Comparison of Oral Health Status Between Special Needs and General Public Schoolchildren Aged 11-13 Years, Nepal

Bandana Pathak
Mahidol University
Samrit Srithamrongsawat
Mahidol University
Pimsurang Taechaboonsermsak
Mahidol University
Yaowaluk Ngoenwiwatkul (yaowaluk.ngo@gmail.com)
Mahidol University

Research Article

Keywords: Dental caries, Oral health, OHI-S, Disability, Missing teeth, Gingivitis

Posted Date: March 17th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-301278/v1

Abstract

Background:

Children with physical disabilities are at greater risk of health problems including oral health. Dental caries is the most common among the aforementioned group and requires special dental treatments procedures. However, it is less clear on the severity of oral health problems among children with disabilities when compared to the general population. This study aimed to determine the current oral health status of children with disabilities aged 11-13 years and compared with general public schoolchildren of the same age. In this study, special needs children are referred to as children who have various physical disabilities and need specialized services or help.

Methods: A cross-sectional study was conducted among 158 children (79 special needs and 79 general public schoolchildren) aged 11-13 years studying in special needs and general public schools in Kathmandu and Lalitpur Districts, Nepal. Dental examination was performed by using a mouth mirror and a probe according to WHO criteria and methods (1997).

Results: Among the 79 special needs children, there were visually impaired (16.5%), hearing and speech impaired (25.3%), and orthopedically challenged (58.2%). Prevalence of dental caries among special needs children was high (75.9%) as compared to that of general public schoolchildren (65.8%). The means DMFT of special needs and others were 3.07 and 2.59 respectively. The means of Missing teeth between special needs and others were statistically significant ($p<0.05$). Only 8.8% of special needs children had good oral hygiene while 32.9% of the others had good oral hygiene. Moreover, untreated caries among special needs children was also higher than that of general children 62% compared with 54.4%.

Conclusions: Nepalese special needs children are at higher risk of oral health problems due to their physical limitation in maintaining oral health care. They have poorer oral health compared to general children. Moreover, dental treatment for the group is limited to simple tooth extraction, and most caries is left untreated. It is imperative the policy that extends oral health preventions for children with disabilities into their community be implemented.

Background

The prevalence of disability has been increasing worldwide. According to the United Nations Development program in 2006 [1] almost 650 million people affected with disabilities and the problems they encountered got worse with age. In 2006, UNICEF stated that children with disabilities were estimated to be 150 million all over the world[2] and reported that approximately 30 million children in South Asia were suffering from various types of disabilities[3]. According to National Population Monograph 2014 published by the Central Bureau of Statistics, overall prevalence of disabilities in Nepal population is estimated to be 2%, out of which 0.99% are children[4]. The disabilities of children age 11- 14 were classified as physical problems (35.6%), visual problems (14%) and hearing problems (13.8%) [4]. These special needs children are disadvantaged physically, mentally and socially[5].

The effect of the disability varies from individual to individual, yet the most common showing is the inability to maintain oral health[6]. Special needs children are more likely to be affected by dental disease, which causes the prevalence and severity of oral pathology of group to be higher than that of the general children[1]. Oral health problem is considered a major Non-Communicable Disease in Nepal. Acharya J et al.[7] reports that 98.3% of

children with various types of disabilities have faced dental problems in Nepal. However, according to Nepal National Oral Health "Pathfinder" Survey 2004 [8], the prevalence of dental caries for 12-13 years general public schoolchildren is 25.6% with mean DMFT of 0.50.

Previous studies state that the children with disabilities are more inclined to have oral health problems compared to non-disabled individuals[9-11]. Special needs children are unaware of the importance of oral health care practice because of their communication difficulties. Moreover, their oral health is often neglected by caretakers as they tend to be more concerned about their children's general health than their dental health.[5, 12-14]. Special needs children are likely to stay at home and tend to consume sugary foods and cariogenic diet[15], resulting in poor oral health. Previous literature indicates that special needs children suffering from dental pain are likely to be taken by their parents to traditional healers for the relief of acute dental pain[16], resulting in a high prevalence of untreated caries among special needs children. Moreover, utilization of dental care services is low among special needs children.

A review of the literatures states that the increase in the mean number of DMFT, age, and untreated caries rate is directly associated with one another [17]. The proportions of D to M and to F components in the younger age group are almost the same. As the age increases, there is an increase in the proportion of M components[5, 14, 18]. Previous studies consistently report that people with special needs have greater number of missing teeth than the general population ($p < 0.01$)[15, 17].

A review of the literature reveals that DMFT varies according to types of disabilities. A cross sectional study of dental caries status among three different types of disabilities shows that the mean number of DMFT for visually impaired is the highest 1.32 ± 1.21, followed by orthopedically impaired with 1.14 ± 1.28 and hearing and speech impaired 1.00 ± 1.24[1]. Having compared the prevalence of dental caries among special needs children and general public schoolchildren, a study in China [13] reveals that the prevalence of dental caries is higher among deaf children (55.9%) than that among healthy children (13.8%). Similarly, the study conducted by Alsadhan SA et al.[12] also reports that the mean DMFS among visually impaired children (5.16 ± 8.1) is higher than those with sighted children (3.10 ± 3.7). Likewise, a previous study in the past shows that the mean number of DMFT among visually impaired children is higher 1.6 ± 1.35 compared to that in general children 1.1 ± 1.25[18].

Literature reviews show that special needs children have poor oral hygiene and have a higher prevalence of periodontal diseases[19, 20]. For example, 90% of the total sample in the study had gingivitis, and 95% with visible dental plaque. Ajami BA et al.[19] and Nurliyanasari L et al.[21] report that approximately one-fourth of special needs children have good oral hygiene (26.4% and 26.9% respectively). This poor oral health among special needs children might correlate with frequent snacking habits along with the fact that the children are often left unsupervised by caretakers during tooth brushing [22, 23].

Thus, the summary from the literature reviews states that dental caries is increasing in association with an increase in age. In addition, the disease exists in all kinds of disabilities, with the only differences being the severity and the prevalence. Oral diseases affect both proper mastication and digestions [24]. Only few studies compared the severity of oral health problem among special needs children with those among general children. The literature also reveals that oral health status among special need children is poor compared to that among general children. In Nepal, so far, a study aimed specifically at the oral health of special children has been conducted. To date, in Nepal, there have not been studies conducted to compare the oral health status among special needs children with that among general public schoolchildren, and therefore will be new finding in Nepal.

Thus, this study is aimed at determining the current oral health status of children with disabilities age 11-13 years and comparing it with that of the general public schoolchildren of the same age.

Methods And Methodology

Study design

A cross sectional study was conducted to compare dental caries experience and oral hygiene status of children aged 11- 13 attending special and general public school in Kathmandu and Lalitpur districts, Nepal.

Study population

The study was conducted in 4 schools; three of which are visually impaired, hearing impaired, and orthopedically impaired schools with one being the general public school. All of the schools are located in two districts in Province 3. Four schools were selected by purposive sampling technique. In this study, each of the selected special schools admits students with only one type of disability, and the students in the general public school was a comparison group. The special need children were selected according to the inclusion and exclusion criteria of the study and by simple random technique.

In Figure 1 showed Map of Kathmandu and Lalitpur District in Province 3 and the Nepal. Map was obtained from Google for non-commercial use.[25]

Sample size determination

The simple random sampling technique was used for the selection of the schoolchildren. Previous study estimates the caries prevalence in special need children to be 98.3%[7]. The standard error is set at 3% and 95% confidence interval. Another 9 % is added to the sample size to be accounted for uncooperative children. At least 79 children are needed in each group.

Inclusion and Exclusion Criteria

The children aged 11-13 years studying in the schools are children with orthopedically and sensory (hearing, speech, and vision) challenges. This also included Nepalese and boarding students whose parents or guardians granted consent. On the other hand, the children with any kind of debilitating disease, under medications (medically compromised), uncooperative, and without consent from parents, guardians or teachers were excluded from the study.

Data collection

The total of 158 children (79 special needs and 79 general public schoolchildren) were examined. The dental examination was performed according to the WHO criteria and methods. DMFT, OHI-S, and Carter and Barnes Index (CBI) were determined and recorded for each child. The physically and sensory challenged children were examined either on wheelchairs or on a lay-down position under the supervision of the school teachers. Free samples of toothbrushes and toothpaste were distributed to each individual after oral examinations.

Ethical approval

The ethical clearance of this study was obtained from Ethics committee of Institutional Review Board Mahidol University (MU-DT/PY-IRB No:78.0517/EC441) and Nepal Health and Research Council (Reg. no 317/2019). We proposed the information sheet to the guardians and children. Then written informed consent was obtained from guardians and children. The current study conducted in full accordance with the relevant guidelines and regulations.

Validity of oral examination measurement tool

The examiners were trained and calibrated. The training session began with photos and presentation slides followed by the examination and calibration of schoolchildren under field conditions. The evaluation of inter-examiner reliability using Cohen's kappa was 0.86 [26].

Data Management and Statistical Analysis

Descriptive analysis, such as the mean and the standard deviation was calculated for DMFT and OHI-S. The percentage was used for gingival status (CBI) and untreated dental caries. Chi- square test and Fisher's extract test were used to evaluate differences in proportion. T-test was performed for comparisons between the groups. In this study, a p-value less than 0.05 was set as statistically significant. SPSS 18.0 statistical software was employed in the data input and analysis.

Results

There are 158 children aged 11-13 years recruited in the study, half of whom are from general public school and others from special needs school. Among children with special needs, 16.5% are visually impaired, 25.3% are hearing impaired and speech impaired, and 58.27% are orthopedically impaired. Out of 158 school children, both special and general public schoolchildren were similar in age and gender. As shown in Table 1, 50.6% of all children are boys, with an average for special and general public school being 12.16 ± 0.83 and 12.12 ± 0.82 respectively. Approximately half of the total children (49.4%) are girls, with an average for special and general public schools being 11.93 ± 0.83 and 12.00 ± 0.79 respectively. The mean age group for special needs and general public schoolchildren were similar as expressed by 12.04 ± 0.83 and 12.06 ± 0.80 respectively.

Table 1. Comparisons of age by gender between special needs children and general public schoolchildren

Characteristics	Special needs children (79)	Public schoolchildren (79)	p - value
	Age (Mean ± SD)		
Gender			
Boys (50.6%)	12.16 ± 0.83	12.12 ± 0.82	0.805
Girls (49.4%)	11.93 ± 0.83	12.00 ± 0.79	0.702
Age (Mean ± SD) of total group	12.04 ± 0.83	12.06 ± 0.80	0.847

*Statistically Significant at $p < 0.05$

Table 2 shows the comparison between the prevalence of dental caries and oral hygiene status among special needs and general public school groups. The dental caries prevalence of special needs children is high (75.9%) when compared to general public schoolchildren (65.8%). The proportion of untreated caries is greater among

special needs children (62.0%) than that among general public schoolchildren (54.4 %). The oral hygiene status of special needs children is unfavorable with only 8.8 % of them in good oral hygiene status, 74.7 % in fair, and 16.5 % in poor condition. On the contrary, 32.9% of the general public schoolchildren are considered good, while 63.4% are fair, and 3.7% are in poor oral hygiene status. These differences in oral hygiene between the two groups are statistically significant.

Table 2. Distribution of Prevalence of Dental caries, Oral Hygiene Index (OHI-S) among the special needs and general public schoolchildren aged 11- 13 years in Kathmandu and Lalitpur District, Nepal

Oral Health Status *(%)*	Special needs children *(79)*	Public schoolchildren *(79)*	p- value
Dental caries	75.9%	65.8%	0.220
Untreated caries	62.0%	54.4%	0.420
OHI-S			
Good	8.8%	32.9%	<0.001*
Fair	74.7%	63.4%	
Poor	16.5%	3.7%	

*Statistically Significant at p <0.05

As presented in Table 3, the Decayed (D) and Missing (M) components are higher in special needs children than in others. In particular, M components are significantly higher in special needs children when compared to those in the public schoolchildren (p-value 0.006). Furthermore, the mean number of DMFT for special needs children (3.07 ± 2.48) is higher than the comparison group (2.59 ± 2.60).

Table 3. Distribution of Dental caries among the special needs and general public schoolchildren aged 11- 13 years in Kathmandu and Lalitpur District, Nepal

Oral Health Status	Special needs children *(79)* *(X± SD)*	Public schoolchildren *(79)* *(X ± SD)*	p - value
D *(Decayed)*	1.92 ± 2.21	1.58 ± 2.00	0.310
M *(Missing)*	0.50 ± 1.11	0.12 ± 0.40	0.006*
F *(Filled)*	0.64 ± 1.28	0.88 ± 1.75	0.327
DMFT	3.07 ± 2.48	2.59 ± 2.60	0.546

*Statistically Significant (t- test) at p <0.05

As presented in Table 4, the means DI-S, CI-S, OHI-S of special needs children are higher than those in general public schoolchildren. However, the differences of the means DI-S, CI-S, OHI-S between the two groups are not statistically significant.

Table 4. Distribution of Oral Hygiene Index (OHI-S), Simplified Debris Index (DI-S) Simplified Calculus Index (CI-S) among the special needs and general public schoolchildren aged 11- 13 years in Kathmandu and Lalitpur District, Nepal.

Oral Health Status	Special needs children (79) (X± SD)	Public schoolchildren (79) (X± SD)	p - value
DI-S	1.49 ± 0.43	1.16 ± 0.32	0.07
CI-S	0.77 ± 0.51	0.47 ± 0.41	0.21
OHI-S	2.27 ± 0.86	1.63 ± 0.67	0.31

*Statistically Significant (t- test) at p <0.05

Oral hygiene and gingival health are closely related. In this study, the gingival health of schoolchildren is evaluated by gingival bleeding index. The results of gingival bleeding using CBI indicate that there is a maximum of 26 sites per child for examination. However, due to retained root and missing adjacent teeth; the mean examination site for special needs children group is 23.1 sites, while that of general public schoolchildren is 24.1 sites. Out of 1106 anterior sites of special needs children, 25 sites are excluded and therefore 1081 sites are included for oral examinations. The findings showed that gingival bleeding of the anterior site among special needs children is 49%. Likewise, out of 948 in posterior site among special needs children, 198 sites are excluded; therefore, 750 sites are included for oral examinations. The results show that gingival bleeding of the posterior sites among special needs children is 69.5%.

Correspondingly, out of 1106 in anterior site among general public schoolchildren, 48 sites are excluded and 1058 sites are included for the oral examinations. The bleeding of anterior site among general public schoolchildren is 29.3%. Out of 948 in posterior site among general public schoolchildren, 95 sites are excluded and 853 are included for the oral examinations. The bleeding of the posterior site among general public schoolchildren is 42.4%. In general, posterior site tend to have more gingival bleeding than anterior site as presented in Table 5.

Table 5: Distribution of anterior and posterior sites bleeding among special needs and general public schoolchildren

Bleeding sites	Special needs children (79)	Public schoolchildren (79)
Anterior		
Total	1106	1106
Exclude	25(2.3%)	48(4.3%)
Examined site	1081	1058
No bleeding	551(51%)	748(70.7%)
Bleeding	530(49%)	310(29.3%)
Posterior		
Total	948	948
Exclude	198(20.9%)	95(10%)
Examined site	750	853
No bleeding	229 (30.5%)	491(57.6%)
Bleeding	521(69.5%)	362(42.4%)
Total bleeding	57.4%	35.2%

Table 6 reveals that the prevalence of gingival bleeding among special needs children is higher (57.4%) than that of general public schoolchildren (35.2%). The result showed statistically significant association between gum

bleeding and children status with OR= 1.632 and 95% CI 1.518,1.755 (p – value <0.001).

Table 6: Comparison of gingival bleeding among special needs children and general public schoolchildren

	Special needs children (79)	Public schoolchildren (79)	OR	95% CI	p - value
Bleeding	1051(57.4%)	672 (35.2%)	1.632	1.518,1.755	<0.001*
No Bleeding	780 (42.6%)	1239 (64.8%)			

*Statistically Significant at p <0.05

Discussion

The study reveals that the prevalence of dental caries for special needs children is 75.9%, which is higher than that of the general public schoolchildren (65.8%). In our study, the prevalence of dental caries for special needs children is 75.9%, which is lower when compared to 98.3% in special needs children aged 12-15 years old in the study conducted by Acharya J et al.[7]. This could be attributed to the younger age group which is included in our study. Furthermore, the present study shows that general public schoolchildren have higher prevalence of dental caries (65.8%) than that of the studies conducted by Subedi B et al. (53.23%)[27] and Khanal S et al.(56.3%)[28].

In our study, the mean ± SD of DMFT score for special needs children is 3.07 ± 2.48, which is higher than that used in the study conducted by Prasad M et al.[1] with 1.10 ± 1.26. Additionally, the M component of special needs children is statistically significant difference from general public schoolchildren. Past studies have showed similar results in accordance with our study that special needs children possess more decayed and missing teeth than other groups[29]. These differences could be attributed to the cumulative neglect of oral health seen among the special needs children and untreated caries is in an advanced stage and requires extraction. Some parents seem to believe in traditional healers and children are taken to them for symptoms alleviation instead of visiting dentists[30]. Moreover, poor oral health and high risk proportion of untreated caries among special needs children might be due to lack of cooperation and causing difficulties in dental care and dental services.

Our study revealed that only 8.8% of special needs children possess good oral hygiene. Results are observed in previous studies in which the percentage of special needs children with good oral hygiene status is lower. This could stem from the presence of the plaque[6] and calculus on the tooth surfaces and the fact that these children do not have any supervision from their caretakers during tooth brushing[1, 19, 21]. As a result, most special needs children possess poor gingival health and oral hygiene[31]. The poor oral health could be attributed to lack to physical abilities among special needs children which causes some difficulties in tooth brushing[31]. The present study shows OHI-S between special needs children and general public schoolchildren as categorized by Greene and Vermillion (1964)[32] under good/fair and poor is statistically significant (p<0.001). Thus, it could be concluded that the presence of dental caries among the children could be attributed to poor oral health status. The previous study presents similar results to our study, revealing that oral hygiene status is statistically significant (p=0.000) and is predicted to be risk factor for dental caries[33].

In addition, the gingival bleeding of special needs children is calculated to be 57.4% as compared to 35.2% among general public schoolchildren. It should be noted that there are 10.8% total excluded site due to retained roots or missing teeth among special needs children as compared to 6.9% of those in general public schoolchildren. Our results indicate that special needs children are more prone to gingivitis than others. In addition, posterior teeth have a higher prevalence of gingivitis than anterior teeth. This could be resulted from difficulty in maintaining the oral hygiene. The present study has highlighted that if the oral hygiene among the special needs and general public schoolchildren is maintained, there could be a decrease in the prevalence of dental caries. In addition, parents and caretakers play an important role in carrying out oral health education as well as guiding these special children in dental health care and its implication.

The untreated caries is also high among special needs children (62.0%) than that of general public health schoolchildren (54.4%). The contributing factor might be due to intake of sugar sweetened food[15], infrequent tooth brushing[34] and lack of awareness of the oral health importance.

Moreover, dental treatments among special needs children require not only special treatments but also, in some cases, dental treatments under general anesthesia. Therefore, this high proportion of untreated caries reveal inequality in access to dental services among special needs children.

In general, special needs children have more dental caries, gingival bleeding, and poor oral hygiene than general public school. These poor oral health status also reflects inequalities in access to dental care among special needs children as compared to that in general public schoolchildren[35]. National Survey of Children with Special Health Care Needs conducted in United states (2005) states that about 9% special needs children are not able to meet their dental needs compared to 5% of general children[36]. The fact that special needs children have a high prevalence of untreated dental caries and poor oral hygiene could be attributed to the caretakers' lack of awareness and cooperation, communication problem, inadequate funding, inequality in dental care, and proper treatment that needs special care with general anesthesia. [9, 35, 37, 38].

Limitation of study

This study was cross-sectional in nature; therefore, it might not indicate a causal inference for oral hygiene status and dental caries, but the results were consistent with other findings. Our study populations group includes boarding Nepalese children with mild disabilities studying in three special schools and does not cover the full disabled population and all schools in Province No:3, Nepal. Hence, the generalization may be limited; however, the fact that the special needs children have greater number of missing teeth than their peers and there are inequalities in access to dental care among special needs children is emphasized.

Conclusions

From the results, it can be concluded that the oral health status among Nepalese special needs children is poor compared to that in general public schoolchildren. The proportion of extraction due to caries is high among special needs children compared to others. Every six out of ten among special needs children has untreated caries. Therefore, it is obvious that there are inequalities in access to dental care among special needs children.

Recommendations

Normally, special needs children and caretakers are more concerned about their disabilities than their oral health. In the context of general heath, the importance of oral health should not be neglected. The oral public health professionals must coordinate with other community health workers to initiate social and general benefits for oral health that sustained for a longer period of time. Campaigns should be carried out for the special needs children to improve their oral health problems. Parents and caretakers of special needs children should be educated about their children's dietary habits. Public Health should provide parents and caretakers with tailored oral health education and encourage them to ingrain proper oral hygiene habits for their special needs children. The effective way to maintain oral hygiene for the visually impaired children would be the combination of verbal, Braille text, and tactile mode of education. Hearing impaired children have limitations in hearing sense, yet they have strong sight, smelling, taste. Thus, visual aids are recommended for these children. Chemical plaque control methods can also be introduced as a substitute method for the mechanical plaque control method to maintain the oral hygiene along with fluoride application. There must be a good co-operation between the dental professional and school educators so as to introduce such preventive measures as brushing technique (practically simple scrubbing and simplified brass technique), frequent visits of oral health check-ups and good accessibility to dental services. The government of Nepal should have long-term public health plans and health care policies for children with disabilities.

List Of Abbreviations

WHO: World health organization

DMFT: Decayed-Missing-Filled Teeth Index

OHI-S: Simplified Oral Hygiene Index

DI-S: Simplified Debris Index

CI-S: Simplified Calculus Index

CBI: Harold G. Carter and George P. Barnes Index

SPSS: Statistical Package for Social Sciences

Declarations

Ethics approval and consent to participate

The ethical clearance of this study was obtained from Ethics committee of Institutional Review Board Mahidol University (MU-DT/PY-IRB No:78.0517/EC441) and Nepal Health and Research Council (Reg. no 317/2019). We proposed the information sheet to the guardians and children. Then written informed consent was obtained from guardians and children. The current study conducted in full accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable since we did not mention any individual person's data in the manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interest

The authors declare that they have no competing interests.

Financial support and sponsorship

Not applicable

Authors' Contributions

BP responsible for data collection and data entry

BP and YN responsible for manuscript design, statistical data analysis, interpretation of the data.

BP, YN, SS and PT critically revised the data, manuscript and approved the final manuscript.

Acknowledgements

Our sincere appreciation and heartfelt gratitude to Dr. Anupama Bohara, Prof. Shankar Raj Pathak, the school teachers and the children for their support throughout the study.

References

1. Prasad M, Patthi B, Singla A, Gupta R, Niraj L, Ali I: **Special care with special child-oral health status of differently abled children attending special schools in Delhi: A cross-sectional study**. *J Indian Assoc Public Health Dent* 2018, **16**(2):137-143. doi: 10.4103/jiaphd.jiaphd_142_17. Acesssed November 2019.

2. UNICEF: The Root Causes of Exclusion. In: The State of World's Children: EXCLUDED and INVISIBLE. Edited by Moccia P: Brodock Press; 2006. http://www.unicef.org/sowc06/profiles/disabilities.php. Acesssed November 2019.

3. Thapaliya M: **A Report on Disability in Nepal. Sydney: Australian Himalayan Foundation (AHF); 2016.** https://www.australianhimalayanfoundation.org.au/.../2016. Acesssed November 2019.

4. Khanal S: **Persons with disability and their characteristics,** Population Monograph of Nepal. ResearchGate; 2015.

5. Sandeep V, Kumar M, Vinay C, Chandrasekhar R, Jyostna P: **Oral health status and treatment needs of hearing impaired children attending a special school in Bhimavaram, India**. *Indian journal of dental research : official publication of Indian Society for Dental Research* 2016, **27**(1):73-77.

6. Ameer N, Palaparthi R, Neerudu M, Palakuru SK, Singam HR, Durvasula S: **Oral hygiene and periodontal status of teenagers with special needs in the district of Nalgonda, India**. *J Indian Soc Periodontol* 2012, **16**(3):421-425. doi: 10.4103/0972-124X.100923. Acesssed November 2019.

7. Acharya J, Chansatitporn N, Narkasawat K: **Dental Caries Status And Oral Health Needs among Disabled Children Living In Care Centers In Kathmandu Valley, Nepal**. *WebmedCentral DENTISTRY 2014;5(2):WMC004539*. http://www.webmedcentral.com/article_view/4539. Acesssed November 2018.

8. Yee R, Mishra P: **Nepal national oral health'pathfinder'survey** In.: Ministry of Health, HMG Nepal; 2004.

9. Suresan V, Das D, Jnaneswar A, Jha K, Kumar G, Subramaniam GB: **Assessment of dental caries, oral hygiene status, traumatic dental injuries and provision of basic oral health care among visually impaired children of Eastern Odisha**. *J Indian Soc Pedod Prev Dent* 2017, **35**(4):284-290. doi: 10.4103/JISPPD.JISPPD_48_17. Acesssed November 2019.

10. Tagelsir A, Khogli AE, Nurelhuda NM: **Oral health of visually impaired schoolchildren in Khartoum State, Sudan**. *BMC oral health* 2013, **13**(1):33. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3720199/. Accessed September 2019.

11. John JR, Daniel B, Paneerselvam D, Rajendran G: **Prevalence of Dental Caries, Oral Hygiene Knowledge, Status, and Practices among Visually Impaired Individuals in Chennai, Tamil Nadu**. *Int J Dent*, **2017**:9419648. doi: 10.1155/2017/9419648. Acesssed November 2019.

12. AlSadhan SA, Al-Jobair AM, Bafaqeeh M, Abusharifa H, Alagla M: **Dental and medical health status and oral health knowledge among visually impaired and sighted female schoolchildren in Riyadh: a comparative study**. *BMC oral health* 2017, **17**(1):154. https://doi.org/10.1186/s12903-017-0446-6. Acesssed November 2019.

13. Wei H, Wang YL, Cong XN, Tang WQ, Wei PM: **Survey and analysis of dental caries in students at a deaf-mute high school**. *Research in developmental disabilities* 2012, **33**(4):1279-1286. doi: 10.1016/j.ridd.2012.02.025. Acesssed November 2019.

14. Shivakumar K, Patil S, Kadashetti V: **Oral health status and dental treatment needs of sensory-impaired children of Satara District, India**. *J Int Oral Health* 2017, **9**(5):197-201. doi: 10.4103/jioh.jioh_158_17 Acesssed March 2019.

15. Shyama M, Al-Mutawa SA, Morris RE, Sugathan T, Honkala E: **Dental caries experience of disable children and young adults in Kuwait**. *Community dental health* 2001, **18**:181-186.

16. Swar B: **Pain practice in Nepal thirty years ago: A practitioner's Quest**. *Journal of Society of Anesthesiologists of Nepal* 2018, **4**:49. doi: 10.3126/jsan.v4i2.21203. Acesssed November 2019.

17. Lee JY, Lim KC, Kim SY, Paik HR, Kim YJ, Jin BH: **Oral health status of the disabled compared with that of the non-disabled in Korea: A propensity score matching analysis**. *PloS one* 2019, **14**(1):e0208246. https://doi.org/10.1371/journal.pone.0208246. Acesssed November 2019.

18. Turkistani B, Elmarsafy S: **Caries experience among visually impaired and normal female students aged 6-18 years in Makkah, Saudi Arabia: a comparative study.** . *Int J Health Sci Res* 2019; 9(12):286-292.

19. Ajami BA, Shabzendedar M, Rezay YA, Asgary M: **Dental treatment needs of children with disabilities**. *Journal of dental research, dental clinics, dental prospects* 2007, **1**(2):93-98. doi: 10.5681/joddd.2007.016. Acesssed November 2019.

20. Jokić N, Majstorović M, Bakarčić D, Katalinić A, Szirovicza L: **Dental caries in disabled children**. *Collegium antropologicum* 2007, **31**:321-324. https://www.researchgate.net/publication/6239969. Acesssed October 2020.

21. Nurliyanasari L, Wardani R, Susilawati S: **The relationship between the dental health knowledge and oral hygiene index of the deaf**. *Padjadjaran Journal of Dentistry* 2009, **21**.
doi : https://doi.org/10.24198/pjd.vol21no2.14103. Acesssed November 2019.

22. Reddy V, Chaurasia K, Bhambal A, Moon N, Reddy E: **A comparison of oral hygiene status and dental caries experience among institutionalized visually impaired and hearing impaired children of age between 7 and 17 years in central India**. *Journal of the Indian Society of Pedodontics and Preventive Dentistry* 2013, **31**:141-145. doi: 10.4103/0970-4388.117963. Acesssed October 2020.

23. Zhou N, Wong HM, McGrath C: **Oral health and associated factors among preschool children with special healthcare needs**. *Oral diseases* 2019, **25**(4):1221-1228. doi: : 10.1111/odi.13057 Acesssed October 2020.

24. Alhazmi A, Alshinqiti I, Aloufi F, Alhejali A, Alsulaimani W, Alharbi MJIJoDS, Research: **Oral Health Knowledge, Practice, Oral Hygiene Status and Dental Caries Prevalence Among Visually Impaired Student in Alnoor Institute of Almadinah Almunawwarah at Saudi Arabia**. 2014, **2**:149-153. doi:10.12691/IJDSR-2-6-7. Acesssed October 2020.

25. Google**. (**n.d**.). Map of Kathmandu and lalitpur, Province 3, Nepal.** Retrieved from https://www.google.com/maps/search/province+3,+Nepal/@27.6649338,85.1839507,11z/data=!3m1!4b1

26. McHugh ML: **Interrater reliability: the kappa statistic**. *Biochemia medica* 2012, **22**(3):276-282. doi: 10.11613/BM.2012.031. Acesssed October 2018.

27. Subedi B, Shakya P, Kc U, Jnawali M, Paudyal B, Acharya A, Koirala S, Singh A: **Prevalence of Dental Caries in 5 – 6 Years and 12 – 13 Years Age Group of School Children of Kathmandu Valley**. *JNMA J Nepal Med Assoc. 2011,* **51**:176-181. https://www.researchgate.net/publication/215831843. Acesssed October 2020.

28. Khanal S, Acharya J: **Dental caries status and oral health practice among 12-15 year old children in Jorpati, Kathmandu**. *Nepal Medical College journal* 2014, **16**(1):84-87. https://www.researchgate.net/publication/274085786. Acesssed October 2020.

29. Solanki J, Chand S, Gupta S: **Comparison of Dental Caries and Oral Hygiene Status Among Blind School Children and Normal Children, Jodhpur City Rajasthan, India**. *Universal Research Journal of Dentistry* 2014, **4**:22. https://www.researchgate.net/publication/309706462. Acesssed October 2019.

30. Acharya S: **Potential Barriers to Accessing Dental Care for the Nepalese Community in the United Kingdom**. *Asian Journal of Dental Sciences* 3(4):29-32,2020. https://www.journalajds.com/index.php/AJDS/article/view/30126. Acesssed January 2021.

31. Altun C, Guven G, Akgun OM, Akkurt MD, Basak F, Akbulut E: **Oral health status of disabled individuals attending special schools**. *Eur J Dent* 2010, **4**(4):361-366. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2948746/. Acesssed October 2020.

32. Peter S: **Essentials of Preventive and Community Dentistry (Public Health Dentistry)**, 4th edn. New Delhi: Arya Medi Publishing House Pvt.Ltd; 2011.

33. Uwayezu D, Gatarayiha A, Nzayirambaho M: **Prevalence of dental caries and associated risk factors in children living with disabilities in Rwanda: a cross-sectional study**. *Pan Afr Med J* 2020, **36**:193-193. doi: 10.11604/pamj.2020.36.193.24166. Acesssed January 2021.

34. Purohit B, Singh A: **Oral health status of 12-year-old children with disabilities and controls in Southern India**. *WHO South-East Asia J Public Health* 2012, **1**(3):330-338. doi:10.4103/2224-3151.207029. Acesssed September 2018.

35. Al-Maweri S, Zimmer S: **Oral Health Survey of 6-14-Year-Old Children with Disabilities Attending Special Schools Yemen**. *Journal of Clinical Pediatric Dentistry* 2015, **39**(3):272-276. doi:10.17796/1053-4628-39.3.272. Acesssed September 2020.

36. Lewis CW: **Dental care and children with special health care needs: a population-based perspective**. *Academic pediatrics* 2009, **9**(6):420-426. doi:10.1016/j.acap.2009.09.005. Acesssed December 2018.

37. Gace E, Kelmendi M, Fusha E: **Oral Health Status of Children with Disability Living in Albania**. *Materia socio-medica* 2014, **26**:392-394 doi:10.5455/msm.2014.26.392-394. Acesssed December 2019

38. Duddu M, Muppa R, Nallanchakrava S, Bhupatiraju P: **Prevalence of dental caries in people attending special schools in Hyderabad-Secunderabad, India**. *J NTR Univ Health Sci* 2016, **5**(2):137-141. doi: 10.4103/2277-8632.185452. Acesssed December 2019.

Figures

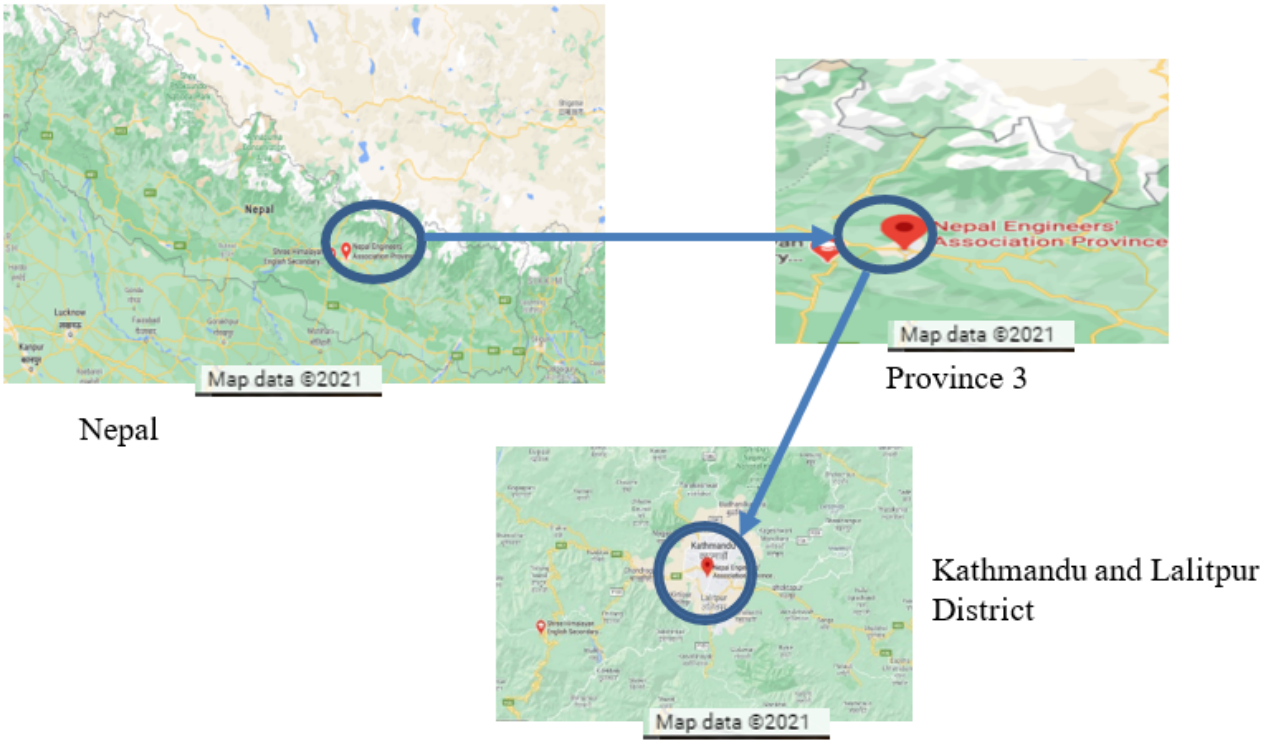

Figure 1

Study setting. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.