Prevalence of xerophthalmia among children in Beheira governorate, Egypt

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انتشار جفاف الملتحمة بين الأطفال في محافظة البحيرة، مصر

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خلاصة: أجري استقصاء على عينة ممثلة لأهالي محافظة البحيرة لتحديد المناطق التي يرتفع فيها خطر الإصابة بعوز الفيتامين "أ"، ولتقدير معدل انتشار جفاف الملتحمة. وفي إطار الدراسة تم اختبار مدى موثوقية استقصاء عنقودي منزلي لتقدير معدل انتشار جفاف الملتحمة. فقام رمدي مدرب بفحص 10 664 طفلا. وبيّنت النتائج أن عوز الفيتامين "أ" موجود في المنطقة ولكن لا يبدو وأنه يمثل مشكلة صحية عامة. وكانت علامات عوز الفيتامين "أ" في العيون أكثر انتشاراً بين الأطفال الأكبر سناً، الأمر الذي يشير إلى تحسّن الأحوال الاجتماعية والاقتصادية والرعاية الصحية خلال السنوات القليلة الماضية. ولقد اتضح أن الاستقصاء العنقودي المنزلي طريقة يعتمد عليها في تقدير مدى انتشار جفاف الملتحمة في المنطقة.

ABSTRACT A survey was conducted on a sample representative of the entire Beheira governorate to identify high-risk areas of vitamin A deficiency (VAD) and assess xerophthalmia prevalence. The study also tested the reliability of a household cluster survey for assessing xerophthalmia prevalence. A trained ophthalmologist examined 10 664 children. The results showed that VAD was present in the region, but did not appear to be a public health problem. Ocular signs of VAD were more prevalent among older children, suggesting an improvement in socioeconomic conditions and health care over the past few years. The household cluster survey appeared to be a reliable method for assessing xerophthalmia prevalence in the region.

Prévalence de la xérophtalmie chez les enfants dans le Gouvernorat de Beheira (Egypte)
RESUME Une enquête a été réalisée sur un échantillon représentatif de l'ensemble du gouvernorat de Beheira afin d'identifier les zones à haut risque d'avitaminose A et d'évaluer la prévalence de la xérophtalmie. Elle a également permis de tester la fiabilité d'un sondage par grappes auprès des ménages pour évaluer la prévalence de la xérophtalmie. Un ophtalmologiste qualifié a examiné 10 664 enfants. Les résultats ont montré que l'avitaminose A était présente dans la région mais ne semblait pas constituer un problème de santé publique. Les signes oculaires de l'avitaminose A étaient plus fréquents chez les enfants plus âgés, ce qui porte à croire qu'il y a eu une amélioration des conditions socio-économiques et des soins de santé au cours des dernières années. Le sondage par grappes auprès des ménages est apparu comme étant une méthode fiable pour l'évaluation de la prévalence de la xérophtalmie dans la région.

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Introduction

Vitamin A deficiency (VAD) is considered a public health problem in many developing countries and its clinical manifestations, including xerophthalmia, are among the most prevalent preventable disorders caused by micronutrient deficiency in children [*1*]. In recent years, a close relationship has emerged between low vitamin A status and childhood mortality, and VAD is now considered a serious public health concern, not just an ophthalmic problem [*2*]. Many developing countries have already conducted assessments and surveys to determine the extent of the problem at both national and regional levels.

VAD is known to affect specific regions of the world and defined areas within these regions. There is also evidence that VAD clusters by households, neighbourhoods and villages [*3*], which probably arises from shared practices and environment. The peculiar distribution of VAD should be taken into account in the design of treatment and control programmes and prevalence surveys. In the case of surveys, the distribution must also be taken into account when defining the sample size.

At present, most of the surveys conducted in developing countries to evaluate the health status of the population and the delivery of health services use simplified methods. One such method is the cluster sampling technique of the World Health Organization (WHO) Expanded Programme on Immunization (EPI) that was first proposed to assess vaccination coverage [*4*]. This method has been modified over time and is now considered adequate for estimating disease prevalence and incidence, even for rare diseases [*5*]. However, this method has not been tested for xerophthalmia surveys and the practice of randomly choosing a number of households within the cluster and visiting only the children in those households is considered inaccurate because of the low prevalence and strong clustering of xerophthalmia cases. Generally, for xerophthalmia surveys it is recommended that all children, or a large proportion of them, in the chosen clusters be examined [*6*].

In Egypt, data on VAD prevalence are limited. The United Nations Children's Fund (UNICEF) Regional Office in Amman reports that VAD is a public health problem in Egypt. WHO considers VAD in Egypt to be a mild problem, but one that needs assessment [*7*]. In the first National Nutrition Survey conducted by the Ministry of Health and Population (MOHP) in 1978, just four cases of Bitot's spots were detected out of nearly 10 000 preschool children examined [*8*]. In 1995, the Nutrition Institute, in collaboration with UNICEF, conducted a national survey to assess vitamin A status in Egypt. The survey examined 1629 children, 6 to 71 months old, living in 5 of the 26 governorates. The survey found that 11.3% of the children had moderate subclinical VAD (plasma retinol 10–20 mg/dL) and 0.6% had severe subclinical VAD (plasma retinol < 10 mg/dL), but only 2 ocular cases (Bitot's spots) were detected [*9*].

In 1996–97, the MOHP undertook a regional survey to assess the health and nutritional status of the population in Beheira. One of the largest governorates in Egypt, Beheira includes most of the land on the west side of the Nile delta and has an estimated population of more than four million. The survey, implemented by the Egyptian–Italian cooperation project *Strengthening Rural Health Services in Beheira, Dakahlia and Qena governorates*, assessed, among other indicators, the prevalence of ocular signs of VAD in a sample of children

representative of the entire population in the governorate [*10*].

The aim of our study was to identify high-risk areas of VAD and assess the prevalence of xerophthalmia. The study also tested the reliability of a household cluster survey for assessing xerophthalmia prevalence.

Subjects and methods

The eye examination survey was conducted in two stages: a regional household cluster survey to identify villages in the region where the risk of VAD is high (October–December 1996); and a village survey to examine all children living in high-risk villages to substantiate the regional data and reliably assess xerophthalmia prevalence in the region (May–June 1997). In total, 10 664 children under 12 years of age were examined by a single trained ophthalmologist.

Diagnosis of xerophthalmia was based on the presence of Bitot's spots or other ocular signs detected during the eye examination [*11*]. Because of the inherent difficulty in diagnosing conjunctival xerosis, it is not considered a clinical indicator of xerophthalmia and was not reported [*12*]. For the same reason, no attempt was made to obtain a history of night blindness, from either the child or the mother. To keep the survey simple, affordable and easily replicable, biochemical indicators were not used.

Regional survey

The sample was selected using a two-stage random cluster sampling technique. In the first stage, clusters, or primary sample units, were selected with probability of inclusion proportionate to size (PPS) [*13*]. Households (HHs) were considered the ultimate sampling units and all children under 12 years living in the selected households, sample children. The minimum sample size was calculated to be 384 HHs [*14*]. The sample was divided into 55 clusters of 7 HHs, a modification of the cluster sampling technique of the EPI, which originally suggested surveying 7 sampling units in 30 clusters [*15*]. The number of clusters was increased for three reasons:

- to ensure that the sample was representative of the whole of Beheira governorate;
- to facilitate stratification by ecological setting;
- to reduce the rate of homogeneity (*roh*), or the measure of variability between clusters as compared to the variation within clusters [*16*].

To adjust for cluster selection, as opposed to a full random selection, the study design effect (*deff*) was calculated using the formula:

$$deff = 1 + (m - 1)\, roh$$

where m is the average expected number of ocular exams per cluster and *deff* is taken as equal to 2 [*17*]. The final sample size was calculated to be 768 HHs (55 clusters of 14 HHs), to represent the entire governorate.

A sampling frame of the region was drawn, taking into account its administrative subdivision into districts, towns and villages and stratified by ecological settings (rural, urban, desert, river and sea). Then a selection of 55 clusters was made by applying the PPS method to the sampling frame, followed by the random selection of HHs within the selected clusters [*17*]. All children under 12 years of age living in the selected households were given ocular examinations.

Village survey

During this follow-up survey, ocular examinations were given to all children under 12 years of age living in the eight villages where at least one child with Bitot's spot was detected during the regional survey. The same ophthalmologist was employed in both surveys. A simple questionnaire covering dietary habits and common risk factors for xerophthalmia, such as literacy of the mother, measles infection and number of siblings, was completed with information supplied by the mother of each child diagnosed. No attempt was made to conduct a complete dietary assessment since other studies have already assessed the vitamin A content of the diet of Egyptian women and children, and its adequacy [*18,19*]. All the children with ocular signs of VAD were treated, regardless of their age, according to WHO guidelines. Any other common ocular disease found was also treated.

In total, 10 664 children under 12 years of age were examined, 2524 children during the regional survey and 8140 during the village survey.

Results

The only clinical signs of xerophthalmia detected were Bitot's spots. No cases of corneal xerosis or keratomalacia were diagnosed. The prevalence of Bitot's spots for the two surveys is presented in Table 1. The prevalence of Bitot's spots in each age group is presented in Figure 1, for the regional survey, and in Figure 2, for the village survey. Most of the cases were concentrated in the older age groups with a low prevalence in children < 72 months in both the regional survey (0.09%) and the village survey (0.21%).

According to the dietary information given by their mothers, the foods eaten daily by the 94 children diagnosed with Bitot's spots during the village survey were broad beans, rice and bread, all of which are poor in carotene and vitamin A. However, carrots are produced in the area and were commonly eaten during the season and fresh cheese was reportedly eaten daily by 99% of the children. More than half of the mothers (53.2%) stated that their children ate vegetables every day and 90% reported using oil for cooking, with an average monthly consumption of 3.4 L.

Literacy among mothers of the children with Bilot's spots was low (16%), as was the mean age at marriage (17.3 years). The average number of children under 12 years of age in the households where Bitot's spots were detected was 4.0, and at least one child death was reported in 27 of the 80 HHs where cases were identified. In addition, 27.2% of the children with Bitot's spots were reported to have had measles.

Discussion

VAD is present in the area, but the prevalence of ocular signs was well below the WHO cut-off point representing a public health problem (X1B < 0.5 among children under 6 years) [*20*]. This was true even in villages where a child with a Bitot's spot

Table 1 **Prevalence of Bitot's spots by age group**

Age group (months)	Regional survey (n = 2524)		Village survey (n = 8140)	
	No.	%	No.	%
<72	1	0.09	8	0.21
72–143	8	0.54	86	1.92
Total	9	0.35	94	1.15

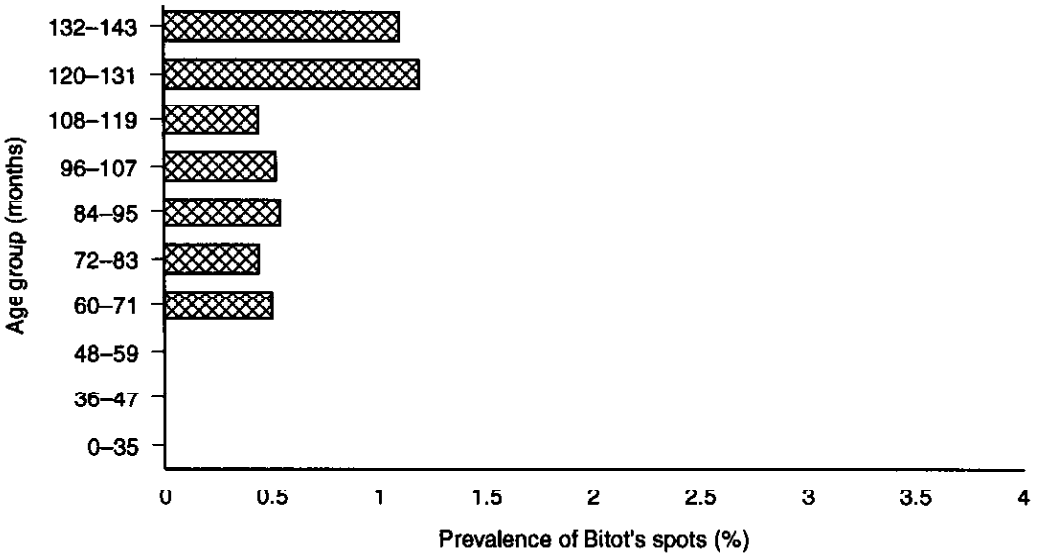

Figure 1 **Regional survey: prevalence of Bitot's spots among children under 12 years of age (*n* = 2524), Beheira, 1996**

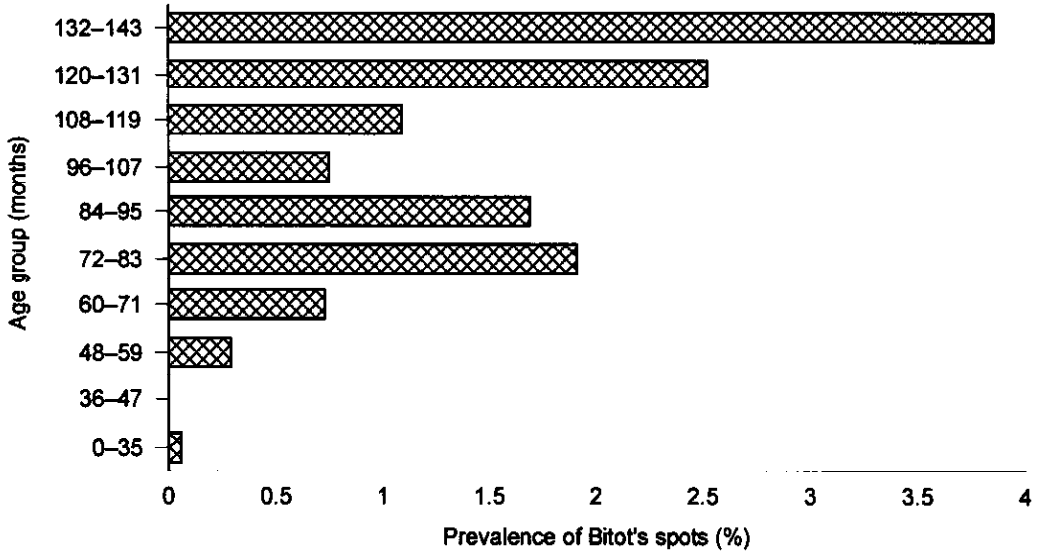

Figure 2 **Village survey: prevalence of Bitot's spots among children under 12 years of age living in high-risk villages (*n* = 8140), Beheira, 1997**

was detected during the regional survey and which were expected to show a higher prevalence of xerophthalmia than the average population [3]. The prevalence of Bitot's spots in the village survey was just 0.2% among children under 6 years, a prevalence double that reported during the regional survey, but still below the WHO cut-off point.

The prevalence of Bitot's spots increased with the age of the children in both surveys. In general, severe VAD is most prevalent among preschool children and corneal xerophthalmia (X2, X3) traditionally peaks from the second to the fourth year when dietary intake of vitamin A is low and risk of precipitating infection high [2]. After the fourth year, the risk of severe VAD with associated blindness and the risk of overall mortality decline. At the same time, mild xerophthalmia (XN or X1B) may extend into adolescence and early adulthood and sometimes the prevalence rate of mild xerophthalmia in those age groups exceeds that of preschool children, even if this finding is uncommon [21]. In one of the few studies which examined children until 10 years of age, the peak prevalence of Bitot's spots was found at 7 years for boys, and at 5 years for girls, although in older children the prevalence decreased [22]. Prevalence rates which increase with age, such as those found in our study, are not seen in countries where severe VAD is still present and vary from the pattern usually seen in South-East Asia and sub-Saharan Africa.

The age distribution of Bitot's spots in the study sample suggests a constant reduction in incidence. This assumption is supported by the fact that not a single case of corneal xerophthalmia was detected among the more than 10 000 children examined.

The peculiar trend detected in Beheira may be due to a variety of reasons, including the improvement of socioeconomic and health conditions in the area, a general reduction in infections among children over the past decade and overall nutritional improvements. Dietary intake of vitamin A in the area does not appear to be severely deficient and recent studies have shown sufficient vitamin A intake for the child population, although for mothers the intake was lower [18].

A number of non-dietary risk factors, such as maternal illiteracy, overcrowding and high prevalence of measles, were common in the area. The practice of early marriage, which was found associated with poor health and sanitation conditions in another study [23], was also common. A high percentage of children with Bitot's spots reported having had measles.

With the increase in maternal literacy and EPI coverage and the improvement of the general health conditions in the area, it seems that the risks associated with these factors have been reduced. This could partly account for the disappearance of corneal xerophthalmia (X2, X3) and the constant reduction over time of the incidence of mild xerophthalmia (X1B) — and consequently the higher prevalence among older children.

The results of the village survey substantiated the results of the regional survey. As expected, the prevalence of xerophthalmia in high-risk villages was higher than the prevalence in the general population (as measured during the regional survey) and the level of risk was consistent with current reported data. Population-based surveys in Africa and Asia have shown that children living in villages where at least one child has xerophthalmia are at 1.2 to 2.3 times higher risk of having xerophthalmia than children in villages where no cases have been detected [2]. The trend of prevalence increasing with age was also confirmed by the village survey.

Generally, the results of the village survey were consistent with those of the regional survey and the prevalence defined by the regional survey can be considered very close to the actual prevalence in the region. A *deff* equal to two seems to be adequate to calculate the prevalence of VAD using a household cluster survey (two-stage random cluster sampling technique with PPS in the first stage), given a number of clusters higher than 50 and a total sample of children examined of at least 1000. Similar cluster surveys would require only limited resources and, if carried out in a precise way, could produce reliable data on the prevalence of clinical VAD in any region of the country.

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