

THE CHANGE OF PREVALENCE OF XEROPHTHALMIA ON LOMBOK, SEPTEMBER 1977 - SEPTEMBER 1983

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ABSTRAK

Berdasarkan data "Survei Prevalensi Kebutaan Gizi" tahun 1977, Lombok, Nusa Tenggara Barat, dinyatakan sebagai wilayah tinggi prevalensi xerofthalmia. Sebagai suatu wilayah dengan prevalensi xerofthalmia paling tinggi di Indonesia, banyak faktor risiko yang diidentifikasi bagi daerah ini, termasuk kejadian kecacingan, kekurangan frekuensi pemberian air susu ibu (ASI) pada anak yang masih menyusui; kekurangan "kamar cuci" di dalam rumah; variasi diet yang terbatas, tidak ada variasi konsumsi bahan pokok selain beras; dan kecilnya konsumsi sumber-sumber protein. Faktor risiko khusus xerofthalmi-korneal berkaitan dengan riwayat penyakit yang baru diderita si anak (campak dan infestasi berat kecacingan) dan kurang kalori protein berat. Sejak tahun 1978, Pemerintah Indonesia telah mengembangkan berbagai macam pendekatan untuk mengawasi (kontrol) xerofthalmia; sampai tahun 1982 telah mencapai 80% sasaran (anak Balita) dan telah menghasilkan penurunan prevalensi xerofthalmia di wilayah ini. Penurunan prevalensi ini di capai tanpa penurunan secara proporsional faktor-faktor risiko terkait.

The island of Lombok, situated in the Eastern Indonesia Archipelago, had in 1977 a very high prevalence of childhood blindness due to xerophthalmia.

Xerophthalmia is a degenerative disease of the eye cause by insufficient vitamin A being available to the ocular epithelial cells that require it. While basically a problem of insufficient intake of vitamin A, xerophthalmia is often complicated by disease, insufficient fat or protein in the diet, diarrhea and malnutrition which in turn are associated with sub standard housing, illiteracy and poverty.

Lombok could be a prosperous island. The land is fertile and surrounded by rich

tropical oceans. Both the east and west sides have plenty of rainfall, but the south center of the island has had periodic droughts. However, when the rains fall on time, the harvest is bountiful.

Rice is the dominant staple in the diet. It is cultivated in mountainous terraced paddies. Dry land crop production includes red sweet potato, cassava and corn, and fish is available from the surrounding seas.

A well developed road network and the availability of adequate means of transportation allow distribution of agricultural products between all major markets. It is a very traditional society, that had in 1980 the highest infant mortality in Indonesia (176 deaths per 1000 births as versus the national of 93 deaths per 1000 live births). Education levels were low, and community sanitation levels often inadequate.

A national nutritional blindness prevalence survey was conducted in 1977-78 to ascertain the magnitude and distribution of the problem of xerophthalmia in 24 of the 27 provinces of Indonesia (1). Examinations were performed on 36,000 children by trained ophthalmologists. Fifteen provinces stood out as having a high risk of disease with over 47% of the nutritional blindness appearing in three provinces:

Aceh

West Java

NTB (Lombok)

Lombok had enough cases of corneal xerophthalmia and Bitot's spots to be ranked among the major endemic enclaves of xerophthalmia in Indonesia. Along with several other provinces, it ranked high in both the prevalence of corneal cases and Bitot's spots among children examined and so became a priority area for the implementation of a vitamin A deficiency control program (2).

The prevalence survey also gathered information on specific dietary patterns, disease history, socio economic status of the family and sanitation facilities. The results led to an estimate that as many as 60,000 Indonesian children a year were developing some form of visual impairment due to vitamin A deficiency (3).

Of the 2,422 children examined (Refer to Table 4 for age break down) in Lombok, the following eye signs associated with vitamin A deficiency were found:

- 34 children had Bitot's spots (X1B)
- 5 children had potentially blinding corneal involvement (X2/X3)

These cases were scattered throughout 80% of the villages. The pattern of occurrence was unusual as the west side of the island had all five cases of corneal involvement and corneal scars, while the eastern side of the island had most of the Bitot's spots.

Several important policy related epidemiological questions arose from these findings.

- Why does Lombok have more xerophthalmia than other areas?
- Does Lombok have different risk factors (or more) than other parts of Indonesia?

What are the risk factors and can the amount of xerophthalmia be reduced without reducing the magnitude of different risk factors (natural ecology)?

Defining risk factor for xerophthalmia

When risk factors for xerophthalmia are discussed, the one that is often mentioned is malnutrition. The picture of the wasted child with melting cornea is the usual one for people acquainted with the clinical situation as most of the children seen in clinics with xerophthalmia are the worst cases and are also often severely malnourished. In many parts of the world, this is indeed the picture that is seen. In the villages of Lombok, however, only 40% of the cases of corneal xerophthalmia and 20% of the cases of Bitot's spots identified in the 1977 survey occurred in malnourished children (P% Standard Weight for Height) (4).

Figure 1 demonstrates the risk of xerophthalmia for children with different nutritional status within the entire sample of Indonesia children and from the children on Lombok in 1977-78. As can be seen, corneal xerophthalmia is more prevalent among poorly nourished children. In general in Indonesia, risk for Bitot's spots is fairly constant across all categories of nutritional status. On Lombok the risk for xerophthalmia among malnourished children is higher than in the rest of Indonesia.

The small number of severely malnourished children throughout Indonesia, are however, at a higher risk for corneal xerophthalmia, as can be seen in figure 1. The high prevalences of severe malnutrition on Lombok, (Figure 2) was the highest of any province in Indonesia in 1977 (Tarwotjo 1983). Lombok also had one of the highest rates of corneal xerophthalmia. It was suggested that in Lombok xerophthalmia could not be controlled without reducing the background level of malnutrition.

Another nutritional related risk factor for xerophthalmia is the frequency and duration of breast feeding. Children who are deprived of breast milk are at much higher risk of xerophthalmia (4), and malnutrition (7).

The basic problem on Lombok (which has many rich, cheap sources of vitamin A) is the dietary pattern of the children. Many foods on Lombok are good sources of vitamin A and its related nutrients. Preformed vitamin A is available from eggs and liver. Dietary protein sources such as meat, fish, cheese, allow for transport of vitamin A to the receptor sites in the eye as well as to other important sites in the epithelium. Green leafy vegetables and fruits are rich sources of beta-carotene which the body alters into vitamin A. Lipids in the diet enhance the absorption and storage of vitamin A. A well nourished children with adequate calorie intake may develop xerophthalmia if intake of vitamin A or related nutrients is insufficient.

The occurrence of additional diseases influence the risk of xerophthalmia. Diarrhea, measles, chickenpox, high fever, severe cough, and heavy worm infestation were demonstrated to be risk factors in Nepal (8). Even within Indonesia, there appears to be much variation on the relative contribution of the different diseases in the etiology of xerophthalmia.

The level of household sanitation make a difference in the amount of disease within that household (9). Household that have water within the house, a special place for washing, a special place for fecal disposal, have a different set of risk factors for diarrhea than households that bathe, gather water, and defecate in the same river or stream.

Xerophthalmia tends to cluster in specific geographical areas. In Indonesia in 1977, less than 40% of all villages sampled in the country had active cases of xerophthalmia. In 1977, 80% of the villages in Lombok had cases of xerophthalmia. Within these villages the disease was clustered within specific neighborhoods.

In Nepal, areas with high proportions of low caste, low income population had much higher prevalences of xerophthalmia (8). When measuring poverty in Indonesia income is not always adequate, as debts are often paid off in labor and in crops. The further one travels from trading centers on Lombok, the less important money (and therefore income) becomes as a measure of social status and wealth. Measurements of possessions of families or of status within the community are more important for identifying poverty. Yet rural inhabitants are often reluctant to admit owning things, so that precise measures of a families social status and access to goods within a community are often difficult to make.

Certain behavioral factors also place the individual at high risk. Permissive child rearing practices that permit the child to choose its own food leads to a higher risk for xerophthalmia. Letting children play in areas where random defecation occurs puts the child at greater risk for heavy worm infestation is associated with malabsorption of nutrients (including vitamin A) and higher risk of malnutrition and disease.

Importance of risk factors

The relative importance of different risk factors for xerophthalmia were compared using logistic regression. This helped identify risk factors for xerophthalmia that would allow for targetting of the capsule distribution program, or for introduction of educational programs that might reduce risk for xerophthalmia. Information on the children within the 1977 Nutritional Blindness National Prevalence Survey was grouped together in risk typologies which included five categories:

- 1) economic status,
- 2) sanitary facilities,
- 3) disease history,
- 4) nutritional status,
- 5) diet

A separate logistic regression was done for each category. The most significant variables within categories were entering into a final analysis.

Some of the risk factors identified in the analysis are shown in Table 1. The results of the analysis suggest that food preference and/or food taboos in infant feedings is an important risk factor for xerophthalmia. The high risk diet is one lacking in variety, protein

and sources of beta-carotene. The xerophthalmic child is also from the household of a manual laborer, lives in a house with no bathroom, and if on the breast is receiving breast milk two or less times a day. Children that have a recent history of measles or worm expulsion were also at elevated risk for xerophthalmia. Children with a recent history of diarrhea and children not living in a household with a "washroom" were at risk for all types xerophthalmia. Malnutrition, a recent history of measles, and recent history of worm expulsion were especially significant risk factors for the corneal cases.

For most cases of xerophthalmia it is not a matter of a single risk factor, but of multiple ones. It appears that poor nutrition and disease were the predominate risk factors for corneal xerophthalmia, while dietary, environmental and economic risk factors were also important in risk for Bitot's spots.

Control of xerophthalmia on Lombok

In 1977, the Indonesian Ministry of Health undertook a massive research project to assess the magnitude and distribution of ocular signs of vitamin A deficiency. For maximum efficiency of its on going capsule distribution program, it was essential for the Ministry of Health to know where vitamin A deficiency was most prevalent.

The capsule distribution programs for the prevention of xerophthalmia usually distribute two mega-doses of 200,000 IU of vitamin A twice a year. In Indonesia, this was done through the distribution of capsules through three different community nutrition programs. These were:

- 1) an capsule distribution program integrated into a family nutrition improvement program (UPGK),
- 2) a single purpose vertical vitamin A distribution program which took place in the fifteen high risk provinces,
- 3) a capsule distribution program integrated into the World Bank Loan funded intensive family nutrition program (NIPP).

In the integrated horizontal programs (UPGK and NIPP), the capsule distribution was an additional activity in a strategy that already included monthly weighing of children, food supplementation and nutrition education. Each program distributed the capsules at different times and the local health center (PUSKESMAS) which handled the field operations, received supplies for all of the programs and administrated them separately.

In order to assess the success of the intervention a small xerophthalmia surveillance exercise took place at the Cicendo eye hospital in Bandung in early 1981. The staff from three health centers in Lombok attended. From their initial surveillance reports it appeared that a high prevalence of xerophthalmia was still found in Lombok. Thus the decision was made to intensify the on going capsule distribution activities in March, 1982.

The NTB provincial nutrition office, under the direction of the Directorate of Nutrition, initiated a program to have all the capsules from the different programs distributed twice a year during two different one week periods called "Vitamin A Week". This campaign

was conducted on the same dates each year. For a month prior to the "vitamin A week", a special push was made through the media (radio) and women's groups. The sentinel Puskesmas vitamin A deficiency monitoring system which still showed high levels of disease in 1981, started reporting a decreasing amount of vitamin A deficiency in preschool children in the Puskesmas after the implementation of the program. This scheme also appeared to be very effective in increasing compliance rates for the intake of the vitamin A capsule. The September 1977 sample sites were revisited in September 1983 to determine the changes in prevalence of xerophthalmia.

Table 2 demonstrates that vitamin A week, instituted in 1982, was effective in increasing compliance with the mega-dose capsule distribution program. The level of compliance reached was not limited to only a fixed vertical single-purpose program. The vitamin A component of integrated programs could also be promoted through such an approach.

The prevalence of xerophthalmia was much lower in September of 1983 compared to September of 1977. As can be seen in Table 3, the difference between the levels of xerophthalmia rates is statistically significant for Bitot's spots, as well as for the number of villages with Bitot's spots and for the number of villages with corneal xerophthalmia.

The reduction is marked in all the different categories (WHO 1984) of the xerophthalmia. While the prevalence of Bitot's spots (X1B) is below the WHO criteria of a significant health problem, the prevalence of corneal xerophthalmia still remains four times higher than the WHO criteria (WHO 1982) although it is approximately 80% lower than in 1977.

While the magnitude of the disease decreased between 1977 and 1983, the patterns of occurrence of Bitot's spots and nightblindness and Bitot's spots were more common than in West Lombok. One case of corneal xerophthalmia was found in West Lombok in 1983 in the same area where all the corneal cases had occurred in 1977. No new corneal scars were seen in the resurvey that dates from after the time period in which the provincial nutrition office increased the coverage of the semi-annual mega-dose capsule distribution program in high risk rural areas.

While the sample site had not changed, the cohort of children measured in 1977 had either increased in age or died. As nutritional status and age are both important risk factors, the age distribution and nutritional status profile of the sample children were compared in the two populations to see if they were similar.

The age distribution of the 1983 resurvey populations appears to have a larger component of older children than did the 1977 survey. This shift in age is a good reason for age adjusting future prevalence estimates in preschool children. Shift of ages toward higher age groups has the potential of increasing the prevalence estimates in preschool cohorts.

Although the nutritional status improved in Lombok between 1977 and 1983, the reduction in prevalence of severe malnutrition rates were less than the reduction in the prevalence of corneal xerophthalmia. As can be seen in Figure 2, the percent of the population in the < 70% standard weight for height category has decreased, but that the

overall rates of malnutrition (defined as $< \%$ standard weight for height) has increased.

Conclusions

Lombok is a rice growing, agriculturally based, densely populated island west of Bali in Indonesia. It was identified as a problem area in the 1978 National Nutritional Blindness Survey. Important risk factors for all the different eye signs and symptoms of xerophthalmia included:

- 1) a history of recent worm expulsion,
- 2) low frequency of breast feeding,
- 3) no family "washroom",
- 4) no egg consumption

For corneal xerophthalmia (corneal ulceration and keratomalacia) important risk factors also include:

- 1) a recent history of disease,
- 2) the presence of protein calorie malnutrition.

While for Bitot's spots:

- 1) the child's diet
- 2) household environmental sanitation

were major risk factors, suggesting a model of interaction between the environment of the child, its diet and infectious disease, that is different for the corneal and conjunctival signs and symptoms of xerophthalmia.

The government was able to establish an effective program to reduce the occurrence of xerophthalmia without dramatically reducing the risk factors. It is likely that several other factors also contributed to the reduction of xerophthalmia in Lombok between the years 1977 and 1983. The capsule distribution program did have an impact even though malnutrition and poverty were not eliminated.

Continued efforts should be made to reduce risk for worms, improve the environmental sanitation of the family and improve food practices and beliefs for preschool children if lasting control of xerophthalmia is to be achieved.

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Richard Manoff in 1980 and development with close cooperation between the Health Education Directorat, the Nutrition Directorat and *Helen Keller International*. The success of both vitamin A week, and the repeat field survey is due in large part to the provincial head of nutrition activities, Dr. I.G. Gredeg, and his staff of nutritionists. Dr. Larry Stiffman of Applied Statistical Labs in Ann Arbor, Michigan arranged for the statistical analysis on the MTS computer system of the University of Michigan. The support and cooperation of the Nutritional Deficiencies sub Directorat within the Nutrition Directorat is the base for all program success in the area of vitamin A in Indonesia.

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Table 1. Prevalence of xerophthalmia in Indonesia by selected risk factors (1977).

Risk Factors	Per Cent of all children with risk factor	Bitot's Spots (X1B)		Corneal Xerophthalmia (X2/X3)		Relative Prevalence Ratio
		Nu.	%	Nu.	%	
Father manual labor	79.9	46	2.5	5	0.27	1.2
Bath outside of house	58.4	34	2.5	3	0.23	1.2
Diarrhea within last month	27.3	20	3.2	3	0.48	1.6
Worms in feces last week	9.4	9	4.2	3	1.39	1.8
Measles last week	6.2	5	3.5	4	2.11	2.4
Not presently breast feeding	53.5	43	3.5	4	0.33	1.7
Nightblindness last month	0.6	10	76.9	0	0.00	33.0
Never eat sweetpotato	4.3	7	7.1	0	0.00	3.1
Low meat consumption	39.9	29	3.1	2	0.22	1.5
Never eat eggs	48.7	35	3.2	3	0.27	1.5
All children	100.0	48	2.1	5	0.22	1.0

Table 2 Mega dose vitamin A capsules distributed Lombok, 1977-1983

Program	Num of capsules distributed/year (in thousands)					
	1978	1979	1980	1981	1982	1983
UPGK	0.0	27.0	68.4	-	-	-
NIPP	5.4	16.2	16.2	36.0	36.0	36.0
SPECIAL	0.0	0.0	88.9	270.7	450.9	500.0
Average number of children covered (in 000'S)	2.7	21.6	86.7	153.4	246.0	268.0
Per cent total covered	0.8%	6.8%	27.1%	47.9%	76.9%	81%

**Table 3 Rates of ocular symptoms of vitamin A deficiency
Lombok, Sept. 1977 - Sept. 1983.**

Category	Prevalence		Sig
	1977	1983	
X1B	1.6%	0.2%	p < .05
X2/X3	0.21%	0.04%	p < .1
Children under 6 yr	2333	2519	
Villages with X1B	80%	30%	< p.01
Villages with X2/X3	25%	5%	< p.01
Villages	20	20	

**Table 4. Age distribution of sample population Lombok
1977 - 1983.**

Age Groups	Per cent	
	1977	1983
1 year	15.0	8.6
1 Year	17.1	17.1
2 Year	16.1	18.2
3 Year	17.9	20.0
4 Year	18.0	18.0
5 Year	17.9	18.1

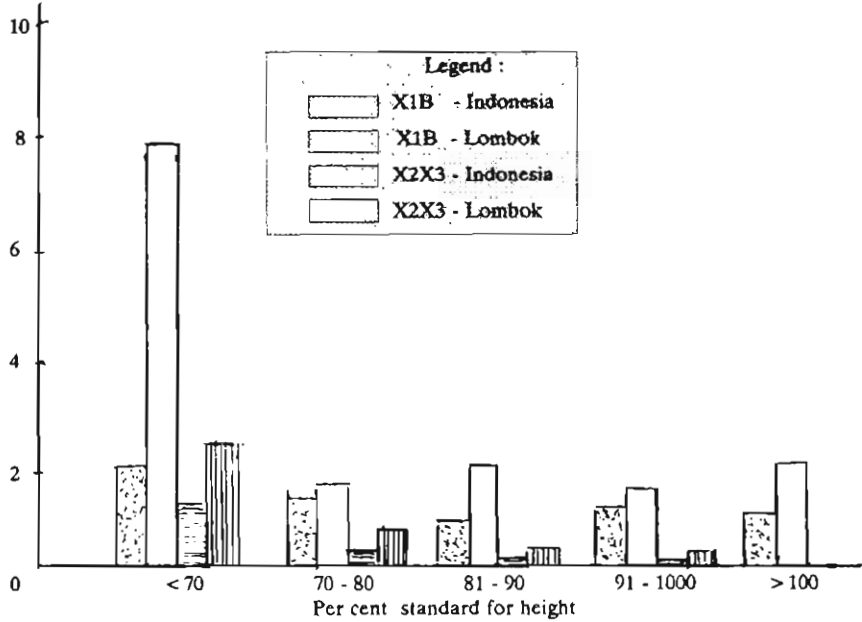


Figure 2. Per cent standard weight for height children under six years.
Lombok 1977 - 1983

