Research Square

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Assessment of dental caries and associated treatment needs among preschool children in Rupandehi District, Nepal: a cross-sectional study

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Abstract

Background

Early childhood caries (ECC) remains a major public health problem in low- and middle-income countries, where dental services and preventive programmes are limited. Untreated disease affects growth, nutrition, speech development and quality of life. This study assessed the prevalence of dental caries and associated treatment needs among preschool children aged 3–5 years in Rupandehi District, Nepal.

Methods

A cross-sectional survey was conducted among 1,500 children aged 3–5 years attending government and private preschools in Rupandehi District. Multistage sampling was used, with the district stratified by municipality type (urban and rural), random selection of preschools within each stratum and cluster sampling of eligible children. Caries experience was recorded using the deft index and oral hygiene using the Simplified Oral Hygiene Index (OHI-S), following WHO Oral Health Surveys: Basic Methods, 5th edition. Treatment need was recorded using WHO intervention urgency codes. Three calibrated examiners performed Type III examinations. Associations between caries status and demographic variables were tested using the chi-square test. Mean deft scores were compared using the Mann–Whitney U test for two groups and the Kruskal–Wallis H test for more than two groups. A p-value < 0.05 was considered statistically significant.

Results

Caries was present in 790 of 1,500 children (52.7%). Mean deft was higher in girls (2.05 ± 2.36) than boys (1.77 ± 2.14; $p = 0.042$) and in children attending government schools (2.13 ± 1.69) than private schools (1.83 ± 2.41; $p < 0.001$). Differences by age ($p = 0.380$) and by rural versus urban residence ($p = 0.272$) were not significant. Caries prevalence differed by age group ($p = 0.001$), school type (76.0% government versus 50.1% private; $p = 0.001$) and oral hygiene status (89.4% with poor hygiene versus 3.7% with good hygiene; $p = 0.001$), but not by gender ($p = 0.457$) or residence ($p = 0.262$). Treatment was not required in 653 children (43.5%); 404 (26.9%) needed prompt treatment, 222 (14.8%) immediate treatment for pain or infection, 135 (9.0%) referral for comprehensive evaluation and 86 (5.7%) preventive or routine care.

Conclusions

More than half of the preschool children examined had dental caries, and a similar proportion required some form of dental treatment. School type and oral hygiene status showed the strongest associations

with caries. These findings support parental oral health education and school- and community-based preventive programmes, with priority given to government preschools.

Background

Dental caries is among the most common chronic diseases of childhood, and preschool children carry a disproportionate share of the burden [1]. Early childhood caries (ECC) is defined as the presence of one or more decayed (non-cavitated or cavitated), missing (due to caries) or filled surfaces in any primary tooth of a child under six years of age [2]. The condition presents a particular challenge in developing countries, where oral healthcare services, preventive programmes and early intervention remain limited [3, 4]. Untreated ECC causes pain and infection, premature tooth loss, impaired nutrition, delayed speech development and psychosocial distress, and reduces overall quality of life [5].

The burden in South Asia, and in Nepal in particular, is substantial. National and regional studies report a prevalence of 40% to 70% among preschool children, shaped by socioeconomic position, dietary habits and limited parental awareness of oral hygiene [6]. Children living in rural areas are affected disproportionately because paediatric dental services are scarce, fluoride use is low and parental oral health education is inadequate [7]. Frequent consumption of sugary snacks and beverages, prolonged bottle feeding, night-time feeding and delayed first dental visits add further risk [8, 9].

Oral health is increasingly recognised as integral to child well-being, yet region-specific epidemiological data to guide health planning in Nepal remain sparse. The deft index and the World Health Organization (WHO) oral health assessment codes provide standardised measures of caries experience and treatment need in children [10, 11]. Surveys of preschool populations in districts such as Rupandehi are rare, which leaves planners without the evidence needed to design and target oral health interventions [12].

This study assessed the prevalence of dental caries and associated treatment needs among preschool children aged 3–5 years in Rupandehi District, Nepal. The findings are intended to inform policymakers, health authorities and community stakeholders developing oral health promotion, preventive strategies and educational interventions for this population.

Methods

Study design and setting

This cross-sectional descriptive study was conducted among preschool children aged 3–5 years in Rupandehi District, Nepal. A complete list of registered preschools in the district was obtained from the District Education Office. According to the most recent publicly available report of the Center for Education and Human Resource Development (CEHRD), Rupandehi District comprises urban municipalities and rural municipalities, and municipality type formed the basis for stratification. Each

municipality type was treated as a separate stratum to ensure adequate geographic representation. A list of all registered preschools was prepared within the selected municipalities.

Study population

The target population comprised preschool children aged 3–5 years enrolled in government and private preschools within the selected areas of Rupandehi District.

Inclusion criteria

- Children aged 3 to 5 years.
- Children studying in the selected preschools.
- Children whose parents or guardians provided informed consent.

Exclusion criteria

- Children with systemic health conditions that restricted oral examination.
- Children who were uncooperative or absent during the school visit.
- Children undergoing dental treatment at the time of the study.

Sample size determination

Sample size was calculated using Cochran's formula with an expected caries prevalence of 19%, taken from a previously published Nepalese study [REF], 95% confidence and 2% absolute precision. This yielded a minimum requirement of 1,478 children. To allow for non-response, 1,500 children were recruited.

Sampling technique

A multistage sampling technique was used. The district was first stratified by municipality type. Preschools were then selected at random from each stratum, and cluster sampling was used to select eligible children within each selected preschool. The overall study methodology is illustrated in Fig. 1.

Data collection tools and procedure

A structured proforma was used to record demographic information, including age, gender, school type and area of residence. Tooth-brushing frequency was recorded from parent or guardian report.

Caries status was assessed using WHO criteria (2013), and the deft index (decayed, extracted due to caries, and filled primary teeth) was used to quantify caries experience [10]. A Type III examination was carried out to assess oral hygiene status using the Simplified Oral Hygiene Index (OHI-S), with a plane mouth mirror and explorer under natural daylight [13]. Radiographs were not used.

Treatment need was recorded using WHO intervention urgency codes:

- 0 = No treatment needed
- 1 = Preventive or routine treatment needed
- 2 = Prompt treatment (including scaling) needed
- 3 = Immediate (urgent) treatment needed due to pain or infection of dental and/or oral origin
- 4 = Referred for comprehensive evaluation or medical/dental treatment (systemic condition)

Examiner training and calibration

Three examiners, all dental professionals, underwent training and calibration to ensure uniform diagnostic criteria. Calibration was performed on 150 children drawn from the study population but excluded from the final analysis of 1,500 participants. Inter-examiner and intra-examiner reliability were assessed using Cohen's kappa statistic, and a kappa value greater than 0.80 was considered acceptable.

Statistical analysis

Data were entered in Microsoft Excel and analysed using IBM SPSS Statistics version 25 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to calculate caries prevalence, mean deft score and the proportion of children requiring each category of treatment. The chi-square test was used to examine associations between demographic variables and caries prevalence. Because deft and oral hygiene scores were not normally distributed ($p < 0.05$), non-parametric tests were applied: the Kruskal–Wallis H test for comparisons across more than two independent groups and the Mann–Whitney U test for comparisons between two independent groups. A p-value < 0.05 was considered statistically significant.

Ethical considerations

Ethical approval

was obtained from the Institutional Review Committee of Universal College of Medical Sciences, Bhairahawa, Nepal (UCMS/IRC/073/25). The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from the parents or legal guardians of all participating children before data collection, and verbal assent was obtained from the children. Privacy and confidentiality were maintained throughout. Children found to have dental disease were referred to a nearby dental care facility for treatment.

Results

A total of 1,500 children aged 3 to 5 years were examined. Of these, 369 (24.6%) were 3 years old, 546 (36.4%) were 4 years old and 585 (39.0%) were 5 years old (Table 1). Boys and girls were almost equally represented, at 51.5% and 48.5% respectively.

Table 1
Demographic distribution and oral health status of the participants (n = 1,500)

Variable	Category	Frequency (n)	Percent (%)
Age	3 years	369	24.6
	4 years	546	36.4
	5 years	585	39.0
Gender	Male	772	51.5
	Female	728	48.5
School type	Government	385	25.5
	Private	1115	74.5
Caries status	Absent	710	47.3
	Present	790	52.7
Location	Rural	578	38.5
	Urban	922	61.5
Oral hygiene status	Good	537	35.8
	Fair	209	13.9
	Poor	754	50.3
Tooth-brushing frequency	Once daily	988	65.9
	Twice daily	512	34.1

Percentages are rounded to one decimal place.

Most children (74.5%) attended private preschools, while 25.5% attended government preschools. Dental caries was present in 790 children (52.7%), and 710 (47.3%) were caries-free. Urban residents accounted for 61.5% of the sample and rural residents for 38.5%. Oral hygiene status was largely unsatisfactory: 35.8% of children had good oral hygiene, 13.9% fair and 50.3% poor. Tooth-brushing frequency was also low, with 65.9% of children brushing once daily and 34.1% brushing twice daily.

Mean deft scores varied across demographic characteristics (Table 2). Mean deft was 1.79 ± 1.88 among 3-year-olds, 1.86 ± 2.32 among 4-year-olds and 2.02 ± 2.39 among 5-year-olds; these differences were not statistically significant (p = 0.380). A significant difference was observed between genders, with girls recording a higher mean deft score (2.05 ± 2.36) than boys (1.77 ± 2.14; p = 0.042). School type was also significantly associated with caries experience, with children from government schools recording a higher mean deft score (2.13 ± 1.69) than those from private schools (1.83 ± 2.41; p < 0.001). Children from rural areas had slightly higher scores (2.10 ± 2.56) than those from urban areas (1.60 ± 1.59), but the difference was not significant (p = 0.272).

Table 2
Mean deft score by demographic variables

Variable	Category	Mean ± SD	p-value
Age (years)	3	1.79 ± 1.88	0.380
	4	1.86 ± 2.32	
	5	2.02 ± 2.39	
Gender	Male	1.77 ± 2.14	0.042*
	Female	2.05 ± 2.36	
School type	Government	2.13 ± 1.69	< 0.001*
	Private	1.83 ± 2.41	
Location	Urban	1.60 ± 1.59	0.272
	Rural	2.10 ± 2.56	

*deft, decayed, extracted due to caries, and filled primary teeth; SD, standard deviation. Kruskal–Wallis H test. Mann–Whitney U test. *p < 0.05 was considered statistically significant.*

Assessment of treatment need showed that 653 children (43.5%) required no treatment (Table 3, Fig. 2). Among those requiring intervention, prompt treatment (code 2, including scaling) was the most frequent category, needed by 404 children (26.9%). Immediate treatment for pain or infection of dental or oral origin (code 3) was required by 222 children (14.8%), and 135 children (9.0%) were referred for comprehensive evaluation (code 4). Preventive or routine treatment (code 1) was required by 86 children (5.7%).

Table 3
Distribution of treatment needs among the participants (n = 1,500)

Treatment code	Description	Frequency (n)	Percentage (%)
0	No treatment needed	653	43.5
1	Preventive or routine treatment needed	86	5.7
2	Prompt treatment (including scaling) needed	404	26.9
3	Immediate treatment needed due to pain or infection of dental or oral origin	222	14.8
4	Referred for comprehensive evaluation or medical/dental treatment	135	9.0

Treatment need was recorded using World Health Organization intervention urgency codes.

Table 4 presents the association between caries status and demographic variables. Caries prevalence differed significantly across age groups (p = 0.001) and was highest among 3-year-olds (65.6%), followed by 5-year-olds (57.4%) and 4-year-olds (49.8%). Gender was not associated with caries occurrence (p = 0.457). School type showed a significant association (p = 0.001): children attending government schools had a markedly higher caries prevalence (76.0%) than those attending private schools (50.1%). Area of residence was not associated with caries status (p = 0.262).

Table 4
Association between caries prevalence and demographic variables

Variable	Category	Caries absent (%)	Caries present (%)	p-value
Age	3 years	34.4	65.6	0.001*
	4 years	50.2	49.8	
	5 years	42.6	57.4	
Gender	Male	43.1	56.9	0.457
	Female	43.5	56.5	
School type	Government	24.0	76.0	0.001*
	Private	49.9	50.1	
Location	Rural	42.2	57.8	0.262
	Urban	44.0	56.0	
Oral hygiene status	Good	96.3	3.7	0.001*
	Fair	54.2	45.8	
	Poor	10.6	89.4	

*Chi-square test. *p < 0.05 was considered statistically significant.*

Oral hygiene status was significantly associated with caries prevalence (p = 0.001). Most children with good oral hygiene (96.3%) were caries-free, whereas 89.4% of children with poor oral hygiene had caries. Children with fair oral hygiene showed an intermediate prevalence of 45.8%.

Discussion

This study examined the prevalence of dental caries and associated treatment needs among preschool children aged 3 to 5 years in Rupandehi District, Nepal. Overall caries prevalence was 52.7%, close to previous reports from Nepal and elsewhere in South Asia. A study of preschool children in Kathmandu reported a prevalence of 58% [12], while an Indian study of the same age group reported 60% [14]. Internationally, systematic reviews place ECC prevalence between 40% and 70%, depending on socioeconomic and cultural context [15, 16]. These figures indicate that ECC remains a substantial public health problem, particularly in low- and middle-income countries, where dietary patterns, limited oral hygiene practice, restricted preventive care and socioeconomic disparities converge.

Caries prevalence differed significantly across age groups, but the pattern was not linear: prevalence was highest among 3-year-olds (65.6%) and lowest among 4-year-olds (49.8%). Mean deft scores, by contrast, rose modestly with age, from 1.79 at 3 years to 2.02 at 5 years, without reaching statistical significance. The gradual accumulation of caries experience with age is consistent with longer exposure

to cariogenic challenge and the progressive eruption of primary teeth, and has been reported in other South Asian populations [17] as well as in China and Brazil [18, 19]. The high prevalence recorded at 3 years is notable and suggests that disease initiation occurs well before school entry, reinforcing the case for preventive contact before the third birthday.

Girls had slightly higher mean deft scores than boys, a difference that reached statistical significance for caries experience ($p = 0.042$) but not for caries prevalence ($p = 0.457$). Some studies attribute higher caries rates in girls to earlier tooth eruption and longer exposure of teeth to the oral environment [20], while studies from Bangladesh and Sri Lanka have found no consistent gender difference [21, 22]. Biological factors, including salivary composition and flow rate, may contribute, as may behavioural and cultural differences in diet and oral hygiene practice. Given the small absolute difference observed here, the finding should be interpreted cautiously.

School type was strongly associated with caries. Children attending government schools had a prevalence of 76.0% compared with 50.1% among private school children. This gradient reflects the role of socioeconomic position in oral health: children from lower-income families have less access to preventive care, oral health education and parental supervision, and government schools in Nepal often lack the infrastructure to deliver school-based oral health activities [23]. Comparable associations between socioeconomic status and caries prevalence have been reported in Nepal [24], India [25] and other low-income settings [26]. Children in private schools more often come from households with better nutrition, more consistent oral hygiene practice and regular access to dental services.

Oral hygiene status was the strongest correlate of caries in this sample. Children with poor oral hygiene had a caries prevalence of 89.4%, against 3.7% among those with good hygiene. This is consistent with findings from Nepal [27] and from international settings [28, 29], where inadequate plaque control and irregular brushing rank among the strongest predictors of ECC. Poor oral hygiene also impedes the clearance of food debris and bacteria from tooth surfaces, accelerating lesion progression. Nearly two-thirds of participants brushed only once daily, which points to inadequate preventive practice in the home and to a need for parental education and supervised brushing, as recommended by the American Academy of Pediatric Dentistry [30].

More than half the children required some form of dental treatment. Prompt treatment was the most common need (26.9%), followed by immediate treatment for pain or infection (14.8%) and referral for comprehensive evaluation (9.0%). These proportions represent a considerable load on paediatric dental services in the region. Comparable findings have been reported from eastern Nepal, where a large proportion of preschool children required restorative care and extractions [31], and from the Philippines and Nigeria, where untreated caries frequently progressed to stages requiring invasive management [32, 33]. Since curative treatment in very young children is technically demanding and often requires behaviour management or sedation, prevention offers the more practical route. The scale of unmet need here reflects limited dental facilities, particularly for paediatric and preventive care, low parental awareness of the importance of primary teeth, and treatment costs.

Caries prevalence and mean deft scores did not differ significantly between rural and urban children, although rural children showed marginally higher disease levels. Nepalese studies have produced mixed results, with some reporting higher prevalence in rural areas because of limited health services [34] and others finding no meaningful regional difference [35]. The absence of a strong association here suggests that caries is widespread across both settings. Urban children have easier access to dental services but greater exposure to processed, cariogenic foods; rural children may consume less cariogenic diets but have poorer access to services and weaker oral hygiene practice. This argues for district-wide public health planning rather than area-specific efforts [36].

Several limitations should be noted. The cross-sectional design provides a snapshot of caries prevalence and treatment need and cannot establish causal relationships. Data were collected in a single district, which limits generalisability to the national population. Dietary intake, feeding history and household socioeconomic indicators were not recorded, so school type served as a proxy for socioeconomic position. Tooth-brushing frequency was based on parent or guardian report and is subject to recall and social desirability bias. Radiographs were not taken, so proximal and early enamel lesions may have been underestimated.

Conclusions

Early childhood caries remains a considerable public health concern among preschool children aged 3–5 years in Rupandehi District, Nepal. More than half of the children examined had caries, and a similar proportion required dental treatment. Caries burden was highest among children attending government schools and those with poor oral hygiene. The results point to a need for early, targeted preventive strategies, including oral health education for parents and caregivers, promotion of appropriate feeding and oral hygiene practices, and strengthening of school- and community-based preventive programmes.

Abbreviations

AAPD
American Academy of Pediatric Dentistry
CEHRD
Center for Education and Human Resource Development
deft
decayed, extracted due to caries, and filled primary teeth
ECC
early childhood caries
IRC
Institutional Review Committee
OHI-S
Simplified Oral Hygiene Index
SD

standard deviation
WHO
World Health Organization.

Declarations

Ethics approval and consent to participate

Ethical approval was granted by the Institutional Review Committee of Universal College of Medical Sciences, Bhairahawa, Nepal (approval number UCMS/IRC/073/25). All procedures were performed in accordance with the Declaration of Helsinki. Written informed consent was obtained from the parents or legal guardians of all participating children, and verbal assent was obtained from the children themselves.

Consent for publication

Not applicable. The manuscript contains no individual person's identifying data, images or clinical details.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

H.S. conceived and designed the study, supervised data collection and drafted the manuscript. S.K. contributed to the study design, carried out data collection and performed the statistical analysis. A.G. contributed to the methodological design, interpretation of the data and critical revision of the manuscript for important intellectual content. All authors read and approved the final version of the manuscript.

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Data Availability

The datasets generated and analysed during the current study are not publicly available because they contain information that could compromise the privacy of the participating children, but are available from the corresponding author on reasonable request.

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Figures

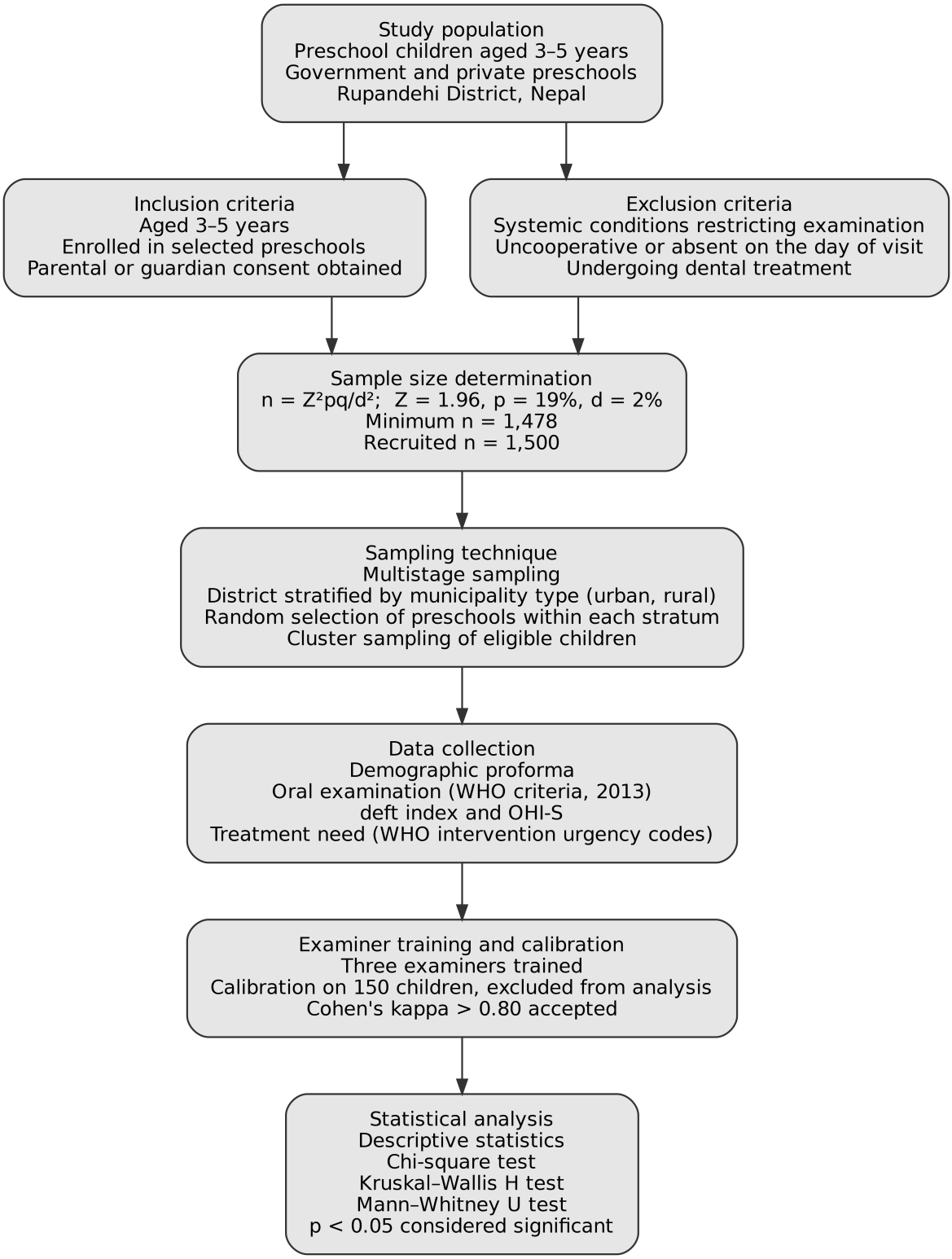

Figure 1

Flow diagram of the study methodology, showing stratification of Rupandehi District by municipality type, random selection of preschools within each stratum, cluster sampling of eligible children, and the number of children examined.

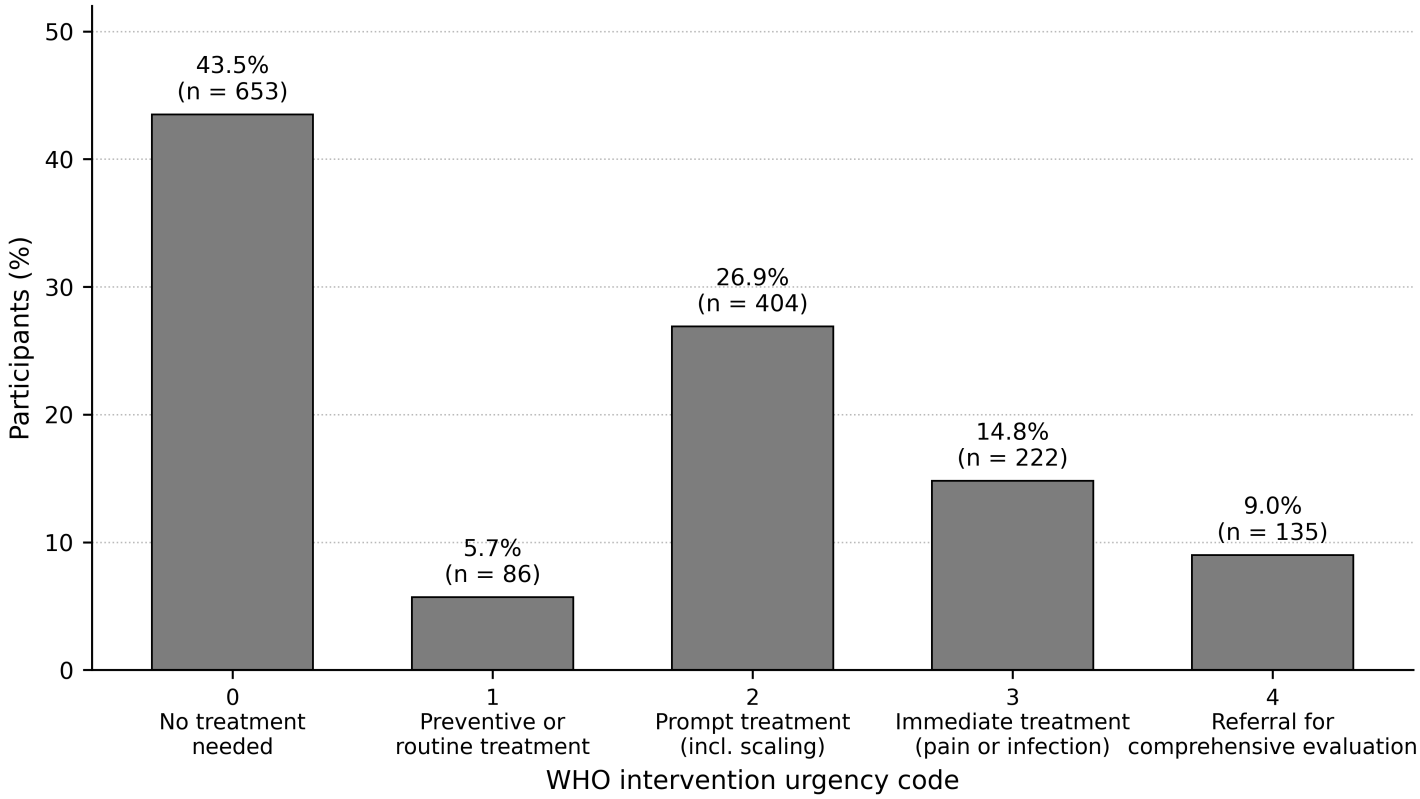

Figure 2

Distribution of treatment needs among participants, by World Health Organization intervention urgency code (n = 1,500).