness were higher for those leasing rather than owning land (OR: 1.78, 95% CI: 1.08, 2.93), parity 6 or more compared to 0 (OR: 2.11, 95% CI: 1.09, 4.08), and with twin pregnancies (OR: 3.23, 95% CI: 1.93, 5.41). Factors not associated with night blindness in the multivariate model were other markers of socioeconomic status such as electricity in the house, radio and television ownership, type of cooking fuel, and household transportation, and number of children under 5 years of age in the household.

Conclusions—Maternal night blindness was prevalent in this population. Being pregnant with twins and of higher parity put women at higher risk. Maternal literacy and higher socioeconomic status lowered the risk.

Keywords

xerophthalmia; vitamin A deficiency; night blindness; pregnancy; India

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Conflict of Interest:

The authors have no financial or other conflict of interest with the work described in this paper.

Introduction

Night blindness during pregnancy and the association with poor dietary vitamin A intake has been reported in the early 20th century in Europe (1). Case studies in South Asia were first reported in the 1960's (2–4), but was largely forgotten until a series of population-based studies 30 years later described the prevalence, risk factors and consequences of night blindness in Nepal (5–9). These and other population-based studies documented that night blindness in pregnancy was prevalent (5,10–12), was associated with vitamin A deficiency (6), and was more common among those who were of poorer socioeconomic and health status (5,6). Furthermore, the common belief that the condition would go away following delivery was contradicted by studies that showed it persisted or returned during lactation in populations with vitamin A deficiency (5) and was also present in non-pregnant women of childbearing age (13). Maternal night blindness was found to increase maternal and infant mortality (9,10,12), and vitamin A supplementation of night blind women improved their survival and that of their offspring (9,10). It has been estimated that more than 6 million women develop night blindness during pregnancy each year (14).

The adverse consequences of maternal night blindness make it important to describe the risk factors that predispose women to this condition. One explanatory model that uses the Mosely-Chen framework would suggest that the most distal risk factors are socioeconomic, such as poverty and illiteracy (15). These lead to a diet deficient in vitamin A, particularly vitamin A obtained from animal sources that are the most bioavailable but also the most expensive (16, 17). This leads to marginal vitamin A stores (17,18). Morbidities, also a consequence of socioeconomic conditions and poor diet, further drain vitamin A stores (6). Vitamin A deficiency also predisposes children to morbidities (19). Pregnancy is a physiologic state that requires increased vitamin A utilization for growth of the fetus, and marginal stores prior to pregnancy increase the likelihood that women will experience night blindness, especially in the third trimester (2,3,20). Very few population-based studies have examined risk factors for maternal night blindness, although the Demographic and Health Surveys have incorporated questions about this condition in many country questionnaires (21). Using the DHS Statcompiler for surveys conducted within the past 5 years, the percent reporting nightblindness in the most recent pregnancy ranged from 1.7% (Indonesia, 2002/2003) to 18.2% (Chad, 2004), with 8.9% in India in 2005/2006. We report here an analysis of risk factors associated with night blindness in pregnancy using data from a population-based trial of newborn vitamin A supplementation undertaken in rural South India.

Materials and Methods

Data for this analysis come from a randomized trial of vitamin A supplementation to newborn infants in South India (22). Women residing in two rural blocks of Tamil Nadu who became pregnant during the study period (1998–2000) were eligible to participate in the trial. Village based workers were trained to identify, consent and enroll pregnant women in their villages. An interview was conducted at the time of enrollment that included information on socioeconomic and demographic characteristics of the household such as age, literacy, religion and occupation of the head of the household, house construction, land and cattle ownership, type of cooking fuel used, presence of electricity, type of transportation, ownership of radios and televisions, number of children under 5 years of age living in the household, age of the pregnant woman, age at first pregnancy, parity, gravidity, and prior miscarriages and stillbirths for multigravid women. Women were enrolled in mid pregnancy, approximately 5–6 months gestation. No specific information was provided to women about maternal vitamin A deficiency or nutrition counseling and prenatal care was not provided by the study staff who were not trained health care providers. At the time of delivery, the trained village worker visited the woman to dose the infant with vitamin A or a placebo within 48 hours of birth. At this time,

the mother was asked whether she had been night blind at any time during pregnancy using the Tamil terminology for the condition (“maalai kann”). No further questions were asked about vision during daylight or duration of night blindness.

Bivariate associations were examined by calculating odds ratios for socioeconomic, demographic and maternal characteristics. A multivariate logistic regression was fit using covariates whose bivariate associations were statistically significant at $p < 0.05$. A final, more parsimonious model was fit with covariates that were significant in the initial multivariate model.

Ethical approval for this study was obtained from the ethical committee of the Aravind Eye and Children's Hospitals, Madurai, Tamil Nadu, the Department of Health, Tamil Nadu State Government, and the Committee on Human Research of the Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland.

Results

A total of 14,035 pregnant women agreed to participate in the trial. Of these, 763 moved out of the study area prior to delivery, 6 women died while pregnant, 82 miscarried, and 11 were still pregnant at the time the trial ended. Of the remaining 13,173 pregnancies, 687 (5.2%) gave a positive history of night blindness in pregnancy. Two women were blind from other causes so their night blindness status was unknown. These women were removed from the numerator and denominator.

In bivariate analyses, household factors associated with night blindness included thatch roof material, lack of land ownership, lack of electricity in the house, lack of ownership of a radio and/or television, low grade household transportation, use of wood or dung as cooking fuel, and religion (Table 1). Maternal characteristics associated with night blindness were age, illiteracy, husband's illiteracy, parity, number of children under 5 years of age living in the household, a history of prior miscarriage, and whether the pregnancy was single or multiple (Table 2).

In the final multivariate regression model (Table 3), women from households with a concrete roof were less likely to have night blindness compared with those whose roofs were made of thatch (OR 0.60, 95% CI: 0.47, 0.78). Women from households whose religion was not Hindu (Christian, Muslim and other) were also at lower risk (OR 0.46, 95% CI: 0.27, 0.76). Leasing land rather than owning it increased the risk of night blindness in women (OR 1.78, 95% CI: 1.08, 2.93). Maternal age followed a U shaped pattern of risk with women under 20 and those 35 and older at highest risk. The risk of night blindness increased with parity and was highest for women of parity 6 or more. Maternal literacy reduced the odds of night blindness (OR 0.58, 95% CI: 0.49, 0.69). A pregnancy with twins increased the odds of night blindness in pregnancy by more than 3 fold (OR 3.23, 95% CI: 1.93, 5.41). Although prior miscarriage was associated with night blindness in the current pregnancy, we did not include this in the multivariate model because it only applies to multigravid women. A separate multivariate model including only multigravid women but including the same covariates as the prior model found that the odds ratio for the association between night blindness and a prior miscarriage, adjusted for the other covariates was 0.72 (95% CI: 0.50, 1.02).

Discussion

The 5.2% prevalence of night blindness in pregnancy meets the 5% cut off for the definition of a public health problem (23) but was lower than previous estimates from Nepal (16.7%), India (12.1%) and Bangladesh (12.8%) (14). Lower socioeconomic status and maternal illiteracy were both risk factors, as seen in other studies (5,6,13,24,25). Factors surrounding

pregnancy have also been associated with maternal night blindness seen in other studies, such as increased risk with higher parity (5,6,25). Studies that have just looked at maternal age show an increase with age, but this is primarily driven by parity (6). In our data, after adjusting for parity, teenage pregnancies were at higher risk, as were the oldest women, findings similar to a prior study in Nepal (5). For teenagers who are still growing, the physiologic demands for vitamin A are likely higher than for those in their twenties. We are not aware of studies showing a higher risk with twins but this makes sense because twins would presumably require more vitamin A than a singleton. The lower risk of night blindness associated with a prior miscarriage but not still birth appears counterintuitive but it may be that conditioned on a prior pregnancy, a miscarriage is less nutritionally depleting than a still birth or prior live birth.

The strengths of this study are that it is population-based so we were able to obtain estimates of prevalence, and the pregnancies enrolled are likely representative of the study area and of rural South India. The large number of pregnancies and cases of night blindness make it possible to estimate relatively small odds ratios with high precision. One potential limitation was the way in which night blindness was ascertained. The woman was asked to recall whether she had been night blind at any time during pregnancy. This is subject to recall bias as well as to interpretation of what is meant by night blindness. Fortunately, there was a specific local term for night blindness (“maalai kann”) which was used. Across different countries, a question about experiencing night blindness using local terms has been shown to be quite sensitive and specific when assessed against serum retinol and is more sensitive and specific when questions about vision in the day versus night are added (2,3,6,26). Questions to ascertain night blindness in pregnancy have now been recommended as the standard population-based indicator of maternal vitamin A deficiency (23,27). Another weakness is the limited number of maternal and pregnancy related risk factors collected in this trial. For example, pre-pregnancy height, morbidity, diet, and weight gain during pregnancy were not obtained. We were also unable to examine the impact of birth spacing on night blindness risk. The association with parity is likely due to the nutritional drain of many pregnancies in a nutritionally deficient environment. It could be that those with shorter birth intervals would be at even greater risk because they would have less time to recover nutritionally between pregnancies. In this population, the proportion who initiated breastfeeding was 99.7% (81.5% initiated breastfeeding within 12 hours), although we do not know how long breastfeeding continued nor whether breastfeeding was exclusive. Hence it is difficult to speculate on the extent to which lactation associated with a prior pregnancy would predispose to night blindness in the current pregnancy.

In this population, maternal night blindness was associated with low birth weight, infant morbidity, and poor growth through 6 months of age (12). WHO/IVACG recommends treatment for night blindness in pregnancy with 10,000 IU daily or 25,000 IU weekly for 4–8 weeks (23,27). Very few countries have adopted this antenatal policy. Nepal does have such a policy but does not have any active case detection program. Many countries do have policies and programs for postpartum supplementation with 200,000 IU within 6 weeks of delivery (21). Among the 37 with DHS coverage information in the past 5 years, coverage is about 50%, with a range from 8.5% for Azerbaijan to 61.5% in Liberia (21). Since night blindness in pregnancy has been shown to have health and survival consequences for women and their infants, identification of night blind women via antenatal programs or more active case finding is important, and because treatment with vitamin A is inexpensive and feasible in many settings. Understanding the conditions under which maternal vitamin A deficiency occurs can help in the design of antenatal programs to reduce the incidence of night blindness during pregnancy.

Acknowledgements

This study was conducted with support received under Cooperative Agreement No. HRN-A-00-97-00015-00 between the Johns Hopkins Bloomberg School of Public Health and the Office of Health and Nutrition, US Agency for

International Development, Washington DC, the National Institutes for Health grant R03 HD049406-01, a grant from the Bill and Melinda Gates Foundation, Seattle, Washington, and commodity support from Task Force Sight and Life, Roche, Ltd., Basel, Switzerland.

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Table 1
Prevalence of maternal night blindness by household characteristics

	N	n	%	Crude OR	95% CI
Roof Material					
Thatch/other	4,143	267	6.4	1.00	
Tile	6,410	335	5.2	0.80	0.68, 0.95
Concrete	2,618	85	3.3	0.49	0.38, 0.63
Land ownership					
Own	6,427	347	5.4	1.00	
Lease	197	18	9.1	1.76	1.04, 2.96
None	6,547	322	4.9	0.91	0.77, 1.06
Cattle ownership					
None	9,584	487	5.1	1.00	
One	1,055	57	5.4	1.07	0.80, 1.43
Two or more	2,532	143	5.7	1.12	0.92, 1.36
Electricity					
No	5,556	367	6.6	1.00	
Yes	7,615	320	4.2	0.62	0.53, 0.73
Radio/TV					
Neither	7,364	449	6.1	1.00	
Radio only	3,331	166	5.0	0.81	0.67, 0.97
TV only	1,201	39	3.3	0.52	0.37, 0.73
Both	1,275	33	2.6	0.41	0.28, 0.59
Transport					
None	7,534	437	5.8	1.00	
Bicycle only	4,879	231	4.7	0.81	0.68, 0.95
Other ¹	758	19	2.5	0.42	0.25, 0.68
Household Fuel					
Kerosene/biogas	1,008	20	2.0	1.00	
Wood/dung	12,163	667	5.5	2.87	1.80, 4.62
Religion					
Hindu	12,384	671	5.4	1.00	
Other ²	878	16	2.0	0.36	0.21, 0.61

¹ Moped, motorcycle, tractor, car

² Muslim, Christian, Jain, Buddhist, Sikh

Table 2
Prevalence of maternal night blindness by maternal characteristics

	N	n	%	Crude OR	95% CI
Husband's Literacy					
No	3,780	260	6.9	1.00	
Yes	9,391	427	4.6	0.64	0.55, 0.76
Maternal Literacy					
No	5,593	408	7.3	1.00	
Yes	7,578	279	3.7	0.49	0.41, 0.57
Maternal Age (y)					
< 20	1,751	83	4.7	1.00	
20–24	6,468	317	4.9	1.04	0.80, 1.34
25–29	3,881	210	5.4	1.15	0.88, 1.50
30–34	843	54	6.4	1.38	0.95, 1.99
>= 35	228	23	10.1	2.25	1.35, 3.74
Parity					
0	4,956	196	4.0	1.00	
1	4,092	207	5.1	1.29	1.05, 1.59
2 or 3	3,474	233	6.7	1.75	1.43, 2.13
4 or 5	514	37	7.2	1.88	1.29, 2.75
6 or more	135	14	10.4	2.81	1.52, 5.11
No. children < 5 y					
0	5,806	254	4.4	1.00	
1	5,572	325	5.8	1.35	1.14, 1.61
2	1,608	91	5.7	1.31	1.02, 1.69
3 or more	185	17	9.2	2.81	1.52, 5.11
Prior stillbirths ^I					
No	8,132	470	5.8	1.00	
Yes	526	33	6.3	1.09	0.74, 1.59
Prior miscarriages ^I					
No	7,608	463	6.1	1.00	
Yes	1,050	40	3.8	0.61	0.43, 0.86
Singletons	13,052	669	5.1	1.00	
Twins	119	18	15.1	3.30	1.92, 5.60

^I Among multigravidae only

Table 3

Multivariate logistic regression identifying risk factors associated with maternal night blindness in rural South India.

Risk Factor	MODEL 1		MODEL 2	
	Odds Ratio	95% CI	Odds Ratio	95% CI
Thatch roof	1.00		1.00	
Tile roof	0.92	0.79, 1.13	0.88	0.74, 1.04
Concrete roof	0.74	0.56, 0.99	0.60	0.47, 0.78
Own land	1.00			
Lease	1.76	1.06, 2.91	1.78	1.08, 2.93
None	0.96	0.82, 1.13	0.96	0.82, 1.13
No electricity	1.00			
Electricity	0.91	0.75, 1.11		
Neither	1.00			
Radio only	0.99	0.80, 1.22		
TV only	0.89	0.61, 1.29		
Both	0.79	0.52, 1.18		
No transport	1.00			
Bicycle only	0.95	0.79, 1.13		
Other	0.72	0.44, 1.18		
Other fuel types	1.00			
Wood or dung	1.38	0.85, 2.24		
Hindu	1.00			
Other	0.49	0.30, 0.82	0.46	0.27, 0.76
Maternal Illiteracy	1.00			
Literacy	0.64	0.54, 0.77	0.58	0.49, 0.69
Age < 20 y	1.00			
20–24 y	0.84	0.64, 1.10	0.81	0.62, 1.07
25–29 y	0.70	0.51, 0.96	0.68	0.50, 0.93
30–34 y	0.71	0.47, 1.10	0.72	0.42, 1.09
>= 35 y	1.08	0.61, 1.93	1.09	0.61, 1.93
Nulliparous	1.00			
1	1.33	0.98, 1.81	1.34	1.07, 1.66
2 or 3	1.83	1.30, 2.58	1.72	1.36, 2.19
4 or 5	1.56	0.94, 2.60	1.54	1.00, 2.37
6 or more	2.19	1.05, 4.54	2.11	1.09, 4.08
No children < 5 y	1.00			
1	0.99	0.76, 1.29		
2	0.79	0.56, 1.11		
3 or more	1.38	0.78, 2.42		
Singletons	1.00			
Twins	3.25	1.94, 5.44	3.23	1.93, 5.41