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CLINICAL STUDY

Prevalence of pterygium and cataract in indigenous populations of the Brazilian Amazon rain forest

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Abstract

Purpose **To compare the prevalence of pterygium and cataract in four indigenous populations of the Brazilian Amazonian rain forest (Arawak, Tukano, Maku, and Yanomami) with different ethnic and social behaviour backgrounds.**

Methods **A cross-sectional pterygium and cataract survey was performed in 624 adult Indians of the Brazilian rain forest belonging to four different ethnic groups. The Indians were classified according to their social behaviour in two groups: Arawak and Tukano (group 1) and Maku and Yanomami (group 2). Slit-lamp biomicroscopy was employed to examine the entire sample. All subjects were classified as 1 or 0 according to the presence or absence pterygium and cataract. Sex and age were also recorded.**

Results **χ^2-tests revealed that the prevalence of pterygium and cataract differed significantly between groups 1 and 2. For pterygia: 36.6% (97/265) and 5.0% (18/359), respectively ($\chi^2 = 101.2$, $P < 0.0001$), and for cataracts: 24.5% (65/265) and 13.7% (49/359) respectively ($\chi^2 = 12.09$, $P = 0.0005$). Gender was not associated with pterygium ($P = 0.1326$) and cataract ($P = 0.2263$) in both groups. Elderly subjects showed a significantly higher prevalence of cataract ($P < 0.0001$). The prevalence of pterygia did not increase with age ($P = 0.8079$) in both groups.**

Conclusion **Indians of group 1 have higher prevalence of pterygia and cataract than Indians of group 2. Social behaviour, especially the rate of sun exposure, appears to be the main factor for the different rates of pterygium and cataract displayed by these indigenous people of the Brazilian rain forest.**

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Introduction

The Rio Negro basin is a region in the Brazilian Amazonian rain forest occupied almost entirely by Indians. The complex social organization of these Amerindians is based on language groups. They belong to four major linguistic divisions: Arawak, Maku, Tukano, and Yanomami. There are few Maku people due to social and health problems beginning about 30 years ago. Therefore, Arawak, Tukano, and Yanomami Indians are the predominant indigenous population of this area (Figure 1).[1]

The Arawaks, Tukanos, and Yanomami people have a working knowledge of agriculture but they have great differences in other important activities. The river people, Arawaks and Tukanos, specialize in fishing and live near the river's edge while the forest-dwelling people, Yanomami and Maku, hunt in the deep forest.

Pterygium is a potentially blinding disease characterized by a fibrovascular mass invading the cornea. The prevalence rates of pterygium vary widely from 1.2 to 23.4%, according to differences in race and an area's latitude and ultraviolet light exposure.[2,3] Age-related lens opacity, cataract, is the most frequent reversible cause of global blindness.[4] The main risk factors associated with cataract are age, sex, racial

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Figure 1 Location of the Rio Negro basin in Amazonas State, Brazil: (1) Arawak, Tukano and Maku areas around São Gabriel da Cachoeira city and (2) Yanomami area along the Marauiá river.

differences, associated systemic disease, and others.[5–7]

The objective of this report is to describe the prevalence of pterygia and cataract among the four Indian ethnic groups of the Rio Negro basin.

Materials and methods

A pterygium and cataract population-based survey was performed by slit-lamp biomicroscopy on 624 adult subjects: 160 Arawak, 105 Tukano, 43 Maku, and 316 Yanomami Indians. Data were collected during two trips to the Rio Negro basin, in the northwest of Amazonas State in Brazil, by the two ophthalmologist authors.

The Arawak's, Tukano's, and Maku's communities near the city of São Gabriel da Cachoeira were examined by one of the authors (AAVCruz), on the first trip in 1997. These communities were randomly selected during this trip. On the second trip in 1999, the first author of this manuscript examined all Yanomami communities (eight) along the Marauiá river on the left bank of the Rio Negro.[8] These communities are located approximately the same distance from the Equator, about 70 km (Figure 1). During each visit, the examiners tried to assess the entire community. The number of subjects examined was lower than the entire population because the Indians often travel for work or social purposes.

The subjects of Arawak's and Tukano's communities were grouped in group 1, characterized by people engaged in fishing activities, and group 2 was composed by Yanomami and Maku communities with predominantly hunting activity. Each person was classified as 1 or 0 for the presence or absence of pterygia and cataracts in at least one eye. No eye dilatation was employed because this procedure would not be accepted by the subjects. We preferred not to use a score system to grade pterygia and cataracts because the ophthalmic examination was performed by two different observers in distinct periods of time. Gender and age were also recorded. Since age could not be accurately determined in any of the communities, this variable was classified into two levels: adults and elderly. A children's group was not included in the statistical analysis because only one child presented with cataract and pterygium. The data were analysed using contingency tables of GraphPad Prism 4 software with significance attributed to $P<0.05$.

Results

The male : female proportion in the population was 0.75 : 1. There was a predominance of adults (413/624; 66.2%) than elderly (211/624; 33.8%). The overall prevalence of pterygium and cataract in this population was 18.4% (115/624) and 18.3% (114/624), respectively.

χ^2 tests revealed that the prevalence of pterygium and cataract differed significantly between groups 1 and 2. For pterygia: 36.6% (97/265 (95% CI: 30.7–42.7%)) and 5.0% (18/359 (95% CI: 3.0–7.8%)), respectively ($\chi^2=101.2$, $P<0.0001$), and for cataracts: 24.5% (65/265 (95% CI: 19.4–30.2%)) and 13.7% (49/359 (95%

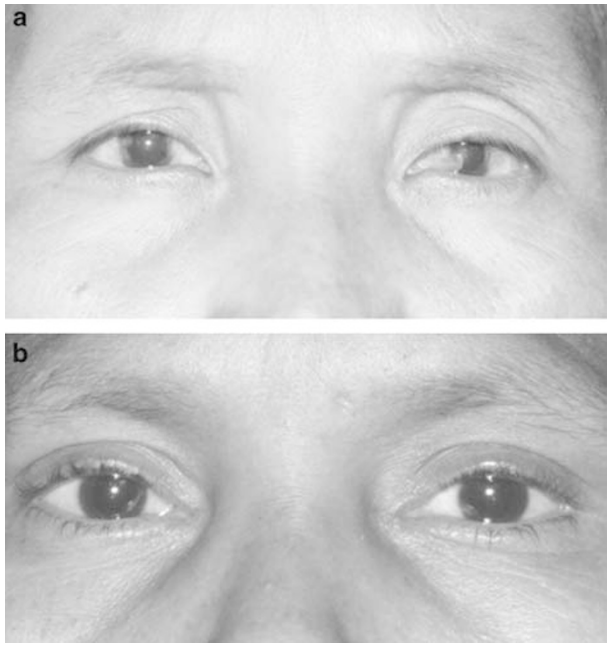

Figure 2 (a) Photography of a Tukano Indian (group 1). Note bilateral nasal pterygia, with a temporal pterygium in the right eye. (b) Photography of a Maku Indian (group 2) with absence of any abnormalities on the ocular surface.

Table 1 Distribution of pterygium and cataract prevalence in the four Indian communities that were studied

Community	*Pterygium*	*Cataract*
Arawak	36.3% (58/160)	26.9% (43/160)
	95% CI: 28.8–44.2%	95% CI: 20.2–34.4%
Tukano	37.1% (39/105)	20.9% (22/105)
	95% CI: 27.9–47.2%	95% CI: 13.6–29.9%
Group 1	36.6% (97/265)	24.5% (65/265)
	95% CI: 30.7–42.7%	95% CI: 19.4–30.2%
Maku	2.3% (1/43)	11.6% (5/43)
	95% CI: 0.06–12.3%	95% CI: 3.9–25.1%
Yanomami	5.4% (17/316)	13.9% (44/316)
	95% CI: 3.2–8.5%	95% CI: 10.3–18.2%
Group 2	5.0% (18/359)	13.7% (49/359)
	95% CI: 3.0–7.8%	95% CI: 10.2–17.6%

Table 2 Distribution of pterygium and cataract prevalence by gender in the studied population

Gender	*Pterygium*	*Cataract*
Male	15.7% (42/267)	16.1% (43/267)
	95% CI: 11.6–20.7%	95% CI: 11.9–21.0%
Female	20.5% (73/357)	19.9% (71/357)
	95% CI: 16.4–25.0%	95% CI: 15.9–24.4%

CI: 10.2–17.6%)), respectively ($\chi^2 = 12.09$, $P = 0.0005$) (Figure 2). The prevalence of pterygium and cataract in each community is shown in Table 1.

Gender was not associated with pterygium ($\chi^2 = 2.262$, $P = 0.1326$) and cataract ($\chi^2 = 1.464$, $P = 0.2263$) (Table 2).

The prevalence of pterygia did not increase in the elderly group ($\chi^2 = 0.059$, $P = 0.8079$). As expected, elderly subjects showed a significantly higher prevalence of cataract in all communities ($\chi^2 = 218.2$, $P < 0.0001$) (Table 3).

Table 3 Distribution of pterygium and cataract prevalence by age in the studied population

Age	*Pterygium*	*Cataract*
Adults	18.2% (75/413)	1.9% (8/413)
	95% CI: 14.5–22.2%	95% CI: 0.8–3.8%
Elderly	19.0% (40/211)	50.2% (106/211)
	95% CI: 13.9–25.0%	95% CI: 43.3–57.2%

Discussion

The different rates of pterygium and cataract displayed by the Indians of the Brazilian rain forest may be explained by several factors. Theoretically, distinct variables linked to nutrition, genetics, climate, and social behaviour could play a role in our results. However, we think that the social behaviour was the determinant factor for the explanation of the higher prevalence rates of cataract and pterygium showed by the Tukanos and Arawaks.

Nutrition is not a valid explanation because the diet of all subjects included in this study is based on manioc ingestion with quite small difference in ingestion of other nutrients. The climate is essentially invariant in the whole region and thus can be dismissed as an important variable. The same can be said with regard to the genetic background of the population because all Amerindians derived from Asian populations.

In our opinion social behaviour is likely to be the main factor involved in the high rates of pterygium and cataract in some groups of Indians in the Brazilian rain forest.

Several investigators have studied the relationship between ophthalmic disorders and exposure to sunlight. Cataract and pterygium are the most important ultraviolet (UV)-related diseases.[7,9] The Indians belonging to group 1 are predominantly fishermen and stay on the river's edge during most of their daily activities. They are highly exposed to UVB sunlight. On the other hand, the Indians of group 2 live deep in dense forest with extended hunting expeditions in the woods. Thus, they are naturally protected from UVB sunlight by the darkness of the dense forest top.

Circumstantial evidence from biochemical, animal, and epidemiological studies suggests an association between exposure to UVB radiation (290–320 nm) and cortical cataract.[7,10] Nuclear and posterior subcapsular cataracts are more correlated with age, systemic and ocular diseases, and drug toxicity[5,11] than with UVB exposure. There are discrepancies in the prevalence of cataracts with sex, with an overall female predominance, mainly in nuclear and cortical forms.[6,11] The data from this survey reveal differences in cataract prevalence between the two groups with much higher prevalence in the elderly group. There is a trend toward lower cataract rates in the forest people (group 2). This can be explained, but not completely, by the degree of sunlight exposure and by age-related factors.

Pterygium is a disfiguring and potentially blinding disease that in the advanced stages can require complex surgery for full visual rehabilitation. Some authors describe a papillomavirus aetiology associated with pterygium[12] and this would explain geographic similarities among different people if the papillomavirus is considered highly contagious.

Several case–control and cross-sectional studies have attempted to accurately quantify UV light exposure and document its relationship with pterygia.[3,9,13,14] UVB

radiation may induce cellular changes in the medial limbus of the cornea. The specific role of UVB irradiation in the pathogenesis of pterygium is controversial and it is associated with interleukins,[15] metalloproteinases,[16]and growth factors.[17]

In this study, river people (group 1) have a seven times higher rate of pterygia than forest-dwelling people (group 2).

Athough we do not know how many subjects were not examined because they had travelled for work or social purposes, we think that this problem did not induce a result bias. It is well known that the rate of mobility of these Indians is not so high and does not differ significantly among the ethnic groups studied. The UV protection of a tree's shade has been estimated to range from 29% at morning to 71% at noon in Queensland, Australia.[18] About 60% of this UV radiation is due to a diffuse component.[19] However, the denseness of the Amazon forest at treetop and at ground level minimizes the diffuse component, while the multitiered canopy of the tall trees in this forest eliminate a much higher proportion of direct light in the Amazon forest. We believe that the difference in the exposure to UV radiation among these Indian populations is due to the dense canopy and ground foliage of the forest blocking direct and diffuse components of UV radiation.

Although an infectious aetiology or genetic attributes may contribute to development of pterygia, it seems clear that the UVB irradiation of sunlight exposure would be the major determinant factor involved in the pathogenesis of pterygia in the Rio Negro basin.

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