Reliability analysis of visual examinations carried out by school-teachers and a dental assistant in the detection of dental caries.

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Aim: This study aims to investigate the reliability of examinations performed by teachers and by a dental assistant in detection of cavitated surfaces. *Methods*: A sample of 168 students, aged 5–14 years, attending a public school in Duque de Caxias, Rio de Janeiro, was examined by persons with three different training backgrounds: a dentist, a dental assistant, and schoolteachers. Examinations were performed in the school with the aid of a tongue blade under natural light. Kappa statistics were estimated to assess agreement between the observers. Sensitivity, specificity, and positive and negative predictive value tests helped validate observations performed by the group of laypersons. *Results*: The findings suggest satisfactory agreement with the dentist, with kappa values of 0.730 and 0.781 for the teachers and the dental assistant, respectively. The absence of cavities was easily detected (specificity = 96%). More caution is required in positive results indicated by the teachers or the dental assistant because these were not always confirmed subsequently (sensitivity = 76%) by the dentist. *Conclusion*: The aid of untrained personnel in dental epidemiology was shown to be a valid alternative for a signposting role.

Key words: Dental assistant, dental caries, reliability, validity, schoolteachers, visual exam.

Introduction

In many countries, generally, the groups most often selected as oral health programme beneficiaries are children and adolescents on the assumption that early dental disease prevention and treatment can improve dental health in the future. At school, actions such as health promotion, prevention, and early detection of problems should be prioritized. This is the rationale for outreach programmes in health education, immunization, fluoride application, evaluation of visual acuity disorders, and other initiatives. Daily contact with schoolchildren provides teachers the opportunity to know them, enabling the observation of certain changes from normality before a specialist can detect the problem. Visual and hearing problems, as well as behavior disorders, may hinder a child's learning and socialization development. As a result, some studies have been carried out to verify the perception of teachers regarding these problems with the purpose of providing input to teacher training programmes, especially in the public education system (Temporini *et al*., 1977; Sperandio, 1990).

Oral diseases, particularly dental caries, aside from causing pain and suffering, have been identified as one of the main causes of loss of productivity at work and in school.

Thus, studies on the prevalence of caries among schoolchildren are important for the referral of children requiring treatment to public or private clinics, for oral health programme planning, for evaluation of previous interventions, or for the orientation of parents or guardians. In Brazil, only dentists have conducted such studies, and the alternative of using other professionals have been unexplored. Nevertheless, the participation of a dental assistant in epidemiological surveys and clinical assessments of dental caries and periodontal disease is common practice in many countries (Mauriello *et al*., 1990; Kwan *et al*., 1996).

The main purpose of this study was to analyze the performance by public schoolteachers and a dental assistant in identifying changes related to dental caries among schoolchildren in an environment with a high prevalence of the disease.

Materials and Methods

The study was performed in 2004 at a Public Education Integrated Center (CIEP 227) located in the town of Duque de Caxias, in the metropolitan region of the state of Rio de Janeiro, Brazil. The school had a total of 550 students aged 5–14 years enrolled in the morning and afternoon shifts.

The sampling criteria considered that once the Research Ethics Committee of the Federal University of Rio de Janeiro (UFRJ) and the school principal had approved the study, it was necessary to identify some teachers that agreed to take part in such research, and six teachers volunteered themselves. The further phase involved voluntary acceptance by students (of these six teachers) and the consent of their parents or guardians. As a result, a group of one hundred sixty-eight (168) children were selected as the sample.

Neither the dental assistant nor the six teachers participating in the study underwent any kind of training or calibration. The idea behind this option was to reproduce the real context, that is, using minimal resources. They were instructed simply to indicate the tooth (or teeth) they judged as having cavities, regardless of the extent of the lesion, and darkened teeth. The main researcher stood beside each observer to take notes. Each teacher examined her own class students in a single session, totaling six groups and examined his/her own group without any previous communication among them.

Each subject had all his or her teeth examined sequentially by the dental assistant, the researcher dentist, and the teacher. By arranging for the dental assistant to examine each subject first, this sequence would remove the likelihood of a memory bias on the part of the dental assistant as she was required to act as a recorder for the dentist.

The DMF-T and dmf-t indices were reduced to the component "D" to represent the dental health status of population, considering the small percentage of underlined missed and filled teeth (1.2%) in the sample. Because the current status of the disease is the key target of this study, the agreement analysis of examinations performed by lay persons and the dentist and dental assistant and the validation of their findings considered only healthy and decayed elements.

The notating used to represent the results of the dental examination was, for each tooth, as follows: 0 (zero) for permanent and healthy, "A" for deciduous and healthy, 1 (one) for permanent and decayed, and "B" for deciduous and decayed.

The results of the visual examination performed by the researcher dentist served as the benchmark for comparing the findings of teachers and the dental assistant.

The diagnostic criteria adopted to define healthy teeth were the absence of treated or untreated decay. The early stages of disease (white spot) that precede cavity formation according to the World Health Organization (1999) were not included because of the difficulty in detecting this condition, which may lead to questionable diagnostic reliability.

The diagnostic criteria adopted to define decayed teeth were when a pit, fissure, or smooth surface lesion presented with decay or loss of substance. Teeth with temporary, infiltrated or fractured restoration, or loose permanent restorations, filled or restored with sealant, and decayed at another site were not considered for purposes of the agreement analysis and validation of examinations performed by the teachers and the dental assistant because they require assessment by a trained professional. The teeth requiring extraction were included in the group of decayed teeth.

To ensure the uniformity of examinations, the environmental conditions were standardized, and patient and examiner positioning were preset. The time spent on each examination was, on average, two minutes for all the examiners.

The visual examination procedure adopted was the same for all observers; it was carried out in the classroom under natural lighting, with the observer facing the student to facilitate the lighting of the oral cavity.

Cleaning and drying of the teeth prior to examination were not performed by the dentist, in the interest of time, and to simulate the conditions under which most epidemiological dental surveys are conducted.

It is also relevant to say that all examinations were scheduled before recess or lunch because there is no guarantee that all children brush their teeth regularly after lunch, and in case the teeth are not clean, the examination could be jeopardized.

The observers used masks, caps, disposable gloves, and tongue blades to retract cheek, tongue, and lips to allow better visualization of tooth surfaces.

The data obtained were analyzed using tables consistent with the measurement scales of the variables studied. The conclusions of the dental assistant and the dentist consist of one pair of data, and the results of the teachers and the dentist form another pair of data. The observation pairs underwent descriptive analyses at the level of both the tooth and the individual.

The kappa coefficient (k), which estimates the rate of agreement discarding identical random observations (Szklo and Nieto, 2000), was used in agreement analysis between the dentist and the layperson, the dental assistant and the teachers. The McNemar chi-square test and the Wilcoxon tests were used to check on a possible bias between examinations to verify need to treat and decay rates, respectively.

Assuming the visual examination of the dentist as the gold standard in identification of decayed teeth, sensitivity and specificity estimates were computed, as well as the predictive values of examinations performed by the teachers and the dental assistant. The data were entered into a database using SPSS software, and the statistical analysis was developed using EpiInfo 6.04d.

Results

Most of the students were male and aged between 8 and 10 years (Table 1).

Of the 168 survey participants, 135 (84.4%) were examined by the three observers (dentist, dental assistant, and teachers), even as the dental assistant and dentist or teacher and dentist examined the remaining students, which explains the different sample sizes in the following tables. The history of the existing caries found by each examiner in the different classes of dentition, as well as the descriptive statistics of the indices (mean, standard deviation, minimum, median, and maximum), can be seen in Table 2. The table analysis indicates that the dental assistants` results are closer to the dentists`, because of both difference of means and p-values.

Table 3 shows the analysis of the prevalence of caries according to each of the observers and the between-observer agreement as regards indication for treatment, taking the individual as the unit of observation. In comparing students requiring treatment (one or more decayed teeth) or not (decay free), all classified by the dentist and the teachers or the dental assistant, the kappa values found were 0.70 and 0.71, respectively, and there was a satisfactory percentage of overall agreement concerning children's need for treatment.

The agreement between the observers according to the healthy or decayed criteria is presented in Table 4.

Table 1. Age and gender distribution of survey sample

Age	Total		Gender			
			Male		Female	
	n	%	n	%	n	%
5 to 7	27	16.1	17	16.8	10	14.9
8 to 10	84	50.0	52	51.5	32	47.8
11 to 14	57	33.9	32	31.7	25	37.3
Total	168	100.0	101	100.0	67	100.0

Table 2. Descriptive statistics of the decayed teeth according to the examiners

Teeth and examiners	Descriptive statistic						p-value of
	n	Mean	Standard deviation	Minimum	Median	Maximum	Wilcoxon test
Permanent decayed teeth							
Dentist (D)	168	1.7	2.2	0	1	14	
Teachers (T)	161	1.9	2.4	0	1	12	
Dental Assistant (DA)	142	1.9	2.3	0	1	12	
D – T	161	-0,18	1.5	-8	0	5	0.176
D – DA	142	-0,13	1.2	-5	0	5	0.193
Deciduous decayed teeth							
Dentist (D)	168	1.9	2.6	0	1	10	
Teachers (T)	161	1.6	2.2	0	1	8	
Dental Assistant (DA)	142	1.9	2.6	0	1	12	
D – T	161	0.21	0.9	-2	0	4	0.005
D – DA	142	0.05	0.9	-3	0	4	0.588
Decayed (permanent + deciduous)							
Dentist (D)	168	3.6	3.2	0	3	14	
Teachers (T)	161	3.5	3.0	0	3	12	
Dental Assistant (DA)	142	3.8	3.2	0	3	14	
D – T	161	0.03	1.8	-8	0	6	0.792
D – DA	142	-0,08	1.6	-5	0	6	0.433

Table 3. Agreement on treatment indication* by visual examination between teachers and dental assistant compared to visual examination by dentist

Treatment indicated by teachers or dental assistant	Total		Treatment indicated by dentist					p-value of
			Yes*		No		Kappa	McNemar
	n	%	n	%	n	%	(95%CI)	$\square^2$ test
Teachers								
Yes*	133	82.6	123	76.4	10	6.2	0.70	
No	28	17.4	5	3.1	23	14.3	(0.54 - 0.85)	0.302
Total	161	100.0	128	79.5	33	20.5		
Dental assistant								
Yes*	115	81.0	107	75.4	8	5.6	0.71	
No	27	19.0	5	3.5	22	15.5	(0.55 - 0.88)	0.579
Total	142	100.0	112	78.9	30	21.1		

*Students with at least a dental element with caries, excluded them lost and filled

Table 4. Tooth by tooth agreement* between visual examination performed by teachers and dental assistant and those performed by the dentist

Visual evaluation by teachers or by dental assistant	Total		Visual evaluation by dentist				Kappa
			Healthy teeth		Decayed teeth		
	n	%	n	%	n	%	
Teachers							
Healthy teeth	3279	85.5	3143	82.0	136	3.5	
Decayed teeth	556	14.5	123	3.2	433	11.3	0.73
Total	3835	100.0	3266	85.2	569	14.8	
Denatal assistant							
Healthy teeth	2833	84.2	2744	81.5	89	2.6	
Decayed teeth	533	15.8	105	3.1	428	12.7	0.78
Total	3366	100.0	2849	84.6	517	15.4	

*Lost and filled teeth were excluded

Table 5. Indicators of validity

Level of analysis	Comparison	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Individual	Teachers vs. Dentist	96.1%	69.7%	92.5%	82.1%
	Dental assistant vs. Dentist	95.5%	73.3%	93.0%	81.5%
DentalTeeth?	Teachers vs. Dentist	76.0%	96.2%	77.9%	95.9%
	Dental assistant vs. Dentist	82.8%	96.3%	80.3%	96.9%

Considering all of the teeth examined, kappa values of 0.73 and 0.78, respectively, were found for the teachers' and the dental assistant's evaluations as compared with that carried out by the dentist; both numbers indicate good response.

Tables 3 and 4 show information generated by the teachers and by the dental assistant at the individual level, whereas overall dental health levels can be seen in Table 5, which confirms that the dental assistant was better at detecting disease in decayed teeth as compared with the teachers, both by sensitivity and specificity figures.

Discussion

Several studies have compared the responses of simplified screening, outside dental offices and not performed by dentists, with the visual examination carried out by a dentist in the dental office (Mauriello et al. 1990; Kwan et al. 1996; Beltrán et al. 1997). They found that differences were not statistically significant, thus providing a simple and easy alternative for the development of oral health programmes.

As reported by Olin et al. (1998), teachers and parents or guardians are able to identify children at risk of disorders development.

Nederfors et al. (2000) evaluated the ability of a dental assistant to estimate oral health status and treatment need in elderly patients of a home care programme in Sweden.

According to this study, treatment need was overestimated, which would be acceptable and not detrimental to the patient because the dentist subsequently reassessed false-positive results more carefully and accurately.

The findings of Hawley et al. (1999) contrast with those reported in this study with regard to the reliability of examinations performed by the dental assistant, for which their kappa coefficient was 0.57. Besides, Hawley et al. (1999) have trained the dental assistants for the test; they questioned whether the approach used for training the dental assistant might have been insufficient.

In Brazil, studies involving the ability to detect caries by laypersons usually involve parents or guardians. Miceli and Soviero (2000) and Silva et al. (2002) evaluated the ability of parents to correctly identify early caries. The authors concluded that instructions on early diagnosis of caries improved detection ability. Miceli and Soviero (2000) found a very poor agreement score (k = 0.09) among the group that did not receive prior instructions, indicating that it is nearly impossible for a layman to recognize the first clinical sign of caries—an active white spot.

Although the current Brazilian legislation prohibits dental assistants from performing epidemiological surveys, such practices have been used in some locations of North America, as mentioned by Grembowskie et al. (1992), highlighting the cost/benefit considerations.

The results found by the collected data indicate that it is possible to develop a programme to identify tooth diseases in communities with little or no access to dentist care. Teachers or dental assistants proved to be able to perform the first screening in such places, and the performance of such a programme would be enhanced by previous training of these groups. As a result, the patients could avoid future pain and costs, whereas society could benefit by reducing absenteeism at work and improving productivity.

Furthermore, the participation of teachers in dental caries detection would bring dentistry closer to the school environment, facilitate dissemination of health promotion concepts, and save dentists' time in case of scarcity of professionals.

Acknowledgements

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