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ORIGINAL ARTICLE

Dental Caries Spectrum Profile and Dental Visits by Preschool Children: Application of Andersen's Model

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ABSTRACT

Objective: To estimate the frequency of preschool children who attended a dental visit and identify associated factors. **Material and Methods:** A cross-sectional study was conducted with children aged 2-5 years enrolled in preschools (n=200) in southern Brazil. Parents/guardians completed a questionnaire, and oral exams were performed using the CAST instrument. The outcome was whether the children had consulted a dentist in their lifetime. Andersen's behavioral model was applied to assess associated factors, including predisposing factors (sex, age, maternal education), enabling factors (family income), need factors (dental caries severity, dental pain, oral health-related quality of life (OHRQoL), and oral hygiene habits), and psychosocial factors (dental fear). Associations were tested using Poisson's regression, obtaining the prevalence ratio (PR) and 95% confidence interval (CI). **Results:** The majority of the children had never visited a dentist (71%; n=141), while 15% (30) had done so for prevention and 14% (29) for oral health problems. Need factors associated with having consulted a dentist included severe dental caries (PR=3.11; 95%CI=1.85-5.20), dental pain (PR=2.04; 95%CI=1.32-2.17), toothbrushing performed by parents (PR=1.99; 95%CI=1.05-3.77), and presence of an impact on OHRQoL (PR=1.87; 95%CI=1.21-2.89). The psychosocial factor of the absence of dental fear (PR=2.28; 95%CI=1.45-3.59) was also associated with the outcome. **Conclusion:** Most preschool children have never visited a dentist. Using a dental service was associated with both need and psychosocial factors.

Keywords: Cross-Sectional Studies; Dental Care; Dental Caries; Epidemiology.

Introduction

Early dental care is crucial in creating parental awareness of children's oral health, identifying oral disease risks, monitoring tooth growth, and ensuring preventive or corrective treatments. Addressing dental needs in their early stages reduces oral issues significantly, preserves primary teeth, and enhances a child's well-being and future oral health-related quality of life [1-3]. However, most children only visit a dentist when they have dental caries, which remains the most common chronic disease in early childhood and the primary threat to maintaining oral health [4]. According to the Global Burden of Disease study, the worldwide prevalence of untreated caries in deciduous teeth was 7.8% (95% UI, 6.5% to 9.1%) in 2017, with the number of prevalent cases totaling 532 million (95% UI, 443 to 622 million) [5]. Additionally, untreated caries decreased at a higher rate in high-income countries than in low-income countries from 1990 to 2017; one likely reason for this trend is improved access to dental treatment [5]. The use of health services results from a complex interaction among users, service availability, and access, influenced by several factors.

In Brazil, the use of dental services by children is both low and often delayed [6-8]. This pattern was revealed by a systematic review that examined determinants of dental services used based on the Andersen model [9]. The well-established Andersen model [10] has been employed in various studies to explore the determinants of hospitalization or doctor visits [11,12]. This model is a significant "behavioral model of health service use" that distinguishes among predisposing characteristics, such as sex or age, enabling resources, like perceived access to healthcare or disposable income, and need factors, such as chronic diseases or self-rated health. The review's findings indicated that visits of children to the dentist were associated with age (a predisposing characteristic), higher income (an enabling resource), and oral health problems (a need factor) [9].

Understanding the disparities in oral health conditions and the use of dental services is crucial for planning interventions to enhance access and quality of care. Using a measure that assesses oral health conditions and provides a detailed view of disease epidemiology, such as the Caries Assessment Spectrum and Treatment (CAST) instrument [13], can assist in determining dental treatment needs and their association with the use of dental services. To date, no study has been found evaluating the morbidity stage and the frequency of dental service use. Furthermore, the studies examining clinical, behavioral, and psychosocial factors associated with seeking oral health care for children are limited [8,14]. This study aimed to estimate how frequently children aged 2-5 years attended a dental visit and what factors were associated with seeking dental care.

Material and Methods

Ethical Clearance

The study was approved by the Local Department of Education, and by the Local Human Research Ethics Committee (#2.531.245). The legal guardians were informed about the research and signed a free informed consent form authorizing the child's participation. Children who refused to undergo the oral exam were excluded from the study. After the oral exam, parents received written information about their children's oral health. The preschoolers were given toothbrushes and participated in oral health education activities; those with pain or infection were referred to the School of Dentistry for treatment. Guidelines set by Strengthening the Report of Observational Studies in Epidemiology (STROBE) guidelines were used to structure the study report [15].

Design and Sample

The present school-based cross-sectional study was carried out with preschool children in the urban area of Capão do Leão, RS, Brazil. In the last demographic census, the city had 24,298 inhabitants, 2,280 of whom were between zero and 5 years old. The town has three public schools serving the study's age group and no private schools. All the children aged 2 to 5 years enrolled in the three public schools of the city were initially eligible for the study. Preschoolers with any physical and psychological disabilities that precluded examination were not included.

As described elsewhere [16], a minimum sample size of 153 children was required to meet the main objective of this study, considering a prevalence of 39% of dental caries, and a 95% confidence level. The power for the present study was calculated a posteriori, using the OpenEpi software program (www.openepi.com). The following parameters were used to estimate the study power: an alpha error probability of 0.05, with a 24% prevalence of dental visits for the non-exposed group (absence of dental caries), and 75% for the exposed group (presence of severe dental caries). The sample included (n=200) a power of 88.9%.

Data Collection

The data were collected between May and August 2018. The school sent the invitation letter and authorization terms to the parents. Those who agreed to participate answered the questionnaire, also sent through the school. The instrument was previously tested in a pilot study with 20 mothers who attended a university dental clinic, and they were not part of the main sample. No alterations were deemed necessary.

Clinical examination of the children's oral cavity was carried out on school premises by a previously trained and calibrated team composed of two examiners (graduate students of Pediatric Dentistry), two note-takers, and an assistant (graduate student). They wore personal protective equipment (gloves and apron) and made use of artificial light (study lamps), toothbrushes, mouth mirrors, Community Periodontal Index (CPI) periodontal probes, gauze, and cotton swabs. The assistants recorded the exams on a form developed by the Microsoft Excel program. The form was designed with functions requiring filling specific fields, limiting the acceptable number of characters. In addition, they were recording the scores directly on the form dispensed with the step of having to type the oral exam data, thus reducing the possibility of errors. Moreover, the form made it easier to record the exam time, by having the annotator click when answering the start and end fields, as commanded by the examiner. The schools were visited as often as necessary so that no more than 10% of children were lost.

Outcome

The outcome of the present study was determining whether the children had consulted a dentist in their lifetime. Information to establish the outcome was collected by means of questionnaires sent to the children's homes [17]. It was obtained from the following question: "When did your child last have a dentist appointment?" The response options were "never," "less than 1 year ago," or "more than 1 year ago." These responses were then categorized as having or not having visited a dentist at least once in the child's life (yes/no). In addition, the reason for the last dental visit was evaluated (preventive vs. problem-driven visits, according to the existence of oral health problems).

Independent Variables

The independent variables were selected based on Andersen's Behavioral Model of Health Service Use [7], including predisposing factors (child's sex and age, and maternal education), enabling factors (family

income), need factors (impact on oral health-related quality of life, dental pain, oral hygiene habits, and dental caries morbidity stage), and psychosocial factors (child's dental fear).

Maternal education was categorized as low when the mother had less than eight years of school or higher education. The monthly household income data were collected in Brazilian currency and subsequently dichotomized according to the Brazilian minimum wage (BMW) in ≤ 1.5 BMW or > 1.5 BMW (1 BMW is equivalent to approximately US$220.00). Impact on oral health-related quality of life (OHRQoL) was evaluated using the Early Childhood Oral Health Impact Scale (ECOHIS) [18,19] and classified as present (ECOHIS sum score ≥1) or absent (score=0). The prevalence of dental pain was investigated with the question: "Has your son/daughter ever had dental pain?" and categorized as no (absent) or yes (present) [6]. Information about who brushes the child's teeth was also obtained and classified as "yes" when an adult brushed the child's teeth or "no" when the child brushed their teeth.

The dental caries morbidity stage was evaluated using the CAST instrument [20]. CAST is composed of 10 codes classified hierarchically as 0: healthy; 1: sealant; 2: restoration; 3: distinct visual change only in the enamel; 4: discoloration related to internal caries in the dentin; 5: distinct cavitations in dentin; 6: involvement of the pulp chamber; 7: abscess/fistula; 8: lost by caries; 9: none of the previous descriptions [21]. The maximum score per tooth was calculated, and the maximum score per child was used to determine the following dental caries morbidity stages: healthy (characterized by children with a maximum score of 0, 1, or 2), pre-morbidity stage (score of 3), morbidity stage (scores of 4 or 5), severe morbidity stage (scores of 6 or 7), and mortality (score of 8).

The Dental Anxiety Question (DAQ), validated by Neverlien [22] and adapted by Oliveira and Collares [23], was used to determine the child's dental fear, as follows: "Do you think your child is afraid of going to the dentist?" The following possible answers were provided: a. "no," b. "yes, a little," c. "yes," and d. "yes, a lot." The categories were dichotomized into "No, my child has no dental fear" (for answers a and b), and "Yes, my child has dental fear" (for answers c and d).

Training and Calibration Process

The researchers undertook theoretical and practical training (12 hours) with some of the authors of the CAST instrument. Their theoretical training (4 hours) included a presentation of the guidelines and structure of the instrument, its scores and descriptors, protocol and manner of conducting the exam, and photographs illustrating the clinical situations covered by the instrument. A practical training session (4 hours) was held involving the examination of photographs and extracted teeth, and disagreements were discussed. Calibration was performed after the training session. A sample of 10 children of the same age group and socioeconomic status was preselected from the main study. The first examinations were discussed between the study examiners and the experienced examiner. Afterward, 20 children were examined individually by each examiner, and the values obtained were compared to those of the experienced examiner to ensure interexaminer agreement. The weighted kappa coefficient (k) was 0.68 and 0.72, and the exact mean percentage agreement (Po) was 96.2% and 97.0%. Ten percent of the sample from the main study was reexamined to determine the intraexaminer agreement, and both examiners achieved acceptable results. The mean weighted kappa coefficient was 0.71, with 0.021 standard error (SE) and 97.0% Po.

Data Analysis

Valid data were collected in the questionnaires, transferred to a specific database in the Microsoft Office Excel program, and analyzed in the Stata 14.0 program (Stata Corporation, College Station, TX, USA). Initially, independent variables were described according to dental services used (never visited, visited for prevention, or visited for treatment), using proportions, and a 95% confidence interval (CI). The chi-squared test was used for associations, and the Poisson regression analysis with robust variance was performed to test the association of independent variables with the outcome of having visited a dentist at least once in the child's lifetime. The prevalence ratio (PR) and 95% CI were estimated. The variables with $p<0.25$ in the crude analysis were included in the adjusted analysis and retained in the adjusted model if they remained associated. All the analyses were performed adopting a 5% statistical significance level ($p<0.05$).

Results

A total of 264 children were eligible. Forty of these (15.1%) did not return the consent form, and 24 (9.1%) were absent or did not accept taking the clinical examination. Thus, 200 children participated in this study (response rate of 75.8%). Table 1 illustrates the sample characteristics based on the use of dental services. The majority of the children were female (50.5%), and most were aged 4 to 5 years (85.5%), with a mean age of 4.1 years. Regarding family characteristics, a significant proportion of mothers had completed eight or more years of schooling (78.01%), and over half of the families had an income below 1.5 minimum wage (52.76%). The majority of children had never visited a dentist (70.50%), while 15% (30) had visited one for preventive reasons, and 14.50% (29) had sought dental treatment due to an oral health problem. The use of dental services was found to be associated with need and psychosocial factors.

Table 1. Sample characteristics and use of dental services according to predisposing, enabling, need, and psychosocial factors.

Variables	Total N (%)	Never Visited Dentist N (%)	Visited Dentist for Prevention N (%)	Visited Dentist for Treatment N (%)	p-value*
Predisposing Characteristics					
Sex					0.636
Male	99 (49.50)	72 (72.73)	15 (15.15)	12 (12.12)	
Female	101 (50.50)	69 (68.32)	15 (14.85)	17 (16.83)	
Age					0.563
2-3 years	29 (14.50)	20 (68.97)	6 (20.69)	3 (10.34)	
4-5 years	171 (85.50)	121 (70.76)	24 (14.04)	26 (15.20)	
Maternal Education**					0.619
Low	42 (21.99)	32 (86.19)	4 (09.52)	4 (09.52)	
High	149 (78.01)	105 (70.47)	23 (15.44)	23 (15.44)	
Enabling Resources					
Family income**					0.941
≤1.5 salary	86 (52.76)	55 (71.43)	9 (11.69)	13 (16.88)	
≥1.5 salary	77 (47.24)	62 (72.09)	11 (12.79)	13 (15.12)	
Need Factors					
Adult brushes teeth**					0.006
No	52 (26.80)	43 (82.69)	1 (01.92)	8 (15.38)	
Yes	142 (73.20)	93 (65.49)	29 (20.42)	20 (14.08)	
Dental pain**					0.001
No	170 (85.43)	127 (74.71)	25 (14.71)	18 (10.59)	
Yes	29 (14.57)	14 (48.28)	4 (13.79)	11 (37.93)	
Impact on OHRQoL**					0.001
No	119 (61.03)	93 (78.15)	18 (15.13)	8 (06.72)	
Yes	76 (38.97)	45 (59.21)	12 (15.79)	19 (25.00)	
Dental Caries Condition					<0.001

Healthy	45 (22.50)	34 (75.56)	9 (20.00)	2 (4.44)	
Pre-morbidity	70 (35.00)	54 (77.14)	10 (14.29)	6 (08.57)	
Morbidity	76 (38.00)	51 (67.11)	10 (13.16)	15 (19.74)	
Severe morbidity	8 (4.00)	2 (25.00)	1 (12.50)	5 (62.50)	
Mortality	1 (0.50)	-	-	1 (100.0)	
Psychosocial Factor					
Dental fear**					0.001
No	79 (45.40)	41 (51.90)	18 (22.78)	20 (25.32)	
Yes	95 (54.60)	75 (78.95)	11 (11.58)	9 (9.47)	
Total	200 (100.0)	141 (70.50)	30 (15.00)	29 (14.50)	

*Chi-squared test; **Missing data.

Table 2 shows the distribution of the children who visited a dentist at least once to treat their most severe caries conditions, according to CAST categories. The number of children using a dental service at least once increased with the severity of dental caries (p=0.009).

Table 2. Distribution of the children according to the most severe caries condition and use of dental services.

Disease Status	CAST Code	Maximum CAST			Visited Dentist		p-value*
		N	%	Total (%)	N	%	
Healthy	0 (Sound)	45	22.50	22.50	11	24.40	0.009
	1 (Sealant)	0	0.0				
	2 (Restoration)	0	0.0				
Pre-morbidity	3 (Enamel)	70	35.00	35.00	16	23.86	
Morbidity	4 (Carious lesion in dentine)	4	2.00	38.00	25	32.89	
	5 (Dentine cavity)	72	36.00				
Severe Morbidity	6 (Dentine cavity with pulp involvement)	6	3.00	4.00	06	75.00	
	7 (Abscess/ fistula)	2	1.00				
Mortality	8 (Lost)	1	0.50	0.50	01	100.00	
Total		200	-	100	59	29.50	

*Chi-squared test.

Table 3 shows the crude and adjusted estimates for the association of enabling, predisposing, need, and psychosocial factors adjusted with having visited the dentist at least once in the child's lifetime. Regarding the predisposing factors, the service demand had no significant association with demographic or socioeconomic variables, such as sex, children's age, and maternal education (p<0.05). Family income was considered an enabling factor, but it was also not associated with having visited a dentist at least once. After adjustments, the need factors, including presence of severe dental caries (PR=3.11; 95%CI=1.85-5.20), toothbrushing performed by parents (PR=1.99; 95%CI=1.05-3.77), and presence of an impact on OHRQoL (PR=1.87; 95%CI=1.21-2.89), and the psychosocial factor absence of dental fear (PR=2.28; 95%CI=1.45-3.59) were associated with having visited a dentist.

Table 3. Crude and adjusted analysis of the association between enabling, predisposing, need, psychosocial factors, and having visited the dentist at least once in the child's lifetime.

Variables	PR	Crude (95%CI)	p-value	PR	Adjusted (95%CI)	p-value
Predisposing Characteristics						
Sex						
Male	1.00		0.566			
Female	1.16	(0.70-1.93)				
Age						
2-3 years	1.00		0.844			
4-5 years	0.94	(0.52-1.70)				
Maternal education§						

Low	1.00		0.479			
High	1.24	(0.68-2.25)				
Enabling Resources						
Family income						
<1.5 BMW	1.00		0.925			
>1.5 BMW	1.02	(0.62-1.67)				
Need Factors						
Adult brushes children's teeth						
No	1.00		0.034	1.00		0.039
Yes	1.99	(1.05-3.77)		1.82	(1.03-3.21)	
Dental pain						
No	1.00		0.001			
Yes	2.04	(1.32-3.17)				
Dental Caries Condition						
Healthy/Pre-morbidity	1.00		0.018	1.00		0.080
Morbidity	1.36	(0.86-2.15)		1.22	(0.79-1.88)	
Severe morbidity/Mortality	3.11	(1.85-5.20)		2.05	(1.00-4.23)	
OHRQoL						
No impact	1.00		0.005			0.015
Impact	1.87	(1.21-2.89)		1.68	(1.10-2.55)	
Psychosocial Factor						
Dental fear						
Yes	1.00		<0.001	1.00		<0.001
No	2.28	(1.45-3.59)		2.22	(1.43-3.45)	

Discussion

The present study adopted the Andersen model [10], and evaluated factors associated with children having visited the dentist at least once in their lifetime. Most of the children studied had never visited a dentist. Children with severe dental caries and dental pain visited the dentist more frequently than those without severe caries or a history of dental pain. In addition, the fact that a child had visited a dentist at least once was associated with oral hygiene practices and dental fear.

The low prevalence of dental visits observed in this study is similar to a previous study conducted in a southern Brazilian city, where only 26% of the children had visited a dentist at the age of 3 [24]. The low frequency of dental visits by children aged 4-5 years in the present study is an even more concerning rate than that of a comparative group of younger children from a study performed ten years earlier in Pelotas. This study found that a similar prevalence of younger children had never attended a dental visit, thus indicating that no substantial change has been observed in the use of dental services in one decade [7]. This low demand for dental care is a concern on the part of both the population and the public sector since it reveals that there is no policy in place to encourage and support early dental care measures [25]. Notably, Brazil has the largest public health system in the world. It provides preventive and curative care to the entire population, including children, and covers strategies for caring for pregnant women. The lack of health literacy in relation to the importance of dental visits during the first years of a child's life may be why there is such a low prevalence of dental services used by children [26].

In the present study, the demand for services had no significant relation to demographic and socioeconomic variables, such as sex, children's age, and maternal education. However, these findings differ from those of other authors, who found significant associations [24,25]. Family income, which is an enabling factor likewise associated with the use of services, was also not related to this demand in the present sample. This can be explained by similarities in the characteristics of the studied sample since all the children went to public schools.

Oral problems often drive children's use of dental services. The fact that the children in this sample visited the dentist at least once was strongly associated with need factors, suggesting that parents take their child to the dentist when they perceive an oral health problem, mainly to treat and not to prevent oral diseases. In the present sample, the presence of severe dental caries influenced parents' taking their children to the dentist. When the CAST codes were considered, the higher the maximum score presented by the child, the higher the frequency of dental service use. A previous study analyzed the predisposing, enabling, and need factors that may influence the willingness to schedule the first dental visit within 1 year of age, and also found that need factors play a vital role in the desire to schedule the first dental visit of infants [27].

It is known that until decay interferes with the child's life, parents may be unaware that a dental problem even exists. Parental perception of their child's OHRQoL was also associated with the use of dental services. This corroborates a previous study showing that caregivers' unfavorable perception of their children's oral health motivated them to seek dental care [7]. These findings confirm that a greater need for oral health (perceived or normative) is an important predictor of preschoolers' use of oral health services. In addition, the use of dental services by children and adolescents is often motivated by the presence of pain. In the same study [7], the pain experience influenced parents to take their children to the dentist, whereas the occurrence of teeth affected by caries did not. However, only 30.9% of the children with pain were taken to the dentist. The fact that an adult performs the child's oral hygiene was also associated with visiting the dentist. This could be attributed to parents being able to detect oral health problems during teeth brushing and subsequently take the child to the dentist or to parents following the dentists' instructions for the adult to ideally brush the teeth of a child in this age group.

Only one of the studies included in a systematic review explicitly examined the role of psychosocial factors in the use of dental services [9]. Children with dental fear visited a dentist less frequently than children without dental fear. It is widely recognized that fear of dental treatment leads patients to miss dental visits or schedule them irregularly. Fearful patients avoid going to the dentist, an attitude that eventually leads to requiring more invasive dental procedures and causing even more significant discomfort or pain. This, in turn, evokes even greater fear of the next appointment, thus establishing the so-called "cycle of fear" [28]. Noteworthily, the children in this sample who visited a dentist may have acquired positive perceptions of the dental environment, which contributed to reducing dental fear. Thus, it should be borne in mind that the answers to the question about children having a fear of the dentist will have a very different meaning to those who visited the dentist (i.e., an actualized experience) versus those who did not (i.e., an anticipatory response or perception).

The strength of the present study is that it included a representative sample of preschool children and that the variables associated with the use of dental services were selected based on the Andersen model. The main limitation was its cross-sectional design, which limited the extent to which causal inferences could be made. Only children enrolled in public schools were included because the city had no registered private schools at the time of data collection. In addition, the authors explored the outcome of dental service use regardless of the reason. They found that the predictors could differ for those who go to the dentist for preventive reasons versus those who go for problems, pain, or emergencies. However, only a few children visited the dentist for preventive reasons, thus limiting the data analysis. The outcome was deemed a significant issue related to the use of dental services [29].

Dental visits are an essential component of health care use. It is concerning that only a few children have ever visited a dentist. Visits to the dentist by preschool children are of fundamental importance for practicing primary oral health prevention measures [3]. Preventive dental consultations in young children decrease the number of subsequent visits related to dental problems and can make care more effective and less

costly compared with emergency or hospital care [30]. Therefore, every effort should be made to ensure that the first dental appointment occurs in the first year of life so that caregivers can receive adequate guidance to introduce good oral hygiene habits and establish a schedule of regular visits. Postponing dental visits can have a deleterious effect on oral health and well-being. In this respect, knowing the factors associated with using dental care services is essential. This knowledge is beneficial because of its clinical relevance in expanding the knowledge of using dental services, and in highlighting the importance of visiting the dentist at least once in the lifetime of the members of a given population. Once the need to visit the dentist has been identified, it is essential to develop means of informing caregivers and raising their awareness of the importance of dental care for preschoolers to maintain their oral health and quality of life.

Conclusion

The present study's findings indicate that most of the preschool children studied had never visited a dentist. Need factors, including severe dental caries and the negative perception of a child's OHRQoL, were strongly associated with having visited a dentist at least once in the child's lifetime. Visiting a dentist at least once was also associated with parents performing oral hygiene with their children and with the absence of dental fear.

Authors' Contributions

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All authors declare that they contributed to a critical review of intellectual content and approval of the final version to be published.

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None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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