# Radiographic Assessment of the Health Status of First Permanent Molars in Paediatric Groups in a Nigerian Tertiary Health Institution: A Retrospective Cross-Sectional Study

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## ABSTRACT

**Background**: The first permanent molars (FPMs) are critical for maintaining normal masticatory functions and dentofacial harmony. However, they are highly susceptible to dental caries, especially in pediatric populations. This study aimed to radiographically assess the health status of first permanent molars in children aged 7 to 16 years at a Nigerian tertiary health institution, focusing on caries prevalence, structural anomalies, and periapical health.

**Methods**: A retrospective cross-sectional study of panoramic radiographs was conducted. Department of Oral Diagnostic Sciences, Aminu Kano Teaching Hospital, Nigeria, from January 2022 to December 2023, following ethical approval from the hospital's Research and Ethics Committee (approval number NHREC/29/01/2025/AKTH/EC/4004). Artifact-free panoramic radiographs of 317 children aged 7-16 years with a mean age of approximately 11 years (SD = 3.26), comprising 142 males (45.2%) and 172 females (54.8%). The outcome measures were caries prevalence, restoration status, missing teeth, periapical pathology (rarefying osteitis), and structural anomalies (hypomineralization/fusion/taurodontism).

**Results:** Overall caries prevalence across all first permanent molars was 36.9% (117/314, 95% CI: 31.5%-42.6%); highest in mandibular molars, with 17.2% in the mandibular left first permanent molar and 11.8% in the mandibular right first permanent molar, suggesting a greater predisposition of mandibular molars to carious lesions.[17] Restorative interventions were noted in only 5.4% (17/314) of the first permanent molars, with the mandibular right first permanent molar exhibiting the highest frequency of restorations. Missing teeth were infrequent, with the highest occurrence of 2.5% (8/314) observed in the mandibular right first permanent molar. The study found 95.2% (302/314) of cases were free of pathology, while 4.5% (14/314), predominantly among individuals aged 15-16 years, presented with rarefying osteitis. Structural anomalies occurred at low frequencies, including hypomineralization 1% (3/314), fusion 0.6% (2/314), and taurodontism 1% (3/314).

**Conclusion:** The majority of FPMs were radiographically intact. Caries prevalence was higher in mandibular molars than in maxillary molars, with the mandibular left showing the highest rate (17.2%), followed by the mandibular right (11.8%), maxillary left (5.7%), and maxillary right (2.5%). Developmental anomalies and periapical pathologies were infrequent, with rarefying osteitis observed only in older children (13-16 years). These findings underscore the need for targeted preventive measures, routine screening, and early intervention to reduce caries incidence and improve oral health outcomes in this population.

**Keywords**: First permanent molars, dental caries, panoramic radiography.

## INTRODUCTION

The first permanent molars (FPMs) are the first permanent teeth to emerge in the oral cavity and are regarded as key teeth due to their role in maintaining normal masticatory functions and dentofacial harmony.[1] They bear the greatest occlusal load and guide the distribution of forces during normal masticatory functions.[2] The FPMs determine the occlusal relationship in the vertical plane, as other teeth are aligned relative to their position. Therefore, their presence affects the vertical distance, occlusal height, and aesthetic ratios between the maxilla and mandible.[3] First permanent molars are more prone to dental caries and are the most frequently extracted teeth due to dental caries.[4] Dental caries is a chronic infectious condition of multiple etiologies involving

a dynamic process characterized by cyclic episodes of demineralization and remineralization of dental hard tissues due to acid metabolism of dietary carbohydrates by plaque microbial biofilm bacteria. Carious lesions result from the concerted interplay of multiple etiologic factors. Although well-known predisposing factors such as cariogenic local substrates, susceptible tooth morphology, salivary flow, and microbial biofilm have been implicated in the etiology of dental caries, other factors such as low socioeconomic status, low level of education, genetics, and cultural and environmental factors are important in determining the prevalence of carious lesions in a young population.[5]

First permanent molars are the first permanent teeth to erupt into the oral cavity and are more exposed to cariogenic factors for a longer duration. They are more susceptible to carious attack, especially during the first 1-3 years post-eruption, with the occlusal surfaces being more vulnerable at the age of six.[6] This susceptibility is also related to their peculiar morphology, such as complicated deep pits and fissures, and surrounding conditions like the operculum covering their distal aspects, which serve as potential areas for accumulation and retention of microbial plaque.[7] The position of the first permanent molars in the posterior quadrants of the oral cavity makes it difficult for children to effectively clean this area. Parental negligence of care due to the misconception of first permanent molars as deciduous teeth in the mixed dentition stage also contributes to their susceptibility to dental caries.[8,9] Various studies have proven that caries in the primary molars increases the risk for caries in the permanent dentition, particularly in the early erupting stages of the first permanent molars.[10] Several other factors can disrupt the health status of the first permanent molars, such as fractures, impactions, congenitally missing teeth, and Molar-Incisor Hypomineralization (MIH). Molar-incisor hypomineralization (MIH) is a qualitative enamel defect of systemic origin, affecting one or more first permanent molars and often associated with defects on one or more incisor teeth. In MIH, the affected first permanent molars are more likely to develop caries (reportedly up to six times) and are also prone to rapid and extensive post-eruptive enamel breakdown.[7]

While first permanent molars are the most susceptible teeth to dental caries, especially in children,[8] dental caries is the most commonly diagnosed preventable chronic infectious disease after the common cold and remains a substantial public health challenge globally.[11-13] Early loss of first permanent molars can lead to various forms and severities of malocclusions, complicate orthodontic treatments, reduce masticatory efficiency, and cause temporomandibular joint discomfort (TMD) and aesthetic problems. Reports suggest an estimated 2.4 billion people suffer from dental caries of permanent teeth globally, and about 60-90% of children are also affected by dental caries.[12,14] In a study evaluating the prevalence of dental caries in children aged 12 in Africa, the mean prevalence was determined to be 36%, with Eritrea having the highest caries prevalence and mean number of decayed, missing, and filled teeth (DMFT) of 78% and 2.50, respectively. The mean DMFT for The Gambia and Libya was 2.11 and 2.27, respectively, while Sudan (0.49), Nigeria (0.60), and Burkina Faso (0.70) had the lowest DMFT scores.[15] Dental caries can negatively affect growth, communication, and general and oral health-related quality of life (OHRQoL). In children and adolescents, it can also affect school attendance. In adults, routine daily activities may be disrupted, leading to considerable economic loss. Despite scientific evidence from various epidemiological studies stating its high prevalence and negative impacts on people and the economy, dental caries and related oral diseases remain a widely neglected public health issue.[16]

This study aimed to radiographically assess the health status of the first permanent molars in children aged 7 to 16 who attended Aminu Kano Teaching Hospital.

## METHODS

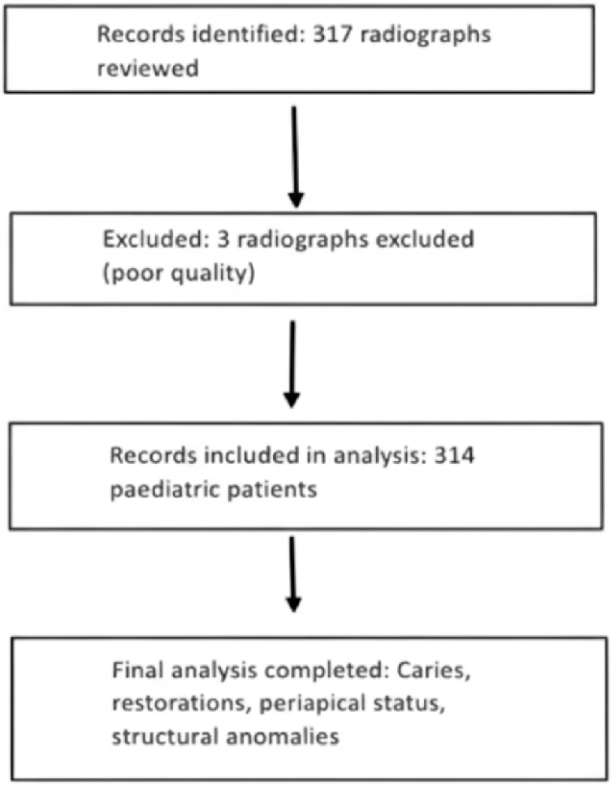
**Study Design**: A retrospective cross-sectional study of panoramic radiographs was conducted from January 2022 to December 2023. This study was conducted and reported in compliance with the STROBE guidelines and the Declaration of Helsinki.
**Setting**: Department of Oral Diagnostic Sciences, Aminu Kano Teaching Hospital, Nigeria, from January 2022 to December 2023, following ethical approval from the hospital's Research and Ethics Committee (approval number NHREC/29/01/2025/AKTH/EC/4004).

**Participants**:
**Inclusion criteria**: Artifact-free panoramic radiographs of children aged 7-16 years stored in the Department of Oral Diagnostic Sciences digital databases.

**Exclusion criteria**: Radiographs with artifacts, incomplete eruption of FPMs, or insufficient clinical data.

**Sample size**: Calculated using Leslie Fischer's formula (n=317) based on a caries prevalence of 68.79% from a prior study[17] (95% CI, precision=0.05). Using the formula with a 50% prevalence for a conservative estimate would still

maintain minimum validity; hence, our calculated sample size was 317.




**Variables assessed**

- Primary Outcome Caries prevalence
- Secondary Outcomes:

- FPM status: Present/absent; if present, categorized as healthy, decayed, filled, root-treated, crowned, or combined treatments (root-treated and crowned).
-Periapical pathology (rarefying osteitis, resorption).
-Morphological anomalies: Hypomineralization (MIH), fusion, taurodontism, fractures.

**Data Sources/Measurements & Bias Mitigation:** Radiographic equipment: PLANMECA ProMax 2D S3 machine with standardized kVp, mA, and exposure time for age/size.

- Image analysis: Two calibrated examiners assessed stored JPGs on an LCD (1980 × 1080, 60p Hz) monitor using magnification, brightness, and contrast tools. Inter-examiner reliability was measured using Cohen's kappa = 0.86.
- Selection Bias was mitigated by consecutive sampling of eligible radiographs.
- Measurement Bias: was mitigated by examiner calibration and standardized diagnostic criteria.

**Statistical Analysis**: Adjusted analysis was performed using logistic regression to control for potential confounding variables such as age and gender. Confidence intervals (CIs) were calculated to assess the precision of the estimates. (Note: Logistic regression was conducted at the patient level. Acknowledgement of potential clustering effects at the tooth level is added in the discussion.) Data were entered into Microsoft Excel 2016 and analyzed using SPSS v21 (IBM Corp, Armonk, NY). Descriptive statistics were conducted including frequencies/percentages for categorical variables (e.g., caries prevalence, restoration types). Associations were evaluated with Pearson's chi-square test to compare categorical outcomes (e.g., caries vs. age group, restoration types).

**Ethical considerations**: Ethical approval was obtained from the Research Ethics Committee of Aminu Kano Teaching Hospital (approval number NHREC/29/01/2025/AKTH/EC/4004). Patient confidentiality was maintained via password-protected storage and anonymized data analysis. Informed consent was waived as per institutional ethics committee guidelines.

## RESULTS

The study included radiographs of 317 participants aged 7 to 16, with a mean age of approximately 11 years (SD = 3.26). Three were further excluded due to poor-quality radiographs that could not be conclusively diagnosed, leaving 314 for analysis. Age distribution was most represented by two prominent groups: ages 7-8 (28%) and 15-16 (25.5%) (Table 1, Figure 1). The sample comprised 142 males (45.2%) and 172 females (54.8%) (Figure 2). Gender distribution revealed a slightly higher proportion of females (54.8%) compared to males (45.2%), indicating a slightly female-skewed sample.

**TABLE 1: Socio-demographic Characteristics**

| VARIABLE | FREQUENCY(314) | PERCENTAGE(100) |
|---|---|---|
| **AGE** | | |
| 7-8 | 88 | 28.0 |
| 9-10 | 60 | 19.1 |
| 11-12 | 46 | 14.6 |
| 13-14 | 40 | 12.7 |
| 15-16 | 80 | 25.5 |
| MEAN(SD) | 11.30(3.264) | 11.30(3.264) |
| **GENDER** | | |
| MALE | 142 | 45.2 |
| FEMALE | 172 | 54.8 |

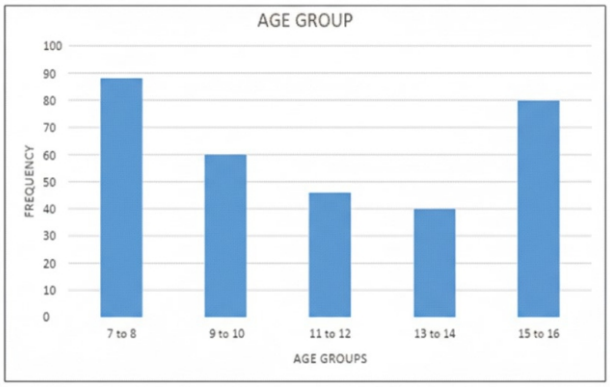



*Figure 1: Age group of study participants*

Gender distribution revealed a slightly higher proportion of females (54.8%) compared to males (45.2%), indicating a balanced but slightly female-skewed sample. This demographic context is essential for understanding how these variables might influence dental health outcomes in this pediatric population.

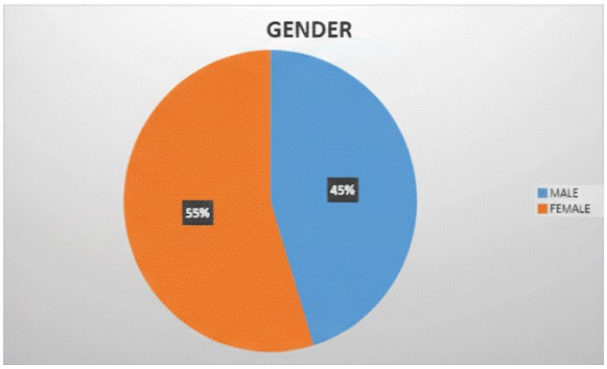



*Figure 2: Gender distribution of study participants*

Sound Tooth Status: The majority of first permanent molars (74.5%, n=234) were radiographically sound, showing no evidence of caries or any structural abnormalities (Table 2).

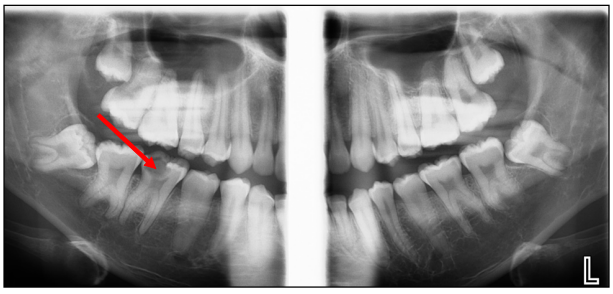


*Figure 3*

Figure 3 shows a carious mandibular right first permanent molar. Note the coronal radiolucency in close proximity to the distal pulp horn on the mandibular right first permanent molar, suggestive of dental caries. Also note the taurodontism on the adjacent permanent second molar. Sectional OPG.

**Caries Prevalence**: Caries prevalence varied by tooth region (Table 2), with only 2.5% (n=8, 95% CI: 0.8%-5.7%) of maxillary right first permanent molars affected by caries, 5.7% (n=18, 95% CI: 3.4%-9.0%) observed on maxillary left first permanent molars, 17.2% (n=54, 95% CI: 13.4%-21.8%) on mandibular left first permanent molars, and an 11.8% (n=37, 95% CI: 8.7%-15.6%) caries rate on mandibular right first permanent molars. Crude prevalence rates are provided; adjusted results controlling for age and gender using logistic regression are presented in Table 5 with 95% confidence intervals. Very few restorations were reported, with the highest restoration rate in mandibular right first permanent molars (5.4%) and the lowest in maxillary left first permanent molars (0.3%). Hypomineralization: Only 1% of the sample had hypomineralized molars (Table 2). See Figure 4 for restorations.

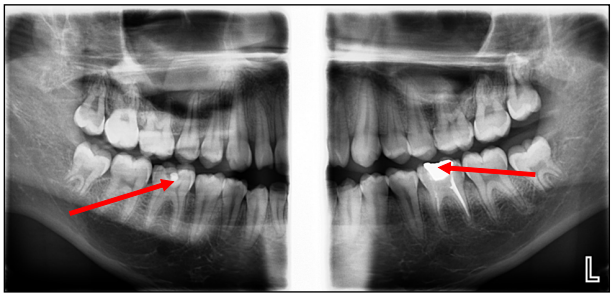


*Figure 4: Sectional OPG*

**TABLE 2: Radiographic findings**

| VARIABLE | | FREQUENCY | PERCENTAGE |
|---|---|---|---|
| Patients with radiographically intact FPMs (no caries/restorations/anomalies) in specified combinations | | | |
| NONE | | 5 | 1.6 |
| Maxillary right first permanent molar | | 7 | 2.2 |
| Maxillary right and left first permanent molars | | 22 | 7.0 |
| Maxillary right and left first permanent molars mandibular left first permanent molar | | 46 | 14.6 |
| Maxillary right and left first permanent molars, mandibular left and right first permanent molar | | 234 | 74.5 |
| **CARIOUS TOOTH** | | | |
| **Maxillary right first permanent molar** | YES | 8 | 2.5 |
| | NO | 306 | 97.5 |
| **Maxillary left first permanent molars** | YES | 18 | 5.7 |
| | NO | 296 | 94.3 |
| **mandibular left first permanent molar** | YES | 54 | 17.2 |
| | NO | 260 | 82.8 |
| **Mandibular right first permanent molar** | YES | 37 | 11.8 |
| | NO | 277 | 88.2 |
| **RESTORED TOOTH** | | | |
| **maxillary right first permanent molar** | YES | 3 | 1.0 |
| | NO | 311 | 99.0 |
| **Maxillary left first permanent molar** | YES | 1 | 0.3 |
| | NO | 313 | 99.7 |
| **Mandibular left first permanent molar** | YES | 14 | 4.5 |
| | NO | 300 | 95.5 |
| **Mandibular right first permanent molar** | YES | 17 | 5.4 |
| | NO | 297 | 94.6 |
| **HYPOMINERALISED** | YES | 3 | 1 |
| | NO | 311 | 99 |

Gender distribution revealed a slightly higher proportion of females (54.8%) compared to males (45.2%), indicating a balanced but slightly female-skewed sample. This demographic context is essential for understanding how these variables might influence dental health outcomes in this pediatric population.


***Figure 5: Sectional OPG***

Figure 5: Sectional OPG showing an empty healing socket following extraction of the mandibular right permanent first molar. Note the faint remnant of the lamina dura around the empty root space, suggestive of bone remodeling, with overlying soft tissue covering..

**Periapical Findings:** It was found that 95.2% of the sample had no periapical pathosis; rarefying osteitis was present in 4.5% of cases, predominantly in the 15-16-year age group; and only one case (0.3%) of resorption was noted.

**Other Findings:** Morphological anomalies were observed at low frequencies (Table 3). Fusion on maxillary left first permanent molars was present in 0.6% of cases (n=2); taurodontism was found in 1% (n=3) of cases, mostly among females; and idiopathic osteosclerosis on mandibular left first permanent molars was observed in only one instance (0.3%).

**TABLE 3: Percentage of missing teeth, periapical findings, and other findings**

| MISSING TOOTH | | FREQUENCY | PERCENTAGE |
|---|---|---|---|
| **Maxillary right first permanent molar** | YES<br>NO | 4<br>310 | 1.3<br>98.7 |
| **Maxillary left first permanent molar** | YES<br>NO | 2<br>312 | 0.6<br>99.4 |
| **Mandibular left first permanent molar** | YES<br>NO | 4<br>310 | 1.3<br>98.7 |
| **Mandibular right first permanent molar** | YES<br>NO | 8<br>306 | 2.5<br>97.5 |

| PERIAPICAL FINDING | FREQUENCY | PERCENTAGE |
|---|---|---|
| NONE | 299 | 95.2 |
| RESORPTION | 1 | 0.3 |
| RARIFYING OSTEITIS | 14 | 4.5 |

| OTHER FINDINGS | | FREQUENCY | PERCENTAGE |
|---|---|---|---|
| **FUSION ON MAXILLARY LEFT FIRST PERMANENT MOLAR** | PRESENT<br>ABSENT | 2<br>312 | 0.6.<br>99.4 |
| **TAURODONTISM** | PRESENT<br>ABSENT | 3<br>311 | 1<br>99 |
| **IDIOPATHIC OSTEOSCLEROSIS ON MANDIBULAR LEFT FIRST PERMANENT MOLAR** | PRESENT<br>ABSENT | 1<br>313 | 0.3<br>99.3 |

**Table 4: Statistically significant difference in the prevalence of rarefying osteitis in relation to age group. (Cramer's V = 0.32, indicating a moderate association)**

| VARIABLE | TOTAL N(%) =314(100%) | PERIAPICAL FINDINGS | | | $X^2$ | P-Value |
|---|---|---|---|---|---|---|
| | | NORMAL | RESORPTION | RARIFYING OSTEITIS | | |
| **AGE GROUP** | | | | | | |
| 7-8 | 88 | 88(100) | 0(0.0) | 0(0.0) | 28.580 | **0.000** |
| 9-10 | 60 | 60(100) | 0(0.0) | 0(0.0) | | |
| 11-12 | 46 | 43(93.5) | 0(0.0) | 3(6.5) | | |
| 13-14 | 40 | 40(100) | 0(0.0) | 0(0.0) | | |
| 15-16 | 80 | 68(85.0) | 1(1.2) | 11(13.8) | | |
| **GENDER** | | | | | | |
| MALE | 142 | 138(97.2) | 1(0.7) | 3(2.1) | 4.516 | 0.105 |
| FEMALE | 172 | 161(93.6) | 0(0.0) | 11(6.4) | | |

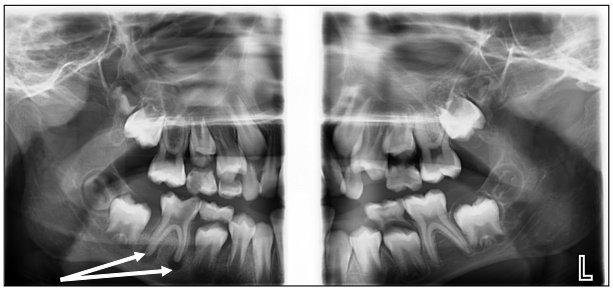


Figure 6: Sectional OPG showing rarefying osteitis associated with the mandibular right first permanent molar, characterized by apical radiolucency on both roots. The crown also shows coronal radiolucency involving the pulp.

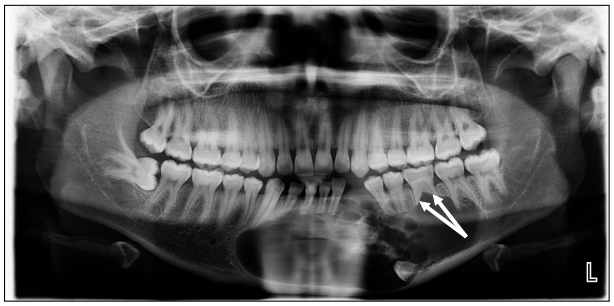


Figure 7: Root resorption affecting the mandibular left first permanent molar and the second premolar, caused by a surrounding radiolucent cystic lesion, possibly an odontogenic tumor. Notice the stunting of the root and smoothing of the root surface. Panoramic image.

**Table 5: Adjusted logistic regression analysis for caries presence**

| Variable | Adjusted Odds Ratio (AOR) | 95% CI (lower) | 95% CI (upper) | p-value |
|---|---|---|---|---|
| Intercept | 0.067 | 0.024 | 0.187 | 0.0000 |
| C(gender) [T.2] | 0.952 | 0.562 | 1.611 | 0.8546 |
| AGE | 1.15 | 1.061 | 1.247 | 0.0007 |

This table shows the results of a logistic regression model assessing the association between caries presence and predictors: age and sex. The dependent variable was the presence of caries in any first permanent molar (coded 1 if caries present, 0 if not). Predictors included continuous age and categorical sex (1 = male [reference], 2 = female). Adjusted Odds Ratios (AORs) and 95% Confidence Intervals (CI) are reported. Each year increase in age was associated with a 15% increase in the odds of caries (AOR = 1.15).

## DISCUSSION

**Findings:** This research examined 314 pediatric patients aged 7 to 16 years at Aminu Kano Teaching Hospital to evaluate the health status of their first permanent molars. The participants had a mean age of 11 years and demonstrated a balanced age distribution, with the largest groups being 7-8 years (28%) and 15-16 years (25.5%). Gender distribution showed a slight female predominance at 54.8% compared to 45.2% males. This demographic composition provides a solid foundation for

analyzing first permanent molar health patterns in this population and establishes valuable baseline data for future comparative studies. The findings indicate that a majority of the first permanent molars (74.5%) were sound, i.e., not presenting any signs of caries, fillings, or any structural abnormality. This corresponds with the results of Annet Kutesa et al., who investigated the Pattern of Dental Caries in Mulago Dental School Clinic, Uganda, in which the second permanent molars were the most affected by caries instead of the first permanent molars, as previous studies by other researchers had depicted.[18] The prevalence of sound first permanent molars could also mean that the participants whose records were studied had considerably good oral health conditions.

Caries prevalence varied across tooth regions, with mandibular left first permanent molars (17.2%) and mandibular right first permanent molars (11.8%) on the lower jaw showing a higher incidence compared to maxillary left first permanent molars (5.7%) and maxillary right first permanent molars (2.5%) on the upper jaw. These findings are consistent with previous studies by Serban et al.[19] and Togoo et al.[20] in children aged 7 to 10 years in Saudi Arabia. However, this is contrary to the results of other studies by Wyne et al.[21] and Batchelor et al. and Sheiham et al.[22] while assessing the bilateral occurrence of dental caries in children 12 to 19 years in which caries prevalence was found to be similar in both jaws. The concentration of caries in the mandibular first permanent molars may be attributed to greater food and plaque accumulation potential since mandibular first permanent molars exhibit more pits and supplementary grooves that are retentive for food and debris. In addition, the mandibular first permanent molars erupt slightly earlier than their maxillary counterparts, as such are exposed to cariogenic factors for a longer duration.

Only 1% of the sample showed signs of hypomineralisation, underscoring its low prevalence in this cohort.

Structural anomalies and other pathologies were also examined, revealing low incidences of these conditions. Fusion on maxillary left first permanent molars was observed in only 0.6% of cases, whereas Taurodontism appeared in 1%. Both conditions were slightly more frequent in females. Idiopathic osteosclerosis was found in only one instance (0.3%), indicating that this abnormality is relatively uncommon among the studied population, potentially due to genetic or environmental factors that limit their expression. The severity and extent of carious lesions were further explored through analyses of restorative treatment needs, missing teeth and periapical findings. Restoration rates were low in the studied groups, with the highest rate on mandibular right first permanent molars (5.4%) and the lowest on maxillary left first permanent molars (0.3%). This suggests that even though carious lesions were present, they either did not often reach the severity that necessitated demand for restorative treatments or factors associated with limited access to/or utilization of dental care came to play such as poverty or negligence of the parents/guardians, undesirable illness behaviors or even the societal perception of the disease.

Missing teeth were infrequent, with mandibular right first permanent molars having the highest rate at 2.5%, while the rest had rates below 1.5%. This infrequency of tooth loss indicates a high level of tooth retention in the studied group, possibly due to effective oral hygiene practices or a relatively low incidence of severe decay necessitating extractions. Periapical health appeared to be generally favorable, as 95.2% of the sample showed no signs of periapical pathology. The remaining 4.5% presented with rarefying osteitis, primarily in the 15-16 age groups. Resorption was observed in only one case and demonstrated external resorption pattern. This further reinforce the overall health status of periapical regions in this pediatric population. When comparing dental health across age groups, caries prevalence and the extent of affected quadrants were higher in older children, particularly in those aged 15-16. For instance, while only 8% of 7-8-year-olds exhibited caries in multiple quadrants, this rose to 25% among 15-16-year-olds, implying an age-related increase in caries risk. The positive correlation between age and incidence of caries further confirms the results of another retrospective observational study of children and adolescents between 7 to 15 years in Romania.[23] This can be explained by the fact that caries being a cumulative and continuous process have increased over the years since time is a cardinal factor in the etiology of all carious lesions. Caries in the younger age groups can be explained by the fact that the enamel is not thoroughly mineralized to significantly withstand the effects of etiologic causes of the lesion, as such early exposure to risk factor such as inadequate brushing can predispose the child to early caries formation.

Periapical pathologies also displayed an age-related trend, with rarefying osteitis more common and in older participants. However, structural anomalies such as fusion and Taurodontism showed no significant correlation with age, suggesting that these conditions remain stable across pediatric groups.

**Implications:** The study findings carry several

practical implications for pediatric dental care. The high rate of sound molars and low prevalence of hypomineralisation or structural anomalies suggest that preventive efforts can be predominantly focused on managing caries. The notable increase in caries and periapical pathosis in older children underscores the importance of age-specific preventive measures, particularly aimed at maintaining oral hygiene and early intervention to prevent progression. Implementing educational programs for caregivers and children could help mitigate the age-related rise in oral diseases by promoting consistent hygiene practices and preventive care and appropriate utilization of oral health services.

**Trade-Offs (Limitations)**

1. Single-center data: Limits generalizability; multi-center studies needed.
2. Radiographic bias: Clinical exams could enhance caries detection accuracy.
3. Surface limitation: Only interproximal/occlusal surfaces assessed.
4. Sample size: Larger cohorts would strengthen statistical power.
5. Unmeasured confounders such as socioeconomic status, dietary habits, and oral hygiene practices may influence caries outcomes and were not included in analysis.
6. Potential tooth-level clustering effects were not modeled for tooth-specific outcomes (e.g., caries by jaw), which may affect precision.

**Take-Home (Conclusion):** This study assessed the health status of first permanent molars (FPMs) among pediatric patients attending Aminu Kano Teaching Hospital. The majority of FPMs were radiographically intact. Caries prevalence was higher in mandibular molars than in maxillary molars, with the mandibular left showing the highest rate (17.2%), followed by the mandibular right (11.8%), maxillary left (5.7%), and maxillary right (2.5%). Developmental anomalies and periapical pathologies were infrequent, with rarefying osteitis observed only in older children (13-16 years). These findings underscore the need for targeted preventive measures, routine screening, and early intervention to reduce caries incidence and improve oral health outcomes in this population.

**Expectations for future research**

1. Multi-center studies are expected to validate findings across diverse populations.
2. Longitudinal designs will help to track caries progression and intervention outcomes.
3. Socioeconomic analysis will help to explore barriers to restorative care access.
4. Advanced imaging studies expected to compare 2D radiographs vs. clinical exams for caries detection.

**Recommendations**

1. For Clinicians:
   - Routine radiographic screening for high-risk molars.
   - Early restorative intervention for mandibular FPMs.
2. For Policymakers:
   - Integrate oral health education into school curricula.
   - Subsidize preventive care for adolescents.
3. For Researchers:
   - Investigate genetic/environmental links to structural anomalies.

**Data availability**: De-identified data supporting findings of this study are available upon reasonable request.

**Conflict of interest**: The authors have declared no conflict of interest

**Funding**: This research received no specific grant from funding agencies.

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