



Research Article

Caries burden and suitability for atraumatic restorative treatment among schoolchildren in Indonesia

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Received : 28 February 2020
Accepted : 22 July 2020
Published : 19 November 2020

DOI
10.25259/JGOH_12_2020

Quick Response Code:



ABSTRACT

Objectives: Dental caries remains among the most prevalent chronic conditions in childhood and remains highly prevalent among schoolchildren in Indonesia. Globally, atraumatic restorative treatment (ART) has been used to good effect in the management of carious lesions among high-risk cohorts, particularly in challenging environments. However, in settings, where labor, time, facilities, and materials are particularly limited, strategic triaging of teeth suitable for ART restorations may be valuable to better direct public health expenditure. Therefore, this study aims to (i) describe the prevalence of dental caries among Indonesian schoolchildren and (ii) evaluate the proportion of lesions indicated for ART.

Materials and Methods: A cross-sectional cohort study of elementary schoolchildren from West Java, Indonesia, was examined and categorized according to Hellman's dental development stages (Groups 1–4 corresponding to the early mixed dentition through to complete permanent dentition). Descriptive statistics and proportional analysis were conducted with the following variables being evaluated: Teeth with early caries (EC), late/advanced caries (LC), recurrent caries (RC), and total caries experience (TC = EC+ART+LC+RC). In evaluating the suitability for ART, additional variables of ART indicated carious lesions (ART) and lower molars with lesions indicated for ART (LM) were assessed.

Results: A total of 437 children ranging from 8 to 14 years of age were examined. Out of 8882 teeth examined, 996 had active carious lesions and only 57 had received satisfactory restorative treatment. Children in Hellman's Group 1 stage of development had the highest prevalence of EC (62%) and ART indicated caries (32%). Meanwhile, older children in Group 4 experienced the highest portion of advanced caries (15%). The proportion of lower molars indicated for ART was 87%, 76%, 70%, and 67% in Groups 1–4, respectively.

Conclusion: Indonesian schoolchildren face a high burden of untreated dental caries from a young age. The younger the developmental stage, the higher the prevalence of early and ART-indicated lesions with the majority being found in lower permanent molars. Although ART and preventive strategies show the highest potential in the early mixed dentition, they alone cannot completely meet the dental needs of populations such as this where the severity and disease burden are extremely high.

Keywords: Atraumatic restorative technique, Caries, Children, Glass ionomer, Risk

INTRODUCTION

Dental caries remains among the most prevalent chronic conditions in childhood and remains highly prevalent among schoolchildren in Indonesia. Recent figures from Indonesia's Ministry of Health National Oral Health Survey suggest that 90% of children have experience caries by 5 years of age with an average dmft of 8.1.^[1,2] Moreover, only 10% of children were reported to have

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received dental treatment.^[2] Atraumatic restorative treatment (ART) has been used to good effect in the management of carious lesions among high-risk cohorts, particularly in challenging environments, such as those faced by many communities across Indonesia. This form of treatment is minimally invasive and does not rely heavily on a specialized dental armamentarium, carious tooth structure is removed using only hand instruments, and the cavity is subsequently restored with a high-viscosity glass ionomer cement.^[3] The use of ART for school-based oral health programs has been advocated by ministerial regulation in Indonesia.^[4] Despite this regulation, there are several barriers to the utilization of ART within Indonesia's public health system. These barriers are not dissimilar to those reported by Mickenautsch *et al.* which include high patient turnover, increased demand on staff workloads, shortage of materials, lack of chair-side assistance, and increased treatment time.^[5] In settings, where labor, time, facilities, and materials are limited, one-way forward may be to initiate a triaged program focusing on specific teeth as a priority. Lower molars in particular are teeth that can be easily and directly visualized by clinicians without the need of a dental mirror. By extension, the management of these teeth may also be simpler for the dentist and may even be carried out by dental auxiliaries. However, there has not been sufficient research on the prevalence of carious lesions in lower molars in the context of ART to support the implementation of such an initiative.

This study aimed to (i) describe the prevalence of dental caries among Indonesian school children, (ii) evaluate the proportion of lesions indicated for ART, and (iii) explore whether a triaged ART approach may limit caries development and thereby better inform public health policy.

MATERIALS AND METHODS

A cross-sectional cohort study was conducted in the Bekasi district of West Java, Indonesia, and involved elementary schoolchildren from Grades 3–5. Bekasi is Indonesia's most populated incorporated suburban district and constitutes a diverse demographic profile representing many different ethnic groups and is representative of both the Indonesian physical landscape and the wider Indonesian population. The study was conducted in full accordance with international ethical principles, including the World Medical Association Declaration of Helsinki (2008) and received approval from the Indonesian Ministry of Health.

Sampling and examination

Purposive sampling was used and Bekasi district was selected for this study based on its representative population as well as the feasibility, cost, practicality, and accessibility of the research team. Agreement and consent to participate in the

survey were obtained from parents of the children. Children with major systemic diseases or syndromes and those who were not cooperative and refused examination were excluded.

The study participants were examined within the school setting using a battery powered mouth mirror light and a blunt-ended probe by trained general dentists. The dentists were trained and calibrated using both intraoral photos and real patients for diagnosis with good interexaminer reliability (Cohen kappa = 0.9). Each dentist examined approximately 100 children with data collection spanning a period of 2 weeks. The caries status was divided into four diagnostic categories:

1. Early caries (EC): Early enamel lesion or lesion involving dentin whose extent was small enough that it could not be entered with smallest excavator
2. Late/advanced caries (LC) = untreated cavitation deemed to be involving or approximating the pulp
3. ART indicated carious lesion = cavities that could be entered with an excavator, no pulp involvement, and adhesive restoration could be suitably placed
4. Recurrent caries (RC) = restorations with signs of recurrent or secondary caries
5. Total caries experience (TC) = the sum of the four caries categories defined above.

Although the above criteria may seem unorthodox on face value, it was used as a culturally appropriate system to meet the unique challenges of diagnosis and service provision in a community setting with limited resources. As such the above criteria enabled the research team to calculate the restorative burden, budget, and plan, the amount of materials required for basic care and classifies lesions when examined using a blunt probe, mouth mirror with a portable lamp, and cotton rolls in a classroom environment.

Teeth that had been previously filled or extracted were also recorded. For the purpose of the analysis, the children in this study were grouped according to a modified version of Hellman's dental development stages.^[6]

1. Group 1: Complete eruption of all permanent first molars and some permanent incisors (modified as 6–12 erupted teeth)
2. Group 2: Eruption of 13–18 permanent teeth
3. Group 3: Early eruption of the permanent second molars (18–24 erupted teeth)
4. Group 4: Complete eruption of the permanent second molars (25–28 erupted teeth).

Statistical analyses

Descriptive statistics and proportional univariate analysis were conducted using the grouped data. Data were compiled using a modified WHO survey form and manually transcribed onto a Microsoft Excel database (Microsoft

Excel 2002, Microsoft Ltd., Seattle). Univariate analysis was conducted along with demographic characteristics and prevalence data on caries burden were reported using measures of central tendency to indicate ratios between caries status and dental development.

RESULTS

The demographic characteristics and eruption status of the children across different school grades are shown in [Table 1]. A total number of 437 participants ranging from 8 to 14 years of age were included in the study resulting in a total of 8882 teeth being examined. The numbers of EC, LC, RC, and ART lesions steadily increased with increased dental development, as shown in [Table 2]. Children in the permanent dentition exhibited a higher proportion of advanced carious as highlighted by the number of LC lesions. A substantial discrepancy between the number of teeth with carious lesions ($n = 996$) and the number of satisfactorily filled teeth ($n = 57$) was noted.

The proportional breakdown in relation to caries severity as well as the proportion of teeth indicated for ART is shown in [Table 3]. EC lesions were found in 578 teeth (56% of all teeth with carious lesions), ART-indicated carious lesions were found in 269 teeth (28% of all teeth with carious lesions), and late carious lesions were found in 118 teeth (12% of all teeth with carious lesions), as shown in [Table 3]. Of all ART-indicated carious lesions, 75% were diagnosed on lower molars.

DISCUSSION

This study highlights the high burden and severity of dental caries affecting Indonesian schoolchildren. Out of 437 children examined, there were 996 active carious lesions and only 57 teeth received satisfactory restorative treatment. The high number of untreated dental caries may point to low levels of oral health literacy among parents and caregivers compounded by a lack of access to timely dental care and services.^[7-10] On examination, only 5.7% of carious teeth were

Table 1: Demographic characteristics and eruption status of participants.

Elementary school grade	Number of participants	Gender		Age			Number of erupted teeth		
		Male (%)	Female (%)	Min	Max	Mean	Min	Max	Mean
3	139	53.4	46.6	8	11	8.6	6	25	13.1
4	151	47.6	52.4	8	14	10.2	10	28	18.1
5	146	50.8	49.2	9	13	10.7	10	28	21.9
Total	437	50.6	49.4	8	14	9.9	6	28	17.7

Table 2: Caries burden with respect to dental developmental stage.

Developmental stage	Number of participants	Erupted teeth	Early caries (EC)	Late caries (LC)	ART-indicated caries	Lower molar ART-indicated (LM)	Filled	Extracted	Recurrent caries (RC)	Total caries (TC)
1	74	811	42	4	22	19	1	0	0	68
2	100	1573	121	16	55	42	4	1	6	198
3	123	2684	170	38	81	56	12	0	13	302
4	140	3814	245	60	111	75	40	2	12	428
Total	437	8882	578	118	269	192	57	3	31	996

EC: Early caries, LC: Late caries, ART: Carious lesions indicated for ART, LM: Lower molar indicated for ART, RC: Recurrent caries and TC: Total caries

Table 3: Proportional percentage of carious lesion severity and ART-indicated lesions.

Developmental stage	Early caries (EC/TC) (%)	Late caries (LC/TC) (%)	ART-indicated caries (ART/TC) (%)	Filled (F/TC) (%)	Recurrent caries (RC/TC) (%)	Lower molar ART-indicated (LM/ART) (%)	Lower molar ART-ind. versus total caries (LM/TC) (%)
1	62	6	32	1.4	0	86	27
2	61	8	28	2.0	3	76	21
3	56	13	27	3.9	4	69	18
4	54	15	28	9.3	3	67	17
Total	56	12	28	5.7	3	75	21

EC: Early caries, LC: Late caries, TC: Active caries, F: Filled, RC: Recurrent caries, ART: Carious lesions indicated for ART, LM: Lower molar indicated for ART

filled ($n = 57$), however of the teeth that had been filled, 54% ($n = 31$) showed signs of RC. This suggests that restorative treatment alone cannot control disease activity and there is also an urgent need for ongoing oral hygiene and oral health education such that any restorations that are placed are well maintained.^[11,12] Similar studies have shown that although school-based caries prevention programs can be effective in increasing care for high-risk populations, the effects are non-linear and vary depending on a child's baseline decay status.^[13] In addition, there is a growing body of literature suggesting that non-invasive, biological treatment approaches are cost effective and not statistically different to conventional operative approaches to caries management in regard to incidence of dental pain or sepsis.^[14]

The greater the child's dental development, the more early lesions were detected but worryingly the numbers of late carious lesions also increased. The progression of untreated carious lesions to this late stage also means that these children can no longer be managed using conservative means and require referral to a health center for appropriate treatment. In the youngest children (Group 1), only 6% of lesions were classified as LC and could not be treated at school. In comparison in the older children (Group 4), the proportion of LC lesions was just over double that of Group 1. The implication is, therefore, that untreated caries is a process that continues to progress and if left unmanaged can potentially double the disease burden for the child within a span of a few years and adversely impact of the child's quality of life.^[15]

EC was attributed to 56% of all carious lesions; the majority of these may be easily managed through simple preventive measures such as fluoride varnish or the placement of fissure sealants.^[16-18] This is reflected by the results showing that 28% of all lesions in this sample were deemed to be suitable for ART and of these 75% were distributed on lower molar teeth, the placement of fissure sealants in the early mixed dentition may, therefore, have some potential in reducing the incidence of these lesions in the future [Table 3]. A higher proportion of ART-indicated lower molars were found on children of younger dental age. This suggests that the caries process commences early during dental development and in the context of lower molars this may be attributed to their complex pit and fissure system favoring areas of plaque stagnation.^[19] This is in agreement with a recent prospective study that suggested that the detection of deep occlusal fissures in the lower first permanent molars could contribute to the identification of children at high risk of dental caries.^[20] More importantly, early intervention and implementation of ART may limit progression of these lesions and reduce the subsequent disease burden among high-risk schoolchildren in Indonesia as has been the case elsewhere in the world.^[21]

The limitations of this study include its cross-sectional nature and as a result although the prevalence of dental caries has been reported and shown to be alarmingly high, the incidence of disease cannot be measured. Furthermore, although associations can be made from the data, the etiological influences for the patterns observed require further investigation and are likely to be difficult to pinpoint given the multifactorial nature of dental caries and influence of upstream social determinants. The results of this study are particularly relevant to other populations where the prevalence of dental caries is very high while the access to resources is limited, however, given the unique context and setting the findings this study should not be generalized without due consideration to the study's limitations. Nevertheless, the study's strength lies in the use of a representative sample and provides a valuable insight into the prevalence of dental caries in this population. Through examining data at both age and tooth level, it will assist in building a foundation of dental epidemiological research to better inform future policy, practice, and research direction into the oral health of children in Indonesia.

CONCLUSION

Indonesian schoolchildren face a high burden of untreated dental caries in their permanent dentition, left untreated these carious lesions can lead to a doubling in the disease burden over the course of a few years. The findings of this study show that carious lesions develop early in the permanent dentition, increase in severity, and the complexity of the required treatment with increasing dental age. Early minimally invasive intervention and triaging lower permanent molars may be a first step in controlling the burden of caries for Indonesian schoolchildren where labor, time, and materials remain in short supply.

Declaration of patient consent

Institutional Review Board permission obtained for the study.

Financial support and sponsorship

The authors acknowledge the support of the Ministry of Health of the Republic of Indonesia for their support of this study.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Adyatmaka I, Patel J. Caries burden and suitability for atraumatic restorative treatment among schoolchildren in Indonesia. *J Global Oral Health* 2020;3(2):77-81.