Original Article

Dental Caries Experience and Oral Health-Related Quality of Life among Secondary School Students in Kigali, Rwanda

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Abstract

Background
Untreated dental caries is a leading cause of poor oral health and has a significant impact on quality of life. This study aimed to assess the effect of dental caries on oral health-related quality of life (OHRQoL) among secondary school students in Kigali, Rwanda.

Methods
An analytical quantitative cross-sectional study was conducted among 646 students aged 12–21. Socio-demographics, oral hygiene, and caries experiences were collected. The oral impact on daily performance score was used to assess oral health-related quality of life. Binary analysis and multiple logistic regression were performed to investigate the association between variables and dental caries.

Results
The study found a moderate DMFT index (3.3 ± 3.9), with decayed teeth at 61.1%. Daily activity affected more than 91% of participants, pain affected 35%, and dissatisfaction with oral health, 58.5%. Participants aged 15–19 years had a higher prevalence of dental caries (AOR 3.3, P=0.03), the same as those who did not brush (P<0.001), chewing foods (P<0.001), or missed school (P<0.001). The OIDP scores were greater among rural residents (P=0.001).

Conclusion
The prevalence of dental caries was moderate. It significantly affected students' social, emotional, and physical well-being. These findings emphasize the need for targeted interventions to improve oral health and its impact on students' quality of life.
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Keywords: Dental caries, oral health, school, students, quality of life

Introduction

Oral health-related quality of life (OHRQoL) is a multidimensional indicator encompassing various health aspects, such as functional and emotional dimensions. It reflects how oral health affects individuals' daily lives and interactions.[1] Worldwide, OHRQoL remains a challenge among adolescents due to dental caries.[2,3] In Rwanda, dental caries is cited as the most prevalent oral disease among adolescents.[4,5] Dental caries commonly causes pain and discomfort among secondary school students. They affect basic activities like eating, speaking, and sleeping, and hinder children's ability to concentrate and perform in school.[6–8]

Chronic pain, absenteeism, and minimal participation in extracurricular activities later on are all reported in secondary school students with untreated dental caries.[9] Discomfort attributed to dental caries leads to school absences, which eventually impact academic performance and hinder social development.[9] Students with obvious tooth decay also feel embarrassed and self-conscious, which might lead to social isolation and avoidance of social situations. This might have negative consequences, such as an inability to build meaningful connections and engage in social activities, which can eventually affect their mental well-being.[10]

Similarly, dental caries can financially impact students and families. The cost of dental treatments, such as fillings, extractions, and other restorative operations, might also put a burden on the already tight budgets, especially in low-income countries. This cost burden may cause families to prioritize dental care above other critical family requirements, such as education and other healthcare needs, resulting in long-term socioeconomic inequities.[11] Students with dental caries may also fear dental appointments or have had poor experiences. They may be less likely to seek preventative treatment, such as regular dental check-ups and cleanings. This creates a cycle of poor oral health behaviours, increasing the likelihood offuture dental issues and negatively impacting quality of life.[2]

Oral healthcare in Rwanda has improved, but dental caries remains the most frequent cause of dental pain in adolescents. However, Little information is known regarding dental caries experience and its impact on oral health-related quality of life among secondary school students. Recently published research studies from Rwanda have predominantly focused on the prevalence of dental caries. This age group was considered valuable data for the WHO classification and comparison of dental caries surveillance. On the other hand, no study has been conducted to assess OHRQoL among secondary schools using the oral impact on daily performance (OIDP) instrument for this purpose. Therefore, the present study was conducted to assess dental caries experience and oral health-related quality of life using the OIDP instrument among secondary schools in Kigali, Rwanda.

Methods

Study design and setting

In Rwanda's capital city of Kigali, a quantitative analytical cross-sectional study was conducted. It was conducted at both public and private secondary schools. From September 2023 to January 2024, data on oral health quality of life distributions and prior caries experiences were gathered in Kigali, the capital city of Rwanda.

Study population

Secondary school students between the ages of 12 and 21 who were present throughout the data collection period were involved in this study. The sample size was determined using 62,408 students registered in secondary schools in Kigali as reported in the 2019 Rwanda Education Statistics.[12]

Inclusion and exclusion criteria

Students registered in secondary schools in the city of Kigali, aged 12 to 21

years old were included in this study. On the other hand, students who were not willing to participate and who did not consent to participate, or who were unable to complete the survey due to cognitive impairment, were excluded.[13]

Sample size determination

The proportion formula for determining sample size was used to estimate the research sample.[14] According to a Rwandan oral health study, 55% of adolescents had dental caries,[5] in which n is the sample size, N is the total population (62,408 students), p is the proportions of students with dental caries (55.7%), q is the percentage of people without dental caries (44.3%), e is the marginal error (4%) and is the critical value, which is 1.96 at the 95% confidence level.

$$n = \frac{N z_{\frac{\alpha}{2}}^2 pq}{e^2(N-1) + z_{\frac{\alpha}{2}}^2 pq} = \frac{62408\,(1.96)^2 * 0.557 * 0.443}{(62408-1) * .04^2 + (1.96)^2 * 0.557 * 0.443} = 586.887 \approx 587 \text{ students}$$

After accounting for a 10% expected non-response rate, 646 students took part in this study.

Sampling strategies

Three districts from the city of Kigali each received an appropriate proportion of the sample size. Within each district, schools from both urban and rural settings were chosen using a stratified selection technique. Out of 117 schools in Kigali, twenty-one urban and twenty-one rural secondary schools were chosen randomly. Using a systematic sampling procedure with a sampling interval of 39, fifteen students were chosen from each using school rosters as the sampling frame.

Data collection procedure and research instruments

A paper-based questionnaire that had been pretested was created in English and translated into Kinyarwanda. Pre-testing was conducted by giving it to 65 secondary school students at one school that was not involved in the study. The survey tool was adapted from an earlier investigation.[15] Data on socio-demographics, oral health characteristics, and oral health practices were gathered. Several variables were assessed, including age, sex, socioeconomic position, residential region, school location, parental education level, dental visits, oral hygiene practices, and dietary habits. Factors like parental education level were divided into three groups (no formal education, secondary, primary and education, and Higher Education), and the social categories were classified into two groups (poor: categories 1 and 2, or rich: categories 3 and 4).

Oral examinations were conducted on portable dental chairs at all schools. Data collection was performed by one research assistant, who was a dentist, and one recording assistant, who was trained during the pilot study. The reliability and validity of the research tool were tested with Cronbach's alpha coefficient, which is a statistical measure commonly used to evaluate the internal consistency of a questionnaire. A Cronbach's alpha value of 0.9 was found, and it was considered acceptable, indicating that the tool produces consistent results and the items effectively measure the same underlying concept.

The assistant was seated close enough to the examiner so that instructions and codes would be recorded. The examiner also verified that the data were being recorded correctly. Dental caries was assessed based on clinical criteria by the WHO for performing an oral health survey.[15] Using disposable dental instruments, including explorers and dental mirrors, dental examinations were performed in class. In addition, headlamps, gloves, and facemasks were employed to guarantee visibility and infection control. [15]

To conduct an oral health survey, the dental caries index was evaluated by the WHO guidelines.[15] Each study participant's decayed (D), missing (M), and filled (F) teeth (T) indices (DMFTs) were recorded. OIDP was used to quantify the OHRQoL.[9, 16] The seven-item impact short form was utilized to assess the aspects of oral health quality.

Functional limitations, handicaps, social impairment, psychological discomfort, physical pain, and physical disability related to dental health were all assessed. Each dimension's responses were coded as follows: “0” means "no", 1” means "yes," and “9” means "don't know." Greater negative effects of oral health problems on quality of life were indicated by higher cumulative scores. The seven items added up to a total score that varied from 0 to 7. These included issues with eating or enjoying food, speaking and correctly pronouncing words, brushing teeth, sleeping and resting, laughing and smiling, emotional health, sociability, and social interactions.[9,16] The impact of dental caries on OHRQoL was categorized into two. A score which was equal to 3 or less was classified as having no impact on oral health, whereas the OIDP, which was equal to 4 or greater, was classified as impact on oral health. This cutoff was a study-specific operational definition to simplify analysis and interpretation, rather than a universally established clinical threshold. This threshold was used in some research to differentiate between no/low impact and meaningful impact.[17,18]

Data analysis

For statistical analysis, the data were entered into an Excel spreadsheet and then exported to IBM SPSS Statistics for Windows version 25.0 (IBM Corp, Armonk, NY, USA). To describe the data, descriptive statistics were calculated, such as variable means and frequencies. The OIDP index was used to measure the OHRQoL, with scores ranging from 0 to 7. The OIDP mean scores and standard deviation were determined. One-way analysis of variance (ANOVA), independent t-tests, and chi-square tests were used to examine the associations among sociodemographic factors, dental caries, and OHRQoL. To ascertain the independent importance of the factors, binary logistic regression analysis was conducted, and 95% confidence intervals and odds ratios (ORs) were computed with a P value of < 0.05 as the significance level.

Ethical consideration

The Institutional Review Board of the University of Rwanda's College of Medicine and Health Sciences (IRB-CMHS/UR) granted ethical clearance for the study, with approval number CMHS IRB/2023 No. 247. The permission to conduct this study was obtained from the city of Kigali and the school administration. After having given thorough information about the study purpose, advantages, and the level of possible hazard, the parents or guardians gave their informed consent on behalf of the students under the age of 18 years. In addition, the under-18-year-olds were asked to give and assent to participate in the study. As for those older than 18 years, informed consent was sought from them and given. Every participant was made aware of their freedom to leave the study or the focus group talks at any moment without facing any repercussions.

Results

Socio-demographic characteristics of the study participants

Table 1. Socio-demographic characteristics of the study participants (N=646)

Variables	Frequency (n)	Percentage (%)
Age		
12-14 years	149	23.1
15-19 years	442	68.4
20-21 years	55	8.5
Gender		
Female	326	50.5
Male	320	49.5
Residence		
Rural	324	50.2
Urban	322	49.8
Father’s education		
No formal schooling	116	18
Secondary/ or primary	357	55.3
Higher learning institution	173	26.8
Mother’s education		
No formal school	106	16.4
Secondary or Primary	366	56.7
Higher learning institution	174	26.9
Social Category		
Poor	304	47.1
Rich	342	52.9

This study included 646 secondary school students aged 12 to 21, with a mean age ± SD of 16.3 ± 2.2 years. The majority of secondary students were aged between 15 to 19 year. Most of the mothers and fathers, had completed secondary school or primary education levels. Sex distribution among study participants was almost equal, for males and for females. Fifty-two percent of the participants, were from rural areas. Three hundred and fifty-seven of the adolescents' fathers and three hundred sixty-seven of their mothers had completed secondary school. The majority of the teenagers, were from rich families' backgrounds. (Table1)

Teeth index among study participants

Table 2 highlights dental caries experience and oral health quality dimensions and components of the DMFT index. A majority of students had dental caries, while missing and filled teeth were less common. The mean DMFT index indicated moderate severity of dental caries. Most of the students reported no recent oral discomfort, and over half had no social contact problems due to dental caries. Most individuals did not miss school or experience shyness due to dental caries, but some reported difficulties in biting and chewing, or smiling. Notably, the majority of students experienced at least one impact on daily performance, reflecting a significant influence of dental caries on overall well-being.

Table 2. Distributions of oral health quality dimensions and components of Decayed Missing and Filled Teeth index among study participants (N=646)

Variables	Frequency (n)	Percentage (%)	MDMFT ±SD
Dental caries (D>0)	395	61.1	3.1(3.7)
Missing teeth (M>0)	33	5.1	0.1(0.3)
Filled teeth (F>0)	11	1.7	0.1(0.5)
MDMFT index			3.3(3.9)
Discomfort in 3months			
No	420	65.0	
Yes	226	35.0	
Social contact			
No	378	58.5	
Yes	268	41.5	
Missing school			
No	551	85.3	
Yes	95	14.7	
Difficulty in biting			
No	496	76.8	
Yes	150	23.2	
Difficulty in chewing			
No	479	74.1	
Yes	167	25.9	
Avoiding smile			
No	507	78.5	
Yes	139	21.5	
Felt shy			
No	560	86.7	
Yes	86	13.3	
OIDP score			
No impact	54	8.4	
Had impact	592	91.6	

D: Decayed teeth, M: Missing teeth, F: Filled teeth

Oral health quality dimensions and dental caries

Table 3 examined the association between dental caries and oral health quality dimensions. With the chi-square test, individuals with dental caries were significantly more likely to report oral Difficulty in cleaning teeth (p=0.001), difficulty in chewing (p<0.001), missing school due to dental caries (p<0.001), dissatisfaction with oral health (p=0.003), and feelings of guilt or shame (p=0.001). However, avoiding smiling (p=0.49) and difficulty in biting (p=0.2) were not associated with dental caries.

Table 3. Bivariate analysis of oral health quality dimensions and dental caries among study participants

Variables	Dental caries			P-value
	No	Yes	Total	
Avoiding cleaning teeth				
No	186(44.3%)	234(55.7%)	420(65%)	<0.001
Yes	65(28.8%)	161(71.2%)	226(35%)	
Avoiding smile				
No	207(40.8%)	300(59.2%)	507(78.5%)	0.49
Yes	44(31.7%)	95(68.3%)	139(21.5%)	
Difficulty in biting				
No	199(40.1%)	297(59.9%)	496(76.8%)	0.23
Yes	52(34.7%)	98(65.3%)	150(23.2%)	
Difficulty in chewing				
No	207(43.2%)	272(56.8%)	479(74.1%)	<0.001
Yes	44(26.3%)	123(73.7%)	167(25.9%)	
Miss school				
No	230(41.7%)	321(58.3%)	551(85.3%)	<0.001
Yes	21(22.1%)	74(77.9%)	95(14.7%)	
Social contact				
No	165(43.7%)	213(56.3%)	378(58.5%)	0.003
Yes	86(32.1%)	182(67.9%)	268(41.5%)	
Felt shy				
No	223(39.8%)	337(60.2%)	560(86.7%)	0.198
Yes	28(32.6%)	58(67.4%)	86(13.3%)	

Factors associated with the OIDP score among study participants

The association between study participants' Oral Impacts on Daily Performance (OIDP) scores, dental caries, and sociodemographic characteristics was investigated using binary logistic regression analysis (Table 4). Participants aged 15–19 years had an adjusted odd ratio (AOR) of 3.3 (95% CI: 1.1–9.8, P=0.0); they were three times more likely to have higher OIDP scores than those in the 12–14 age group. Significant gender differences in OIDP scores were observed, as females had significantly higher OIDP scores (P<0.001), yet the AOR for males (1.4, 95% CI: 0.8–2.4, P=0.20) was non-significant. The participants from the rural area experienced much higher OIDP scores compared to the urban residents, with a P value of (P=0.001); however, the AOR for urban residents (1.0, 95% CI: 0.5–2.0, P=0.90) was not statistically significant. Additionally, the presence of dental caries was correlated with more severe OIDP (P < 0.001), although the AOR (1.06, 95% CI: 0.6–2.0) was not statistically significant.

Table 4. Binary logistic regression between OIDP score according to socio-demographic characteristics and dental caries among study participants (n=646)

Variables	AOR for OIDP	95% CI for AOR		P-value
		Lower	Upper	
Age				
12-14 years	Ref.			
15-19 years	0.66	0.3	1.44	0.3
20-21 years	0.31	0.1	0.92	0.03*
Gender				
Female	Ref.			
Male	0.72	0.4	1.29	0.27
Father's education				
No formal school	Ref.			
Secondary or primary	0.58	0.23	1.44	0.24
University	0.32	0.11	0.94	0.03*
Mother's education				
No formal school	Ref.			
Secondary or primary	2.39	1.09	5.2	0.02*
University	1.95	0.73	5.25	0.18
Residence				
Rural	Ref.			
Urban	0.88	0.46	1.69	0.71
Social category				
Poor	Ref.			
Rich	1.43	0.74	2.76	0.28
Dental caries				
No	Ref.			
Yes	0.93	0.51	1.68	0.81

AOR: Adjusted Odds Ratio; OIDP: Oral Impact on Daily Performance; CI: Confidence Interval, Statistical significance, *P<0.05, Ref.: Reference group

The binary logistic regression analysis examined factors associated with the likelihood of experiencing oral impacts (OIDP) among students. Three variables showed statistically significant relationships. Adolescents aged 20–21 years were significantly less likely to report oral impacts compared to those aged 12–14 years (AOR = 0.31, 95% CI: 0.10–0.92, p = 0.036), suggesting that older students may have developed better oral health habits or stronger coping mechanisms. Likewise, students whose fathers had completed a university education had significantly lower odds of experiencing oral impacts compared to those whose fathers had no formal education (AOR = 0.32, 95% CI: 0.11–0.94, p = 0.039), indicating a possible protective effect of higher paternal education. Conversely, students whose mothers had attained primary or secondary education were significantly more likely to experience oral impacts than those whose mothers had no formal schooling (AOR = 2.39, 95% CI: 1.09–5.20, p = 0.028), possibly reflecting increased awareness and reporting of oral issues in families with somewhat more educated mothers. Other variables, including gender, place of residence, social category, and presence of dental caries, were not significantly linked to oral impacts after adjusting for other factors in the model.

Discussion

This study aimed to assess the dental caries experiences and the quality of life related to oral health among secondary school students in Kigali. The findings revealed that 61.1% of the adolescents surveyed had decayed teeth, indicating a significant prevalence of dental caries. This figure was markedly higher compared to the lower rates of missing teeth (5.1%) and filled teeth (1.7%). This study found considerable impact of dental caries on daily activities, with 91.6% of participants experiencing at least one oral impact on daily performance (OIDP > 0). The most common issue reported was psychological discomfort caused by poor oral health, affecting 58.5% of the students. Additionally, 35% of participants experienced functional limitations due to dental pain, and those aged 20–21 years were less likely to report oral health impacts than those aged 12–14 (AOR = 0.31, 95% CI: 0.10–0.92, p = 0.03). This suggests that older students may have better oral health practices or coping skills. Students with university-educated fathers had lower odds of oral health impacts. This indicated that higher paternal education may offer a protective effect on the oral health of these students (AOR = 0.32, 95% CI: 0.11–0.94, p = 0.03). However, students whose mothers had primary or secondary education faced higher oral impact (AOR = 2.39, 95% CI: 1.09–5.20, p = 0.02). possibly reflecting increased awareness and reporting of oral issues in families with somewhat more educated mothers.

Comparing of findings with those of other studies, the results of this study were consistent with other research showing that dental caries continues to be a major public health issue, particularly among adolescents, affecting their oral health-related quality of life (OHRQoL) in schoolchildren.[4, 5] In developed countries such as the United States, dental caries had a significant effect on the OHRQoL of secondary school students, and more than half (57%) of those aged 12 to 19 suffer from dental caries.[19]

Furthermore, the current results support previous research that found oral health quality dimensions attributed to dental caries. The majority of secondary school students reported higher levels of psychological distress due to their oral health issues.[20,21] These similarities may be explained by the fact that untreated dental caries have caused various negative outcomes, including psychological distress and functional limitations, which were prominently reported in the current study.[19] This similarity might be seen as evidence that dental caries affected psychological discomfort, social stigma, and functional limits, as acknowledged in the current study results.

On the other hand, literature has produced contradictory findings. A systematic review conducted by Kimmie-Dhansay and Bhayat in 2022 reported a lower pooled prevalence of dental caries among 12-year-olds in Africa, which was 36% of adolescents.[22] The current results also did not demonstrate an association between dental caries and overall OHRQoL, which was contrary to another study done in the Massai adolescents of Tanzania [23] and Zambia.[21] This difference might be attributed to sociodemographic factors that are critical to the study's findings. Age was found as significant to OHRQoL, and this was similar to other research done supported that older adolescents were less likely to report adverse oral health impacts than their younger peers.[21] This might be due to age-related vulnerability to dental caries during adolescence.[23–25] This suggests that with specific intervention targeting age-related dental caries by integrating oral health education into school-based curricula, so that the students can develop lifelong habits and gain the knowledge necessary for maintaining good oral health, ultimately leading to an improved quality of life.[19,24]

Limitations

Finally, a number of important limitations need to be considered.

Since a cross-sectional study design was used, the study findings were unable to establish causality, as data on exposure and outcome were collected simultaneously, which made it unclear whether the risk factors preceded the outcome. Thus, this study only provided a snapshot of prevalence of dental caries at particular point in time, limiting its ability to capture changes or trends over time. On the other hand, these results may have underestimated the true prevalence of dental caries due to methods used for data that only relied on visual and tactile screening methods to detect dental caries. Lastly, this study might be prone to recall bias due to participants relying on memory to report past events and controlled and minimized through validation processes of research tool and data collection.

Strengths

Despite these limitations, the study was useful for generating hypotheses and providing a quick, cost-effective overview of associations of dental caries and OHRQoL within these school children. on the hand, this study had strength of establishing the relationship between variables through bivariate and multiple logistic regression. Therefore, conducting a cohort study within the same age group is essential for a more comprehensive understanding of the relationship between dental caries and OHRQoL.

Conclusion and recommendation

The main goal of the current study was to determine dental caries experiences and the quality of life related to oral health among secondary school students in Kigali. This study has shown a moderate prevalence of dental caries among these students. Teeth filling was found as scarce among students indicating need for teeth restorations. Age-related vulnerability to dental caries during adolescence was also profound highlighted by this study. On the other hand, the study also found an impact of dental caries on daily activities among students, with the majority of students experiencing at least one oral impact on daily performance attributed to dental caries.

This study has also found no significant impact of dental caries on adolescents' oral health-related quality of life.

The findings of this study have practical implications to policymakers and concerned authorities that should consider the implementation of periodic dental checkups for secondary school students, especially for the high-risk age group. Greater efforts are needed to ensure regular oral health education programs and school-based oral health curricula that can help change the student's lifestyle and oral health behaviors. These study findings also point to the need for teeth filling among these students for improving their OHRQoL. Finally, further researches such as perspectives studies are needed to examine more the relationship between dental caries and OHRQoL.

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Conflict of interest

The authors declare that there is no conflict of interest related to this study.

Authors' contributions

SJTM, JM, PU, and AKA contributed to designing the study and were involved in all aspects of the work including the manuscript development and review.

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