Prevalence of necrotizing ulcerative gingivitis and associated factors in Koranic boarding schools in Senegal

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Background: Necrotizing ulcerative gingivitis is the most common clinical syndrome preceding noma. It is found in developing countries and in malnourished children and especially in deprived groups such as children at Koranic boarding schools. The objective of this study was to determine the prevalence of necrotizing ulcerative gingivitis and factors associated with its occurrence in a boarding school population. **Methods**: This was a cross-sectional study of children in Koranic boarding schools in the city of Touba, Senegal. A multistage sampling strategy was used and 8 out of 17 schools were selected. The variables collected were gender, age, oral hygiene habits, duration of residence, presence of ulcerative gingivitis and plaque, and gingival bleeding index. A logistic regression analysis with R software using the manual procedure down was used to identify factors associated with the dependent variables. **Results**: There were 501 participants and boys made up 92% of the study group. The mean age was 9.3 (sd 4.0) years. The mean of duration residence was 3.4 (sd 1.5) years. The prevalence of necrotizing ulcerative gingivitis was 37% and 81% of children did not use a toothbrush or a chewing-stick. The length of residence, school size, hygiene habits and plaque and bleeding indices were significantly associated with necrotizing gingivitis after adjustment for other variables. **Conclusion**: It is necessary to develop oral hygiene programs, to establish policies to manage the oral health of children and to improve health and nutrition at Koranic boarding-schools.

Keywords: *necrotizing ulcerative gingivitis, noma prevalence, risk factors, children, Koranic boarding school, Daara, Senegal*

Introduction

Necrotizing ulcerative gingivitis is the most common clinical condition that precedes noma. It manifests itself as ulcerations of the interdental papilla with presence of tissue necrosis accompanied by gingival bleeding, pain and foul breath (Folayan, 2004). Benign in healthy children, this necrotizing ulcerative gingivitis is, on the other hand, serious or fatal in cases of severe malnutrition in children with concurrent other diseases, especially measles. Many studies conclude that malnutrition is one of the risk factors most important in the occurrence of necrotizing ulcerative gingivitis (Gordon, 2007; Dashash, 2000; Dietrich *et al*., 2005; Leggott *et al*., 1991). This condition is encountered in developing countries, particularly among children with malnutrition and especially in disadvantaged areas (Dashash, 2000; Ndiaye *et al*., 1999). It is described by several authors as the initial stage of noma, which is a serious disease that can be associated with a mortality of 60-90% (Berthold, 2003; Enwonwu *et al*., 1999)

Among the malnourished children, the students in Koranic boarding schools, called Daara, made up a large group. These students are generally marginalized, left to themselves and frequently have little to eat. They have poor living conditions, characterized by poor hygiene, overcrowding and poverty. During this period while learning the Koran, perhaps for several years, these children, mostly boys, often do not benefit from social and health care. The religious practice is purely traditional of a type encountered in West Africa, particularly in Senegal (Marguerat and Poitou, 1994). Scientific studies on this population are relatively rare. The social group is characterised by poor utilisation of health and social services and a tendency to prefer traditional medicine for economic reasons. The aim of this study was to determine the prevalence and factors associated with necrotizing ulcerative gingivitis of students in Koranic boarding schools in the holy city of Touba, a religious fast-growing city (population over a million) 200km east of Dakar, the capital of Senegal.

Methods

The cross-sectional study involved students aged 2-25 years, of both genders in 15 Koranic schools in Touba; all were Daara recognized by the Islamic Schools League of Touba. Daara were chosen because they are well organised and allow easy access to the participants. A multistage sampling technique (cluster sampling) was used, based on 17 villages or clusters that make up the community of Touba. The clusters were numbered 1 to 17 in alphabetical names order and those with even numbers selected: Darou Khoudoss, Darou Minam, Djanatoul Mahwa, Haliya, Khaira, Ndamatou, Ndindy and Touba Mosque.

In each of the selected clusters Daara were chosen: just one Daara in most clusters but two in Touba Mosque to give similar numbers of participants. The sample comprised 501 students including all children in the selected Daara.

Prior informed consents of the Koranic teachers and the students were requested and given and ethical aspects were approved by an independent ethics committee. Information was collected using a questionnaire in a face-to-face interview and a clinical oral examination. The questionnaire focused on socio-demographic characteristics: gender, age and length of time at boarding school; oral hygiene habits (use of brush or chewing stick) and gingival conditions (hygiene and bleeding).

Oral hygiene was assessed using the plaque index of Silness and Löe (1964) which determines the quality of oral hygiene by quantifying the deposits on tooth surfaces. The scores were: 0=no plaque, 1=plaque detected with a sharp probe by scraping the tooth surface in contact with the gingival margin, 2=plaque visible to the naked eye moderate amount, 3=tooth surface covered with a significant amount of plaque. The vestibular surface of upper right central incisor (11), right lateral incisor (12), the right first molar (16) and left first molar (26), lower right central incisor (31) and right lateral (32) as well as the lingual surface of the lower left molar (36) and the lower right (46) were examined. When the permanent tooth had not erupted, assessments were done on the corresponding deciduous tooth. In case of a missing tooth or substantial or total destruction of the crown, no score was assigned. The mean plaque index was calculated for each patient by the total scores divided by the number of teeth examined.

The degree of bleeding was assessed by the Papilla Bleeding Index of Saxer & Mühlemann (Martin and Bercy, 2002). This records the tendency to bleed after stimulation of the papilla and the intensity of bleeding. These were scored using the following grades: 0=no bleeding, 1=onset of a bleeding point, 2=appearance of a trail of blood, 3=appearance of a triangle of blood, 4=immediately after probing, blood flows into the interdental space.

For this index, only certain papillae are stimulated: the vestibular papilla of the upper right central incisor (11), the lateral (12), the right first molar (16) and palatal gingiva of the left central incisor (21), left lateral incisor (22) and left maxillary first molar (26); in the mandible, the first molar lingual lower right (46), the lower right second incisor (42), the lower right central incisor (41), the vestibular gingivae of the lower left incisor (31), the lower left side (32) and the left first molar (36) were assessed. When a permanent tooth had not erupted, the corresponding deciduous tooth was used. The presence of non-necrotizing ulcerative gingivitis was also noted. The diagnosis was made when there was a simultaneous presence of gum ulceration, pseudo-membranes, pain and halitosis. The gum ulceration and halitosis were selected as primary criteria for diagnosis.

Data were entered into Epi Info v3.3.2 and analysed using R software v2.9.0 with the significance level set at 5%. Results were expressed as proportions and means with standard deviations. Quantitative variables were retained in the analysis if they had an association with the linear dependent variable. Bivariate analyses were conducted to examine the association between the presence of necrotizing ulcerative gingivitis and explanatory variables.

Variables for which the level was less than 25% were selected for multivariate analysis. The size of Daara variable was created in order to neutralize the effect of the Daara size. The final model was constructed using logistic regression with a manual backward procedure.

Results

Table 1 includes the general demographic characteristics of the Koranic boarding school students. Male students made up 92% of the group and the mean age was about 9.3 (sd 4.0) years. The Daara of Khoudoss had the largest number of students (n=106, 21%) followed by that of Mosque (n=101, 20%). The Daara of Khayra was the smallest (n=29, 6%). The mean time spent at boarding school was 3.4 (sd 1.5) years. The mean plaque and bleeding index scores were respectively 2.8 and 3.2. A majority of the children (81%) did not use a toothbrush or a chewing stick.

The prevalence of necrotizing ulcerative gingivitis was 37% and the variation by Daara and gender ranged from 16% in males at Haliya to 71% in males at Mahwa. (Table 1)

From bivariate analysis, gender was the only explanatory variable not significantly associated with the presence of necrotizing ulcerative gingivitis (p=0.07). Table 2 presents the summary results of the backward multiple regression anlaysis. The final model revealed number of years at the Daara, the size of the Daara, hygiene habits, plaque and bleeding index variables were all significantly associated with the presence of necrotizing ulcerative gingivitis.

Discussion

The descriptive cross-sectional study determined the prevalence and associated risk factors for necrotizing ulcerative gingivitis. Subjects were all students present (99% attendance) in the selected Daara at the time of investigation. Clinical examination was performed by one dentist using a standard set of instruments for all examinations. This approach was chosen to reduce information bias and especially non-incremental classification. Some possible risk factors, such as malnutrition, would have been difficult to measure in the context of the study and information on these was not collected. We are not aware of other studies on this population group with which to compare our results. In all the selected Daara most of the children were boys and they made up 92% of the subjects (Table 1). The predominance of boys is explained by the fact that Daara have a traditional character and many prefer that students be boys. It should be noted that this trend is beginning to change, thanks to initiatives and policies to promote literacy and schooling for girls. Gender was not significantly associated with the occurrence of necrotizing ulcerative gingivitis (Table 2). A study in Texas of over 10,000 2-17 year olds living in crowded conditions found that necrotizing ulcerative gingivitis was more common in boys (Shulman, 2005).

The mean age of our population, 9.3 years, is similar to that reported by Dashash (2000) in Syria who studied the relationship between malnutrition and gingivitis in 840 children. Gingivitis most often affects subjects of this age. They are characterized by a mixed dentition and display substantial local physiological and general

Table 1. Characteristics and prevalence of necrotizing ulcerative gingivitis of students in Koranic boarding schools

Variables	Units/modalities	n	%	Mean	sd	Mean Age (sd)	Prevalence of necrotizing ulcerative gingivitis			
							Males n	%	Females n	%
Gender	Male	461	92							
	Female	40	8							
Age in Years		501	-	9.3	4.00					
Daara	Khoudoss	106	21			10.1 (2)	95	22	11	18
	Miname	50	10			9.3 (3)	33	33	17	18
	Mahwa	91	18			8.0 (1)	91	71	0	undetermined
	Haliya	46	9			8.5 (2)	37	16	9	0
	Khayra	29	6			10.0 (3)	29	24	0	undetermined
	Ndamatou	44	9			9.4 (2)	44	32	0	undetermined
	Dindy	34	7			9.0 (3)	31	36	3	33

Table 2. Relation between necrotizing ulcerative gingivitis and characteristics of students from multiple regression anlaysis

Variables	Unit/modalities	n	OR [95% CI]	p-value
Gender	Male	461	1.4 [0.7; 1.9]	0.35
	Female	40	1 Ref.	
Age	Years	501	1.7 [0.8; 2.4]	0.06
Time in boarding school	Years	501	3.1 [2.2; 5.1]	0.001
Size of Daara			2.3 [1.4; 3.1]	0.026
Oral hygiene habits	Neither brush nor stick	406	2.9 [1.6; 3.5]	0.033
	Only chewing stick	74	1.8 [1.1; 2.4]	
	Brush once of day	21	1 Ref.	
Plaque index		501	2 [1.5; 2.9]	0.025
Beeding index		501	4.1 [2.9; 5.4]	<0.0001

changes (inflamed gums, poor immune defence) which can make children vulnerable to onset of necrotizing ulcerative gingivitis. In Thailand, it has been found that many oral lesions appeared in the mixed dentition (49%) (Dhanuthai *et al.*, 2007). In our study, the risk of developing necrotizing ulcerative gingivitis was not significantly related to age, after adjusting for other variables (Table 2).

The mean length of time in boarding school, 3.4 years (Table 1), was significantly associated with the risk of necrotizing ulcerative gingivitis. Indeed, the risk of necrotizing ulcerative gingivitis increased proportionately with time and the association was strong (OR 3.1, 95% CI 2.2, 5.1). This trend seemed logical because of the precarious living conditions. The more people remained in poverty, the greater the risk.

The high prevalence of cases of necrotizing ulcerative gingivitis in the Daara of Djanatoul Mahwa (Table 1) may be explained by the presence in this area of a large Islamic school housing many children aged 3-12 years. These children are taught before being sent to work in the religious leaders' fields. The large population of this Daara, exceeding its capacity, could increase children's stress and so encourage disease. Daara size was associated with disease.

The prevalence of necrotizing ulcerative gingivitis in our student sample was 37%. In Senegal, a 22% prevalence of stomatitis was found in children admitted to a military hospital (Yam *et al.*, 2006). The high prevalence of necrotizing ulcerative gingivitis (37%) in our study is probably linked to poor hygiene of students in the Daara. Indeed, 81% of students reported using neither toothbrush nor chewing stick (Table 1). Oral hygiene habits were associated with the disease, even after adjusting for other independent variables. This result is similar to that found in Nigerin 2-12 year olds where living conditions and quality of oral hygiene were related to necrotizing ulcerative gingivitis and noma (Idigbe *et al.,* 1999). Other authors also listed oral hygiene among the key risk factors for the occurrence of gum disease (Enwonwu *et al.*, 1999). Poor hygiene leads to plaque and tartar accumulation on the dental surfaces, providing oral bacteria with a fertile culture medium and encouraging virulence and pathogenicity. Students cleaned their mouths rarely; only 4% brushing daily.

In our study the risk of developing necrotizing ulcerative gingivitis doubled when the plaque index increased by one unit (Table 2). It is clear from this study that papillary bleeding was strongly associated with necrotizing ulcerative gingivitis (R=4.1, CI [2.9, 5.4]).

Conclusion

Necrotizing ulcerative gingivitis is considered to be the initial stage of noma. It is a consequence of several risk factors including poor oral hygiene, personal over-crowding and malnutrition. In vulnerable groups such as students at Koranic boarding schools, the prevalence of this disease is high. There is a need to develop prevention programs, to have access to good hygiene, to spread awareness among Koranic teachers, to reduce student crowding and to implement policies to promote health assured by regular medical inspections. These policies and programs may assist the fight against poverty and substantially reduce social inequalities in health among children.

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